Examining the Built Environment and Childhood Obesity in Santa Clara County: Is the Distribution of Fast Food Restaurants Correlated with the Location of Public High Schools?

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Chapter I: Introduction

BACKGROUND

Thirty percent of U.S. children consume fast food in a typical day.[1] With children becoming a larger segment of fast food sales, it is a priority for the industry to locate near their target demographics. Further, a major focus of fast food marketing is now targeted toward this growing demographic, children and adolescents.[2] This market segment spends an estimated $140 billion annually and influences an additional $200 billion of household spending.[3] Given that twelve percent of U.S. household income is spent on food products, marketing and branding these products is a competitive necessity.[4] In an effort to build their brand, fast food franchises heavily market to children to develop brand loyalty at an early age because children can develop brand preferences by the age of two.[5] Over ninety-five percent of fast food advertising is television-based, and the bulk of this advertising focuses on energy-dense or unhealthy food.[6] A study by French, et al. concluded that the frequency of television watching was positively associated with the frequency of fast food restaurant use among children.[7]

Fast food restaurant consumption among adolescents increased nearly 300 percent between 1977 and 1996.[8] In 1977, fast food meals accounted for just three percent of meals consumed and three percent of daily caloric intake, while by 1995, these figures increased to nine percent and twelve percent, respectively.[9] During this period, food portions served at fast food restaurants also significantly increased.[10] By 2003, nearly sixty-six percent of adults and sixteen percent of children were overweight

[1] Paul A. Simon et al., "Proximity of fast food restaurants to schools: Do neighborhood income and type of school matter?" *Preventive Medicine* 47 (March 2008): 284-88.
[2] Mary Story and Simone French, "Food Advertising and Marketing Directed at Children and Adolescents in the US," *International Journal of Behavioral Nutrition and Physical Activity* 4, no. 1 (2004 February 10): 1-17.
[3] Story and French.
[4] Story and French.
[5] Story and French; Thomas N. Robinson, MD, MPH, Dina L. G. Borzekowski, EdD, Donna M. Matheson, PhD and Helena C. Kraemer, PhD, "Effects of Fast Food Branding on Young Children's Taste Preferences," *Archives of Pediatrics and Adolescent Medicine* 161, no. 8 (August 2007): 792-97.
[6] Ibid.
[7] Mary Story and Simone French, "Food Advertising and Marketing Directed at Children and Adolescents in the US," *International Journal of Behavioral Nutrition and Physical Activity* 4, no. 1 (2004 February 10): 1-17.
[8] Paul A. Simon et al., "Proximity of fast food restaurants to schools: Do neighborhood income and type of school matter?" *Preventive Medicine* 47 (March 2008): 284-88.
[9] Jean L. Wiecha, PhD, Daniel Finkelstein, EdM, PhD, Philip J. Troped, PhD, MS and Maren Fragala, MS, "School Vending Machine Use and Fast-Food: Restaurant Use Are Associated with Sugar-Sweetened Beverage Intake in Youth," *Journal of the American Dietetic Association* 106, no. 10 (October 2006): 1624-30.
[10] Julie Samia Mair, Matthew W. Pierce, and Stephen P. Teret "monograph entitled, The Use of Zoning to Restrict Fast Food Outlets: A Potential Strategy to Combat Obesity," The Centers for Law & The Public's Health, http://www.publichealthlaw.net/Zoning%20Fast%20Food%20Outlets.pdf (accessed November 28, 2008).

or obese.[11] The rate at which obesity has increased cannot be attributed to genetics changes alone, but rather to increased consumption of excess calories and decreased physical activity.[12]

Physical activity is impacted by urban form. Given that children consume the majority of their daily calories during school hours, examining the built environment in close proximity to schools is warranted.[13] Schools, in an effort to generate new sources of revenue, enter into agreements with food manufacturers to supply food and beverages as well as advertise on school campuses.[14] Further, schools with open campus lunch policies often compete for on-campus lunch revenues with off-campus fast food restaurants, referred to herein as the "secondary school food environment."[15] In an effort to generate revenue from on-campus food sales, campus cafeterias often provide similar unhealthful foods on-campus to compete with off-campus choices.[16] Thus, the concentration of fast food restaurants off-campus may also impact the healthfulness of on-campus choices and the youth's waistlines.

This study examines the secondary school food environment in an attempt to determine if correlations exist between childhood overweight and obesity with the built environment. Limited research has shown that individuals that live in sprawling environments are more likely to walk less, weigh more, and have a higher incidence of hypertension than individuals living in dense urban environments.[17] This examination of the built environment's contribution to childhood obesity should inform policymaker's decisions to design communities that are promotive of public health.

RESEARCH QUESTION

Is the geographic distribution of fast food outlets in Santa Clara County correlated with the location of Santa Clara County high schools and childhood obesity? If so, what policies could Santa Clara County municipalities enact to limit additional fast food outlets within 800m of schools?

FAST FOOD OUTLET DEFINITION

To examine the availability of unhealthy food outlets in Santa Clara County within close proximity to public high schools, a definition was developed from a literature review of the topic. The result of this review yielded the following definition for unhealthy food:

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[11] Allison A. Hedley, PhD et al., "Prevalence of Overweight and Obesity Among US Children, Adolescents, and Adults, 1999-2002," *The Journal of the American Medical Association* 291, no. 23 (June 16, 2004): 2847-50.

[12] Anthony N. DeMaria, "Of Fast Food and Franchises," *Journal of the American College of Cardiology* 41, no. 7 (April, 2, 2003): 1227-28.

[13] Anthony Winson, "School Food Environments and the Obesity Issue: Content, Structural Determinants, and Agency in Canadian High Schools," *Agriculture and Human Values* 25, no. 4 (17 April 2008): 499-511.

[14] Ibid.

[15] Ibid.

[16] Ibid.

[17] Reid Ewing et al., "Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity," *American Journal of Health Promotion* (September/October 2003): 47-57 http://www.smartgrowthamerica.org/report/JournalArticle.pdf (accessed November 29, 2008).

Any formula-based fast food outlet with a national footprint.

The following clarifying definitions further define unhealthy food for the purposes of this analysis:

Formula-based: Standardized features whose appearance is identical to other outlets in the chain (e.g. menu, employee uniforms, architectural design, decor, or signage).[18]

Fast Food: "Inexpensive food that is [pre-]prepared and served quickly to consumers, often through drive-thru or curbside service, that tends to be high in fat and low in nutritional value."[19]

National footprint: Any outlet with locations in more than one state.

Although there are additional food outlets that offer unhealthy choices as well as fast food outlets that offer healthful alternatives, collectively, the fast food industry generates the majority of its revenues from products that contain excessive amounts of fat, calories, and sugar.[20] Together, these national chains generate more revenue than the remainder of the fast food industry. McDonald's alone generates 42 percent of all fast food sales.[21] Since independent and local chain fast food outlets represent such a small portion of the total market share, these outlets were excluded from this study.

STUDY AREA

This research study will be the first of its kind conducted in Santa Clara County, a county where approximately 22 percent of children aged 5-19 are overweight.[22] Statewide, 13.2 percent of children are overweight, and the national average is 14.8 percent.[23] Santa Clara County is located in the heart of Silicon Valley and is comprised of fifteen cities and is 1,291 square miles.[24] The county is bounded by

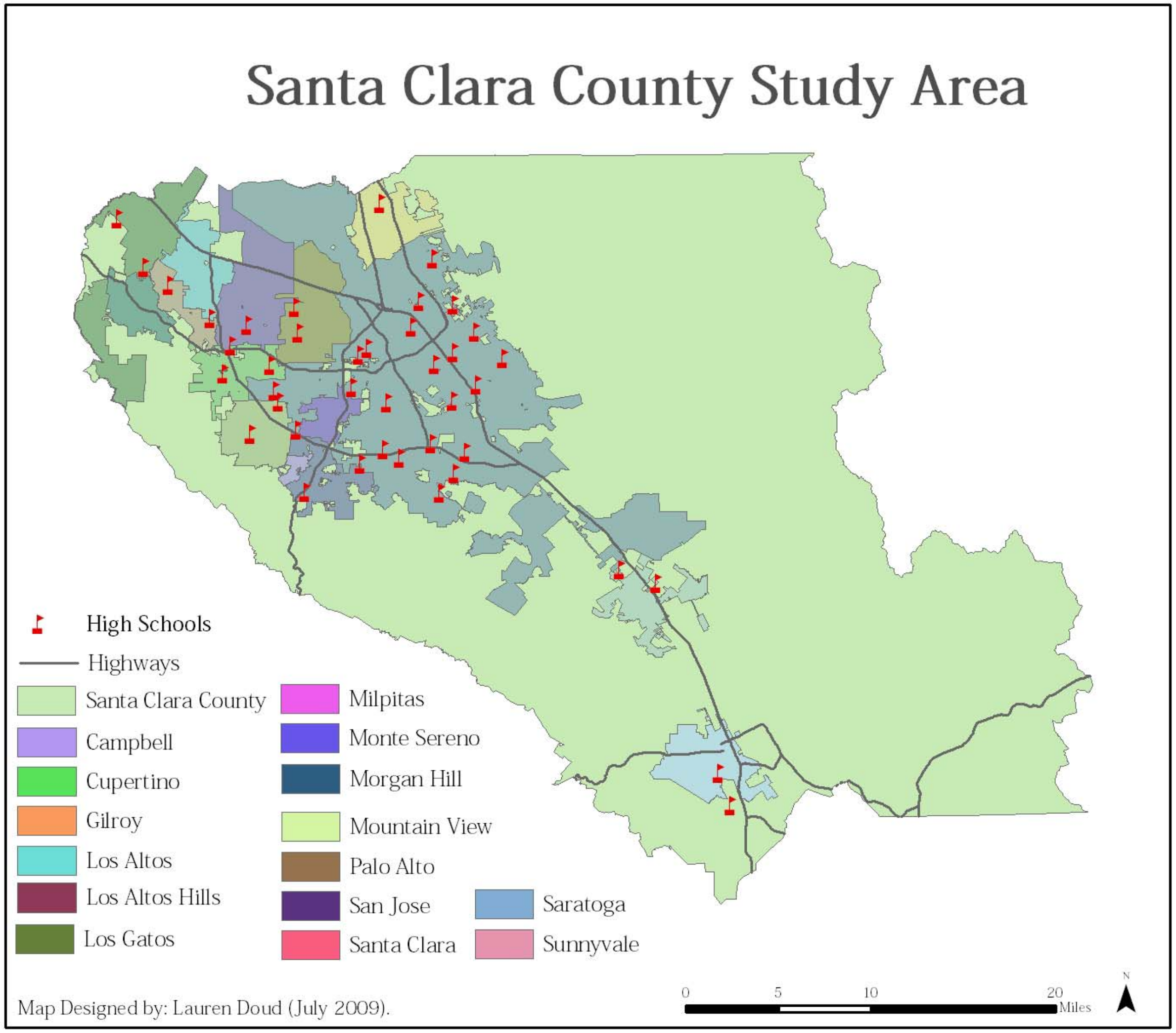
[18] "News," Town of Cape Elizabeth, http://www.capeelizabeth.com/news/fastfood.html (accessed November 28, 2008).
[19] James G. Hodge, Jr., J.D., LL.M., "The Use of Zoning to Restrict Access to Fast-Food Outlets: A Potential Strategy to Reduce Obesity," Public Health Law, http://www.publichealthlaw.net/Zoning%20and%20Fast%20Food%20-%20Hodge.ppt#358,1,Slide 1 (accessed November 28, 2008).
[20] Karen Stein, MFA, "Healthful Fast Foods Not Part of Healthful Revenue," *Journal of the American Dietetic Association* (March 2006): 344-45.
[21] Elsa H. Spencer, PhD, Erica Frank, MD, MPH and Nichole F. McIntosh, MD, MPH, "Potential Effects of the Next 100 Billion Hamburgers Sold by McDonald's," *American Journal of Preventive Medicine* 28, no. 4 (2005): 379-81.
[22] "2005 Santa Clara County Children's Report," Santa Clara County, http://storage.ugal.com/3283/childrens_report_2005.pdf (accessed November 29, 2008).
[23] "The National Survey of Children's Health - Overweight and Physical Activity Among Children: A Portrait of States and the Nation 2005," Department of Health & Human Services Health Resources and Services Administration, http://mchb.hrsa.gov/overweight/printit.htm (accessed March 8, 2009).
[24] "Natural Environment," Santa Clara County, http://www.sccgov.org/portal/site/scc/chlevel3?path=%2Fv7%2FSCC%20Public%20Portal%2FCounty%20Connection%2FAbout%20the%20County%2FNatural%20Environment (accessed April 17, 2009); and "State and County Quick Facts," U.S. Census, http://quickfacts.census.gov/qfd/states/06/06085.html (accessed April 17, 2009).

the San Francisco Bay to the northwest, the Santa Cruz Mountains to the west, and the Diablo Range to the east.[25] Nearly half of the county is grassland, chaparral, and oak savannah.[26]

Figure 1 shows the urbanized portion of Santa Clara County as designated by the U.S. Census Bureau's 2007 TIGERLine files. The U.S. Census Bureau defines urban areas as "all territory, population, and housing units in urbanized areas and in places of 2,500 or more persons outside urbanized areas."[27] The U.S. Census estimated that the 2007 population was 1,748,976.[28] According to the California Department of Education, there were twelve public high school districts with 61,251enrolled students in 2008.[29] Of total enrolled students, approximately 27 percent participated in the National School Lunch Program (NSLP).[30]

[25] Ibid.
[26] Ibid.
[27] "Urban and Rural Definitions," U.S. Census Bureau, http://www.census.gov/population/censusdata/urdef.txt (accessed May 5, 2009).
[28] "State and County Quick Facts," U.S. Census, http://quickfacts.census.gov/qfd/states/06/06085.html (accessed April 17, 2009).
[29] "DataQuest California Physical Fitness Test," California Department of Education, http://data1.cde.ca.gov/dataquest/page2.asp?Level=District&submit1=Submit&Subject=FitTest (accessed April 17, 2009).
[30] "2007-08 Growth Academic Performance Index (API) Chart School Demographic Characteristics," California Department of Education http://api.cde.ca.gov/reports/page2.asp?subject=API&level=School&submit1=submit (accessed April 17, 2009).

Figure 1: Study Area



Sources: Valley Transportation Authority, California Department of Conservation, U.S. Census 2007 TigerLine Files, and California Department of Education as modified by Lauren Doud (July 2009).

HYPOTHESIS

There is a positive correlation between the concentration of fast food restaurants and Santa Clara County high schools. Overall, high schools located in predominantly commercial areas will have higher concentrations of fast food outlets than high schools located in predominantly residential neighborhoods. Further, higher concentrations of fast food outlets in the secondary school food environment are also positively correlated with increased childhood obesity rates.

Several studies support this hypothesis. A study by Simon et al. researched the proximity of fast food restaurants to K-12 schools and neighborhood income in Los Angeles County. Results showed that higher concentrations of fast food restaurants existed within close proximity of high schools in lower income, highly commercial areas.[31] Kipke et al. studied neighborhood-level characteristics that may contribute to childhood obesity in East Los Angeles. There was greater access to fast food than healthy food minimizing the choices available to children in East Los Angeles.[32] A study by Ewing et al. concluded that that the probability of being overweight/obese was significantly associated with the urban form of the county where an individual lived.[33] Additionally, available park space and recreation facilities were scarce and located in areas that required transportation.[34] Existing park space was heavily used by young children during daylight hours.[35] However, these facilities did not offer ample opportunities for individual exercise for adolescents and adults.[36]

A 2005 review by Cummins and Macintyre discussed the results of research that examined neighborhood-level characteristics and obesity rates, also known as obesogenic environments. United States studies' results differ greatly from studies conducted abroad. In the United States, access to unhealthy food may be a contributing factor for obesity, yet causality has yet to be determined. Additionally, White (2006) reviewed obesogenic environment studies and also concluded that studies in the United States and abroad differed greatly. The primary difference between studies conducted in the United States and abroad was socioeconomically based. Studies abroad have routinely found no correlation between socioeconomic status and prevalence of fast food. However, studies in the United States have repeatedly found higher concentrations of fast food restaurants in poorer minority neighborhoods. This may mean that the United States "is a more unequal society, where issues such

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[31] Paul A. Simon et al., "Proximity of Fast Food Restaurants to Schools: Do Neighborhood Income and Type of School Matter?" *Preventive Medicine* 47 (2008): 284-88.
[32] Michele D. Kipke, Ph.D. et al., "Food and Park Environments: Neighborhood-level Risks for Childhood Obesity in East Los Angeles," *Journal of Adolescent Health* 40 (2007): 325-333.
[33] Reid Ewing et al., "Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity," *American Journal of Health Promotion* (September/October 2003): 47-57 http://www.smartgrowthamerica.org/report/JournalArticle.pdf (accessed November 29, 2008).
[34] Kipke et al..
[35] Ibid.
[36] Ibid.

as food retail access are genuinely worse for the poor, and in particular, African Americans."[37] Thus, the United States may be a unique environment whereby obesogenic environments exist.

Maddock (2004) examined the relationship between fast food restaurants and obesity on a national scale.[38] His findings indicated that there was a correlation between fast food restaurant density and state-level obesity prevalence.[39] Frank et al. (2004) reached similar conclusions stating that street network connectivity, residential density, land use mix, physical activity, and time spent in cars were predictors of obesity, particularly among white cohorts.[40]

REPORT STRUCTURE

The remainder of this report is organized into five sections that summarize the current state of the literature, outline this study's methodology, report the findings and conclusions, and concludes with policy recommendations.

The following chapter is a review of the existing literature that has examined the built environment and public health which provides additional background information. Chapter III summarizes the methodologies undertaken to perform this study's analyses. Chapter IV summarizes the results and of the geospatial and linear regression analyses, ethnographic observations as well as research limitations. Lastly, Chapter V discusses conclusions and policy recommendations.

[37] M. White, "Food Access and Obesity," *Obesity Reviews* 8, no. 1 (19 February 2007): 99-107.
[38] Jay Maddock, "The Relationship Between Obesity and the Prevalence of Fast Food Restaurants: State-Level Analysis," *The Science of Health Promotion* 19, no. 2 (November/December 2004): 137-43.
[39] Ibid.
[40] Lawrence D. Frank, PhD, Martin A. Andresen, MA and Thomas L. Schmid, PhD, "Obesity Relationships with Community Design, Physical Activity, and Time Spent in Cars," *American Journal of Preventive Medicine* 27, no. 2 (August 2004): 87-96.

Chapter II: Review of the Literature

CHAPTER OVERVIEW

This chapter is a review of existing academic research and attempts to synthesize studies that examined how the built environment contributes to adult and childhood obesity. The chapter is divided into an introduction, major themes and debates, and a conclusion. The major themes and debates section is further sub-divided into the following thematic areas:

- Do land use patterns cause adult obesity?
- Do land use patterns cause childhood obesity?
- Does socioeconomic status impact the availability of healthy and unhealthy food?
- Does access to healthy and unhealthy food retail impact adult obesity rates?
- Does access to fast food in the secondary school food environment cause childhood obesity?

The conclusion summarizes existing relationships as well as suggests how the field can build upon existing research to more effectively examine how the built environment impacts adult and childhood obesity more comprehensively.

INTRODUCTION

As early as 1867, cities in the United States began to implement laws to safeguard the public's health.[41] Historically, public health regulations implemented by urban planning professionals primarily regulated noise exposure, sanitation, and overcrowding. Despite efforts to regulate public health, living conditions in cities continued to decline.[42] As prosperity increased in the 1920s, so did automobile ownership.[43] This newfound mobility made suburban development feasible. By the mid-twentieth century, suburbs continued to flourish and central cities continued to decline.[44] These new suburbs were developed for the automobile rather than the pedestrian.[45] By the late twentieth century, public health professionals were grappling with an obesity epidemic.[46] Individual weight-loss interventions developed by public health professionals were unsuccessful.[47] As a result, public health literature began to examine if automobile-oriented development and food retail access were contributing factors for obesity.

[41] *The Practice of Local Government Planning*, 2nd ed., ed. Frank S. So, and Judith Getzels (Washington DC: International City Management Association, 1988), 24.
[42] Ibid, 29.
[43] Ibid, 33.
[44] Ibid, 7.
[45] Ibid.
[46] Katie M. Booth, Megan M. Pinkston and Walker S. Carlos Poston, "Obesity and the Built Environment," *American Dietetic Association* 105, no. 5 (May 2005 supplement 1): S110.
[47] Jay Maddock, "The Relationship Between Obesity and the Prevalence of Fast Food Restaurants: State-Level Analysis," *The Science of Health Promotion* 19, no. 2 (November/December 2004): 137.

A growing body of public health literature surfaced in the twenty-first century that examined the connection between public health and the built environment. This new sub-set of public health research, also known as health promotion, continues to find a strong connection between the built environment and public health.[48] The built environment can either encourage or deter physical activity based upon access to open space and non-motorized transportation networks that are perceived as safe by the public. Further, the conditions of these environments, for example, sidewalk conditions, are further enablers or disablers of healthy behavior.[49]

Healthy behavior, however, is not only dependent on physical activity but also dependent on dietary choices. Access to healthy and unhealthy food impacts the nutritional choices available to the public. 'Food desert,' a term coined in the early 1990s in Scotland, is an area of the built environment whereby residents cannot access affordable and healthy food.[50] More recently, however, the literature has moved away from the term 'food desert' to the term 'obesogenic environment.'[51] This new sub-set of public health literature examines not only the effects of the built environment on physical activity but also the effects of availability and accessibility of healthy and unhealthy food.[52]

Most recently, obesogenic research has further expanded to examine the geospatiality of healthy and unhealthy food, especially fast food outlets.[53] By mapping the food environment, geospatially, researchers can examine the availability of healthy and unhealthy food in communities throughout the United States and abroad. To date, much of this research has examined the correlations between food locations, both healthy and unhealthy, with socioeconomic status. An even smaller body of research has examined the 'secondary school food environment,' or the built environment in close proximity to schools.[54]

MAJOR THEMES AND DEBATES

Obesity is a complex public health issue. Although over-simplified, obesity results from an individual consuming more calories than are expended.[55] The complexity arises from what causes an individual to consume more energy than he/she expends. Clearly, personal choices impact weight status. However, current literature suggests that personal choices may be impacted by the built environment. Academic

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[48] Lawrence D. Frank and Peter O. Engelke, "The Built Environment and Human Activity Patterns: Exploring the Impacts of Urban Form on Public Health," *Journal of Planning Literature* 16, no. 2 (February 2001): 207.

[49] Frank and Engelke, 208.

[50] Steven Cummins and Sally Macintyre, ""Food deserts"—Evidence and Assumption in Health Policy Making," *British Medical Journal* 325 (24 August 2002): 436.

[51] Jennifer L. Black and James Macinko, "Neighborhoods and Obesity," *Nutrition Reviews* 66, no. 1 (January 2008): 6.

[52] M. White, "Food Access and Obesity," *Obesity Reviews* 8, no. 1 (19 February 2007): 99-107.

[53] M. White: 99.

[54] Anthony Winson, "School Food Environments and the Obesity Issue: Content, Structural Determinants, and Agency in Canadian High Schools," *Agriculture and Human Values* 25, no. 4 (17 April 2008): 499-511.

[55] W. Maziak, K.D. Ward and M.B. Stockton, "Childhood Obesity: Are We Missing the Big Picture?" *Obesity Reviews* 9, no. 1 (January 2008): 35-42.

research has yet to find a causal relationship between any built environment variable and obesity. However, there is evidence to support that correlations between several variables exist.

Do land use patterns cause adult obesity?

Three studies evaluated the relationship between land use patterns and adult obesity.[56] All three developed indices in an attempt to measure the quality of the built environment (see Table 1). Each study attempted to measure opportunities for engaging in physical activity by including street network connectivity, availability of green and open spaces, and public transit in their representative indices. Further, each also attempted to define the geographic dispersion of land uses by measuring residential density and land use mix. Both Ewing et al. and Frank et al. found that land use mix had the strongest correlation with obesity.[57] Controlling for socioeconomic factors, Frank et al. concluded that for each quartile increase in land use mix, obesity risk decreased by 12.2 percent.[58] Similarly, Ewing et al. found a direct relationship between urban sprawl and increased obesity.[59]

Table 1: Built Environment Variables Used to Examine Correlation with Adult Obesity

Study	Location	Study Area	Variables
Li et al. (2009)	448 U.S. Counties and 83 Metropolitan areas	Walkability Index	• Land use mix • Street connectivity • Public transit stations • Green and open spaces
Frank et al. (2004)	Atlanta	Built environment Measures	• Street network connectivity • Net residential density • Land use mix
Ewing et al. (2003)	Portland	Smart Growth America's Metropolitan Sprawl Index	• Residential density • Land use mix • Degree of centering • Street accessibility

Sources: Lawrence D. Frank, PhD, Martin A. Andresen, MA and Thomas L. Schmid, PhD, "Obesity Relationships with Community Design, Physical Activity, and Time Spent in Cars," *American Journal of Preventive Medicine* 27, no. 2 (August 2004): 87-96; Fuzhong Li et al., "Built Environment and 1-Year Change in Weight and Waist Circumference in Middle-Aged and Older Adults: Portland Neighborhood Environment and Health Study," *American Journal of Epidemiology* 169, no. 4 (January 19, 2009): 401-8; and Reid Ewing et al., "Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity," *American Journal of Health Promotion* (September/October 2003): 47-57. .http://www.smartgrowthamerica.org/report/JournalArticle.pdf (accessed November 29, 2008).

[56] Lawrence D. Frank, PhD, Martin A. Andresen, MA and Thomas L. Schmid, PhD, "Obesity Relationships with Community Design, Physical Activity, and Time Spent in Cars," *American Journal of Preventive Medicine* 27, no. 2 (August 2004): 87-96; Fuzhong Li et al., "Built Environment and 1-Year Change in Weight and Waist Circumference in Middle-Aged and Older Adults: Portland Neighborhood Environment and Health Study," *American Journal of Epidemiology* 169, no. 4 (January 19, 2009): 401-8; and Reid Ewing et al., "Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity," *American Journal of Health Promotion* (September/October 2003): 47-57 http://www.smartgrowthamerica.org/report/JournalArticle.pdf (accessed November 29, 2008).

[57] Ewing et al. (2003): 54.

[58] Frank et al., (2004): 91.

[59] Ewing et al., (2003): 54.

One additional land use variable examined by Ewing et al. was the degree of urban sprawl in a community. Ewing et al. found a small direct correlation among sprawl, weight, hypertension, and time spent walking.[60] The findings were stronger in sprawling counties than in metropolitan areas.[61] Thus, sprawl appears to have a positive relationship to obesity. Further research will need to be undertaken to further delineate the relationship between sprawl and obesity.

Do land use patterns cause childhood obesity?

Limited, yet compelling research has shown that land use patterns are correlated with adult obesity. These relationships, however, remain poorly understood.[62] Similarly, research conducted for children has reached similar conclusions albeit testing for one additional variable, access to park space (as shown in Table 2). Kipke et al. argue that park space is an important land use variable when examining childhood obesity. Parks are often utilized most by children because of the availability of playground equipment.[63] Adult park rate utilization is usually lower because parks often lack opportunities for individual adult exercise activities such as walking, jogging and biking.[64] Thus, it is not surprising that all four studies used green space as a proxy for physical activity promotion among children.[65]

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[60] Reid Ewing et al., "Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity," *American Journal of Health Promotion* (September/October 2003): 54 http://www.smartgrowthamerica.org/report/JournalArticle.pdf (accessed November 29, 2008).
[61] Ewing et al., (2003): 55.
[62] Gilbert C. Liu, Jeffrey S. Wilson, Rong Qi and Jun Ying, "Green Neighborhoods, Food Retail and Childhood Overweight: Differences by Population Density," *American Journal of Health Promotion* 21, no. 4 (March/April 2007): 322.
[63] Kipke et al., (2007): 328.
[64] Kipke et al., (2007): 329.
[65] Janice F. Bell, Jeffrey S. Wilson and Gilbert C. Liu, "Neighborhood Greenness and 2-year Changes in Body Mass Index of Children and Youth," *American Journal of Preventive Medicine* 35, no. 6 (December 2008): 547-53; Irina B. Grafova, "Overweight Children: Assessing the Contribution of the Built Environment," *Preventive Medicine* 47, no. 3 (September 2008): 304-8; Gilbert C. Liu, Jeffrey S. Wilson, Rong Qi and Jun Ying, "Green Neighborhoods, Food Retail and Childhood Overweight: Differences by Population Density," *American Journal of Health Promotion* 21, no. 4 (March/April 2007): 317-25; and Michele D. Kipke, Ph.D. et al., "Food and Park Environments: Neighborhood-level Risks for Childhood Obesity in East Los Angeles," *Journal of Adolescent Health* 40 (2007): 325-33.

Table 2: Environment Variables Used to Examine Correlation with Childhood Obesity

Study	Study Area	Variables Measured
Bell et al. (2008)	Marion County, Indiana	• Satellite imagery of greenness • Residential density
Grafova (2008)	United States	• Population density • Street connectivity • Urban design • Neighborhood physical disorder (neighborhood conditions)
Kipke et al. (2007)	East Los Angeles	• Quality and utilization of local parks
Liu et al. (2007)	Marion County, Indiana	• Population density • Satellite imagery of greenness

Sources: Janice F. Bell, Jeffrey S. Wilson and Gilbert C. Liu, "Neighborhood Greenness and 2-year Changes in Body Mass Index of Children and Youth," *American Journal of Preventive Medicine* 35, no. 6 (December 2008): 547-53; Irina B. Grafova, "Overweight Children: Assessing the Contribution of the Built Environment," *Preventive Medicine* 47, no. 3 (September 2008): 304-8; Gilbert C. Liu, Jeffrey S. Wilson, Rong Qi and Jun Ying, "Green Neighborhoods, Food Retail and Childhood Overweight: Differences by Population Density," *American Journal of Health Promotion* 21, no. 4 (March/April 2007): 317-25; and Michele D. Kipke, Ph.D. et al., "Food and Park Environments: Neighborhood-level Risks for Childhood Obesity in East Los Angeles," *Journal of Adolescent Health* 40 (2007): 325-33.

Researchers differed in their methodological approaches for measuring the presence of park space with childhood obesity. Both Liu et al. and Bell et al. used satellite imagery to measure greenness density. While this methodology is likely an accurate method to determine the amount of green space within a study area, the quality of the green space cannot be determined with this analysis approach. Kipke et al. took the analysis one step further by conducting ethnographic research. All parks within the study area were observed by researchers to determine park utilization rates as well as park quality perception.[66]

Two studies found that access to green space decreased the likelihood of childhood overweight and obesity.[67] Liu et al. found that vegetation was a significant predictor of childhood obesity in regions with high population density.[68] Bell et al. found that irrespective of residential density, greenness was significantly associated with lower childhood obesity rates.[69] Kipke et al. found that parks within the East Los Angeles study area were well utilized by children.[70] Although not specifically stated, the implication was that the amount of park space was insufficient, increasing the likelihood of childhood obesity.

Although park space is a primary focus of current literature, Grafova examined other land use variables to assess the relationship between land use patterns and childhood obesity (see Table 2). Observational

[66] Kipke et al., (2007): 327.
[67] Bell et al., (2008): 547-553; and Liu et al., (2007): 317-325.
[68] Liu et al., (2007): 321.
[69] Bell et al., (2008): 551.
[70] Kipke et al., (2007): 325.

research was undertaken to determine the presence of "physical disorder."[71] To examine residential urban form, the year a house was built was indicative of the census tract's "urban design."[72] The rationale for including this variable stemmed from prior research which found that "loops and lollipops" developments from the 1970s onward were less pedestrian friendly, thus reducing a neighborhood's walkability.[73] She found that children living in "loops and lollipops" neighborhoods had a higher probability of overweight.[74] Further, children were more likely to be overweight where the presence of physical disorder existed.[75] Given the state of the current literature, a conclusion can be drawn that land use patterns contribute to both adult and childhood obesity rates. However, long-term longitudinal studies will need to be undertaken to determine causality.

Does socioeconomic status impact the availability of healthy and unhealthy food?

The majority of research conducted to date has examined the correlations among socioeconomic factors and access to healthy and unhealthy food. Ten studies examined socioeconomic factors as primary outcomes.[76] While income findings were mixed, trends have emerged with regard to ethnicity. The literature reveals that ethnic minorities, particularly African-Americans, are more likely to live in communities with scarce access to grocery stores and supermarkets and excessive access to fast food outlets. Two studies examined whether ethnicity affects access to healthy food as primary outcomes.[77]

[71] Grafova, (2008): 305.
[72] Ibid.
[73] Ibid.
[74] Ibid, 307.
[75] Ibid, 307.
[76] Naa Oyo A. Kwate, Chun-Yip Yau, Ji-Meng Loh and Donya Williams, "Inequality in Obesogenic Environments: Fast Food Density in New York City," *Health and Place* 15 (2009): 364-73; Manuel Franco et al., "Neighborhood Characteristics and Availability of Healthy Foods in Baltimore," *American Journal of Preventive Medicine* 35, no. 6 (December 2008): 561-67; LaVonna Blair Lewis et al., "African Americans' Access to Healthy Food Options in South Los Angeles Restaurants," *American Journal of Public Health* 95, no. 4 (April 2005): 668-73; Jason P. Block, MD, MPH, Richard A. Scribner, MD, MPH and Karen B. DeSalvo, MD, MPH, MSc, "Fast Food, Race/Ethnicity, and Income: A Geographic Analysis," *American Journal of Preventive Medicine* 27, no. 3 (2004): 211-17; Steven C.J. Cummins, PhD, Laura McKay, MA and Sally MacIntyre, PhD, "McDonalds Restaurants and Neighborhood Deprivation in Scotland and England," *American Journal of Preventive Medicine* 29, no. 4 (2005): 308-10; Eric Hemphill, Kim Raine, John C. Spence and Karen E. Smoyer-Tomic, "Exploring Obesogenic Food Environments in Edmonton, Canada: The Association Between Socioeconomic Factors and Fast-food Outlet Access," *The Science of Health Promotion* 22, no. 6 (July/August 2008): 426-32; Kimberly Morland, Steve Wing, Ana Diez Roux and Charles Poole, "Neighborhood Characteristics Associated with the Location of Food Stores and Food Service Places," *American Journal of Preventive Medicine* 22, no. 1 (January 2002): 23-29; Sally Macintyre, Laura McKay, Steven Cummins and Cate Burns, "Out-of-home food outlets and area deprivation: case study in Glasgow, UK," *International Journal of Behavioral Nutrition and Physical Activity* 2, no. 16 (25 October 2005); Shannon N. Zenk et al., "Neighborhood Racial Composition, Neighborhood Poverty, and the Spatial Accessibility of Supermarkets in Metropolitan Detroit," *American Journal of Public Health* 95, no. 4 (April 2005): 660-67; and C.M. Burns and A.D. Inglis, "Measuring food access in Melbourne: Access to Healthy and Fast Foods by Car, Bus and Foot in an Urban Municipality in Melbourne," *Health and Place* 13 (2007): 877-85.
[77] Manuel Franco et al., "Neighborhood Characteristics and Availability of Healthy Foods in Baltimore," *American Journal of Preventive Medicine* 35, no. 6 (December 2008): 561-67; and Shannon N. Zenk et al., "Neighborhood Racial

Franco et al. found that predominantly black neighborhoods in Baltimore lacked access to healthy food.[78] High quality healthy foods were found in predominantly white neighborhoods 68 percent of the time. However, in predominantly black neighborhoods high quality healthy foods were found only 19 percent of the time.[79] Zenk et al. found that in the lowest income black neighborhoods, access to a supermarket was 1.1 miles further than in the lowest income white neighborhoods.[80] These studies clearly show a correlation between ethnic minority status and access to healthy food.

Two additional studies examined ethnic status and access to unhealthy food.[81] Block et al. concluded that predominantly African-American neighborhoods had greater access to unhealthy foods in New Orleans. They found that there were twice as many fast food outlets per mile in African-American neighborhoods than in predominantly white neighborhoods.[82] Similarly, Kwate et al., found that the density of fast food outlets in predominantly black neighborhoods was higher than predominantly white neighborhoods in New York City.[83] Further, the highest concentrations of fast food restaurants in New York City were in predominantly black and Latino neighborhoods.[84] These findings further demonstrate that ethnic minority status affects access to unhealthy as well as healthy food.

Several studies examined the correlation between income and access to both healthy and unhealthy food.[85] Morland et al, found that food retail locations were correlated with income.[86] Supermarkets were less prevalent in lower income neighborhoods.[87] Similarly, Franco et al. found that eleven percent of food outlets in lower income neighborhoods were supermarkets compared to 42 percent in higher

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Composition, Neighborhood Poverty, and the Spatial Accessibility of Supermarkets in Metropolitan Detroit," *American Journal of Public Health* 95, no. 4 (April 2005): 660-67.

[78] Manuel Franco et al., "Neighborhood Characteristics and Availability of Healthy Foods in Baltimore," *American Journal of Preventive Medicine* 35, no. 6 (December 2008): 564.

[79] Franco et al., (2008): 563.

[80] Shannon N. Zenk et al., "Neighborhood Racial Composition, Neighborhood Poverty, and the Spatial Accessibility of Supermarkets in Metropolitan Detroit," *American Journal of Public Health* 95, no. 4 (April 2005): 663.

[81] Jason P. Block, MD, MPH, Richard A. Scribner, MD, MPH and Karen B. DeSalvo, MD, MPH, MSc, "Fast Food, Race/Ethnicity, and Income: A Geographic Analysis," *American Journal of Preventive Medicine* 27, no. 3 (2004): 211-17; and Naa Oyo A. Kwate, Chun-Yip Yau, Ji-Meng Loh and Donya Williams, "Inequality in Obesogenic Environments: Fast Food Density in New York City," *Health and Place* 15 (2009): 364-73

[82] Block et al., 211.

[83] Naa Oyo A. Kwate, Chun-Yip Yau, Ji-Meng Loh and Donya Williams, "Inequality in Obesogenic Environments: Fast Food Density in New York City," *Health and Place* 15 (2009): 364.

[84] Kwate et al., (2009): 367.

[85] Kimberly Morland, Steve Wing, Ana Diez Roux and Charles Poole, "Neighborhood Characteristics Associated with the Location of Food Stores and Food Service Places," *American Journal of Preventive Medicine* 22, no. 1 (January 2002): 23-29; Manuel Franco et al., "Neighborhood Characteristics and Availability of Healthy Foods in Baltimore," *American Journal of Preventive Medicine* 35, no. 6 (December 2008): 564; Naa Oyo A. Kwate, Chun-Yip Yau, Ji-Meng Loh and Donya Williams, "Inequality in Obesogenic Environments: Fast Food Density in New York City," *Health and Place* 15 (2009): 364; and LaVonna Blair Lewis et al., "African Americans' Access to Healthy Food Options in South Los Angeles Restaurants," *American Journal of Public Health* 95, no. 4 (April 2005): 672.

[86] Kimberly Morland, Steve Wing, Ana Diez Roux and Charles Poole, "Neighborhood Characteristics Associated with the Location of Food Stores and Food Service Places," *American Journal of Preventive Medicine* 22, no. 1 (January 2002): 23-29.

[87] Morland et al., (2002): 28.

income areas.[88] Lewis et al. found that lower income African-American neighborhoods in South Los Angeles had fewer healthy food outlets and more fast food restaurants than higher income white neighborhoods in West Los Angeles.[89] Interestingly, the study also examined menu choices of food outlets within the study area. Menu choices were predominantly unhealthy. This is one of very few studies that examined food choices, not just number of outlets. Conversely, Kwate et al. concluded that income was not correlated with unhealthy food access; both low income and high income predominantly black neighborhoods had similar healthy food deprivation levels, with African-Americans having poor access to healthy food.[90] Clearly, studies conducted throughout North America consistently find that income as well as ethnicity is correlated with access to both healthy and unhealthy food outlets.

Generally, lower income and minority neighborhoods have greater access to fast food and poorer access to grocery stores and supermarkets. These findings are consistent across multiple geographies in North America. Although income correlations are somewhat inconsistent, the majority of studies conducted to date examining income as a primary variable have found that lower income neighborhoods are more deprived. Additional studies will need to further examine these correlations in an attempt to determine causality.

Does access to healthy and unhealthy food retail impact adult obesity rates?

Given that research conducted in the United States generally concludes that socioeconomically disadvantaged populations have greater access to unhealthy food and scarce access to healthy food, research has further examined if this access contributes to obesity. Six studies examined if obesity rates were correlated with access to (un)healthy food retail.[91] Generally, healthy food retail includes supermarkets and grocery stores. Supermarkets can be defined as large national chain outlets, while grocery stores are smaller independently owned outlets.[92] Unhealthy food retail is generally defined as

[88] Franco et al., (2008): 564.

[89] LaVonna Blair Lewis et al., "African Americans' Access to Healthy Food Options in South Los Angeles Restaurants," *American Journal of Public Health* 95, no. 4 (April 2005): 672.

[90] Kwate et al., (2009): 370-371.

[91] Jamie Pearce, Rosemary Hiscock, Tony Blakely and Karen Witten, "A National Study of the Association between Neighourhood Access to fast-food Outlets and the Diet and Weight of Local Residents," *Health and Place* 15, no. 1 (March 2009): 193-97; Jay Maddock, "The Relationship Between Obesity and the Prevalence of Fast Food Restaurants: State-Level Analysis," *The Science of Health Promotion* 19, no. 2 (November/December 2004): 137-43; Fuzhong Li et al., "Obesity and the Built Environment: Does the Density of Neighborhood Fast-Food Outlets Matter?" *The Science of Health Promotion* 23, no. 3 (January/February 2009): 203-9; Kimberly Morland, Ana V. Diez Roux and Steve Wing, "Supermarkets, Other Food Stores, and Obesity: The Atherosclerosis Risk in Communities Study," *American Journal of Preventive Medicine* 30, no. 4 (April 2006): 333-339; Neil K. Mehta and Virginia W. Chang, "Weight Status and Restaurant Availability: A Multilevel Analysis," *American Journal of Preventive Medicine* 34, no. 2 (February 2008): 127-33; and Kimberly B. Morland and Kelly R. Evenson, "Obesity Prevalence and the Local Food Environment," *Health and Place* 15, no. 2 (June 2009): 491-95.

[92] Kimberly Morland, Ana V. Diez Roux and Steve Wing, "Supermarkets, Other Food Stores, and Obesity: The Atherosclerosis Risk in Communities Study," *American Journal of Preventive Medicine* 30, no. 4 (April 2006): 333-339; and Kimberly B. Morland and Kelly R. Evenson, "Obesity Prevalence and the Local Food Environment," *Health and Place* 15, no. 2 (June 2009): 335.

convenience stores and fast food chain restaurants. Full service restaurants are generally classified as healthy food retail. Consistently, each study conducted in the United States found that access to unhealthy food retail increased the prevalence of overweight and obesity among adult populations. Maddock found that that there was a correlation between both fast food outlet density and the ratio of persons to fast food outlet with statewide obesity rates.[93] Li et al. found that for older adults (mean=sixty-five years of age), the availability of fast food outlets proximal to residential neighborhoods may further increase obesity likelihood.[94] They not only examined proximity but also examined consumption patterns. As expected, individuals that lived in close proximity to fast food outlets and consumed food at these outlets at least once per week had higher obesity rates.[95]

The mix of restaurants types, both full service and fast food, also impacts obesity prevalence. Mehta and Chang found that restaurant type mix was associated with overweight and obesity.[96] As the ratio of full service restaurants increased, overweight and obesity decreased.[97] As the ratio of fast food outlets increased, obesity rates also increased.[98] As ratio of fast food to full service increased, obesity rates too increased.[99] Interestingly, the United States Department of Agriculture found that the nutritional content of full service restaurant meals was similar to that of fast food meals.[100] This may mean that other extraneous variables may affect obesity rates than just the mix of restaurant types.

Does access to fast food in the secondary school food environment cause childhood obesity?

Food retail within close proximity to schools is often referred to as the 'secondary school food environment.[101] Although 'proximity' varies by study, the most common proximity metrics used by researchers are between one tenth and one half mile of a school. Academic research has historically focused on the primary school food environment, or the on-campus environment. However, youth consumption patterns are changing, and recent academic research has begun to recognize these shifts and more closely examine youth consumption patterns in the secondary school food environment. Nielson et al. found that children consumed more of their meals and snacks from restaurants and fast

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[93] Jay Maddock, "The Relationship Between Obesity and the Prevalence of Fast Food Restaurants: State-Level Analysis," *The Science of Health Promotion* 19, no. 2 (November/December 2004): 137-43.
[94] Fuzhong Li et al., "Obesity and the Built Environment: Does the Density of Neighborhood Fast-Food Outlets Matter?" *The Science of Health Promotion* 23, no. 3 (January/February 2009): 207.
[95] Li et al., (2009): 203-9.
[96] Neil K. Mehta and Virginia W. Chang, "Weight Status and Restaurant Availability: A Multilevel Analysis," *American Journal of Preventive Medicine* 34, no. 2 (February 2008): 131.
[97] Mehta and Chang, (2008): 131.
[98] Mehta and Chang, (2008): 131.
[99] Mehta and Chang, (2008): 127.
[100] Biing-Hwan Li, Elizabeth Frazão and Joanne Guthrie, "Away-From-Home Foods Increasingly Important to Quality of American Diet," United States Department of Agriculture Economic Research Service, http://www.ers.usda.gov/Publications/AIB749/ (accessed March 22, 2009).
[101] Anthony Winson, "School Food Environments and the Obesity Issue: Content, Structural Determinants, and Agency in Canadian High Schools," *Agriculture and Human Values* 25, no. 4 (17 April 2008): 502.

food outlets and consumed less from the primary school environment.[102] In fact, Nicklas et al. concluded that between 22 percent and 34 percent of total calories consumed daily by children were from snack foods.[103] Further, Davis and Carpenter found that children were more likely to consume french fries and soda when schools were within one half mile of a fast food outlet.[104]

Six studies found that fast food outlets are located in close proximity to schools.[105] One study conducted by Austin et al. observed that fast food outlets were not only in close proximity to schools but also clustered around schools in Chicago.[106] Fast food outlets were three to four times more likely to be located within 1.5 kilometers of a school than anywhere else in Chicago.[107] Thirty-five percent of all schools had at least one fast food outlet within 400m of campus.[108] The percentages increased to 80 percent within 800m of a school.[109] Zenk and Powell examined the proximity issue on a national scale and did not find clustering, but found that 33 percent of schools in the United States had at least one fast food outlet within one-half mile of a middle school or high school campus.[110] Similarly, Sturm examined the food environment within 400m and 800m of middle schools and high schools throughout the United States and found that Hispanic students were significantly more likely to attend a school in close proximity to convenience stores, restaurants, snack shops and fast food outlets.[111] Simon et al. concluded that 23.3 percent and 64.8 percent of schools in Los Angeles County had at least one fast food outlet located within 400m and 800m of a high school respectively.[112]

[102] Nielson, Samara Joy, Anna Maria Siega-Riz, and Barry M. Popkin. "Trends in Food Locations and Sources among Adolescents and Young Adults." *Preventive Medicine* 35, no. 2 (August 2002).
[103] Theresa A. Nicklas, DrPH et al., "Children's Food Consumption Patterns Have Changed over Two Decades (1973-1994):: The Bogalusa Heart Study," *Journal of the American Dietetic Association* 104, no. 7 (July 2004): 1135.
[104] Brennan Davis and Christopher Carpenter, "Proximity of Fast-Food Restaurants to Schools and Adolescent Obesity," *American Journal of Public Health* 99, no. 3 (March 2009): 507.
[105] Brennan Davis and Christopher Carpenter, "Proximity of Fast-Food Restaurants to Schools and Adolescent Obesity," *American Journal of Public Health* 99, no. 3 (March 2009): 505-10; Roland Sturm, "Disparities in the Food Environment Surrounding US Middle and High Schools," *Journal of the Royal Institute of Public Health* 122, no. 7 (July 2008): 681-90; Shannon N. Zenk and Lisa M. Powell, "US Secondary Schools and Food Outlets," *Health and Place* 14, no. 2 (June 2008): 336-46; Janet Currie, Stefano DellaVigna, Enrico Moretti and Vikram Pathania, "The Effect of Fast Food Restaurants on Obesity," *American Association of Wine Economists* (February 2009): 1-47; Paul A. Simon et al., "Proximity of Fast Food Restaurants to Schools: Do Neighborhood Income and Type of School Matter?" *Preventive Medicine* 47 (2008): 284-88;; and S. Bryn Austin, ScD et al., "Clustering of Fast-Food Restaurants Around Schools:: A Novel Application of Spatial Statistics to the Study of Food Environments," *American Journal of Public Health* 95, no. 9 (September 2005): 1575-81.
[106] S. Bryn Austin, ScD et al., "Clustering of Fast-Food Restaurants Around Schools:: A Novel Application of Spatial Statistics to the Study of Food Environments," *American Journal of Public Health* 95, no. 9 (September 2005): 1575-81.
[107] S. Bryn Austin, ScD et al., "Clustering of Fast-Food Restaurants Around Schools:: A Novel Application of Spatial Statistics to the Study of Food Environments," *American Journal of Public Health* 95, no. 9 (September 2005): 1575.
[108] Austin, ScD et al., (2005): 1577.
[109] Austin, ScD et al., (2005): 1577.
[110] Shannon N. Zenk and Lisa M. Powell, "US Secondary Schools and Food Outlets," *Health and Place* 14, no. 2 (June 2008): 336.
[111] Roland Sturm, "Disparities in the Food Environment Surrounding US Middle and High Schools," *Journal of the Royal Institute of Public Health* 122, no. 7 (July 2008): 681.
[112] Paul A. Simon et al., "Proximity of Fast Food Restaurants to Schools: Do Neighborhood Income and Type of School Matter?" *Preventive Medicine* 47 (2008): 284.

Fast food outlets are also more prevalent near high schools than primary schools. Both Zenk and Powell and Simon et al. found that high schools had more fast food outlets nearby than primary schools. Both suggested that fast food retailers may co-locate in close proximity to high schools because this age group has increased mobility and may be more likely to patronize fast food outlets before, during, and after school.[113] Simon et al. also suggested that siting of fast food restaurants within close proximity to high schools may be intentional because these teenagers have greater mobility.[114]

Open campus policies increase student mobility during school lunch hours. Schools with open campus policies allow students to leave campus during the lunch period. Neumark-Aztainer et al. concluded that children that attend high schools with open campus lunch policies are significantly more likely to consume fast food than students that attend closed campus schools.[115] Likewise, Winson observed that off-campus fast food outlets were well patronized by high school students in Canada.[116] To date, no research appears to have examined open/closed campus policies status with food consumption patterns and resultant obesity rates.

Proximity to fast food restaurants is correlated with increased overweight and obesity. Davis and Carpenter examined the proximity of fast food outlets and schools in California and found that when fast food outlets were within one half mile of a school, childhood overweight and obesity increased.[117] Currie concluded that a fast food outlet within a tenth of a mile of a high school increased ninth grader obesity rates by 5.2 percent.[118] No relationship was found between fast food outlets and obesity at quarter mile or half mile distances.[119]

Although limited, the existing research concludes that a relationship exists between the presence of fast food in the secondary school food environment and childhood obesity. Therefore, land use policies that limit access may be warranted. Davis and Carpenter suggest that local governments should consider "restricting commercial permits for fast-food restaurants within walking distance of a school."[120] Further research will need to determine if a causal relationship exists between proximity and childhood obesity. If a causal relationship is found, researchers may be able to develop macro-level interventions to curtail the childhood as well as adult obesity epidemic.

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[113] Zenk and Powell, (2008): 344.
[114] Simon et al.: 287.
[115] Dianne Neumark-Sztainer et al., "School Lunch and Snacking Patterns Among High School Students: Associations with School Food Environment and Policies," *The International Journal of Behavioral Nutrition and Physical Activity* 2, no. 14 (2005 October 6): 1.
[116] Anthony Winson, "School Food Environments and the Obesity Issue: Content, Structural Determinants, and Agency in Canadian High Schools," *Agriculture and Human Values* 25, no. 4 (17 April 2008): 507.
[117] Brennan Davis and Christopher Carpenter, "Proximity of Fast-Food Restaurants to Schools and Adolescent Obesity," *American Journal of Public Health* 99, no. 3 (March 2009): 505.
[118] Janet Currie, Stefano DellaVigna, Enrico Moretti and Vikram Pathania, "The Effect of Fast Food Restaurants on Obesity," *American Association of Wine Economists* (February 2009): 1.
[119] Janet Currie, Stefano DellaVigna, Enrico Moretti and Vikram Pathania, "The Effect of Fast Food Restaurants on Obesity," *American Association of Wine Economists* (February 2009): 1.
[120] Brennan Davis and Christopher Carpenter, "Proximity of Fast-Food Restaurants to Schools and Adolescent Obesity," *American Journal of Public Health* 99, no. 3 (March 2009): 509.

CONCLUSIONS

The obesity epidemic continues to perplex researchers across disciplines. Individual-level interventions have been unsuccessful.[121] Examining macro level determinants, such as the built environment, may provide public health advocates with additional methods to curtail the obesity epidemic. Although this body of research is in its infancy, early examinations of built environment variables reveal that there are correlations between facets of the built environment and obesity. The walkability of a community, for example, is directly related with weight status. Neighborhoods that are perceived unsafe or unsuitable for walking consistently show higher rates of overweight and obesity than neighborhoods that are more pedestrian friendly.

Safe walking and bicycling routes to schools also provides an opportunity for adolescent physical activity. These walking routes may also contain opportunities to consume healthy or unhealthy food. Since overweight children are more likely to become overweight adults, research has begun to examine the primary and secondary school food environments. Although this sub-set of health promotion literature is new, findings reveal that the food environment within and in close proximity to schools impacts childhood overweight and obesity. Children exposed to fast food advertising and retail outlets are also more likely to be overweight or obese.[122] Open campus lunch policies further perpetuate the issue. Academia has proposed policies that limit access to the secondary school food environment including adopting closed campus lunch policies as well as enacting zoning ordinances that ban fast food outlets within close proximity to schools.[123]

Socioeconomic factors are also determinants for overweight and obesity in the United States. Predominantly lower income African-American neighborhoods are obesogenic environments. Individuals in these neighborhoods do not have access to grocery stores and supermarkets in close proximity to their homes. Further, these neighborhoods often have high concentrations of fast food outlets. Without access to healthy food options, individuals cannot make healthy food choices.

Examining causality also begs the question which came first, the fast food outlet or the people? Do fast food outlets intentionally locate in lower income minority neighborhoods and/or in close proximity to schools? Or, are there more complex interactions at play including zoning regulations and density? [124] To date, research has not yet comprehensively examined multiple built environment variables with obesity. For example, a study may examine proximity of food outlets to schools, but not also examine

[121] Katie M. Booth, Megan M. Pinkston and Walker S. Carlos Poston, "Obesity and the Built Environment," *American Dietetic Association* 105, no. 5 (May 2005 supplement 1): S110.

[122] Mat Walton, Jamie Pearce and Peter Day, "Examining the Interaction between Food Outlets and Outdoor Food Advertisements with Primary School Food Environments," *Health and Place* 15, no. 2 (June 2009): 1.

[123] Janet Currie, Stefano DellaVigna, Enrico Moretti and Vikram Pathania, "The Effect of Fast Food Restaurants on Obesity," *American Association of Wine Economists* (February 2009): 1-47; Brennan Davis and Christopher Carpenter, "Proximity of Fast-Food Restaurants to Schools and Adolescent Obesity," *American Journal of Public Health* 99, no. 3 (March 2009): 505-10;

[124] S. Bryn Austin, ScD et al., "Clustering of Fast-Food Restaurants Around Schools:: A Novel Application of Spatial Statistics to the Study of Food Environments," *American Journal of Public Health* 95, no. 9 (September 2005): 1579.

children's consumption patterns and obesity rates. While examining spatial closeness is relevant, consumption must also be examined. If a fast food outlet exists, will individuals choose to patronize these outlets? Further, if healthy choices are available, do individuals purchase healthy options? Thus, the built environment is a complex system with many interrelated variables. Further research will need to examine the built environment more comprehensively to determine causality.

The next chapter will discuss the methodology used to examine the geospatial distribution of fast food, youth fast food consumption patterns, and statistical analysis undertaken for this project. This study attempts to build upon the existing knowledge base by examining proximity as well as consumption within the secondary school food environment.

Chapter III: Methodology

CHAPTER OVERVIEW

This chapter discusses the methodology undertaken to evaluate the impact of the secondary school food environment with childhood obesity. To test the hypotheses that fast food outlets cluster within close proximity to public high schools in Santa Clara County and higher concentrations of fast food outlets in the secondary school food environment are positively correlated with increased childhood obesity rates, three separate analyses were conducted, a geospatial analysis, ethnographic student observation, and linear regression analysis.

The remainder of this chapter is organized into the following four sections: data sources, geospatial analysis, ethnographic student observation, and statistical methods. The data sources section summarizes all of the data sources used for this study. The geospatial analysis section describes the methodology undertaken to determine if clustering exists in the secondary school food environment. The ethnographic student observation section contains the ethogram as well as the methodology used to select fast food outlets for student observation. The chapter's final section, statistical methods, summarizes the statistical methods undertaken to evaluate whether built environment and socioeconomic variables are correlated with school obesity rate.

DATA SOURCES

Schools

School address data was obtained from the California Department of Education (CDE) for the 2007-2008 academic year. API scores and demographic data were obtained from the CDE's 2008 Growth Academic Performance Index (API).[125] The body composition variable, or body mass index (BMI), was acquired by the CDE through the local administration of the California Physical Fitness Test. This test attempts to assess the physical fitness level of school-aged children and is administered in the fifth, seventh, and ninth grades. Body composition is one of six fitness activities measured during testing.[126] The Cooper Institute developed "healthy fitness zones" (HFZ) for each activity.[127] Based upon these standards, children are classified as either "within" or "not within" a HFZ. For the purposes of this study, ninth grade children that fall outside the healthy fitness zone for body composition are classified as overweight and/or obese. To protect children's privacy, HFZ data is aggregated to the school level, and school level data is not available when fewer than eleven students are tested.

[125] "API Data Files," California Department of Education, http://www.cde.ca.gov/ta/ac/ap/apidatafiles.asp (accessed April 18, 2009).
[126] "Program Overview: Overview of the California Physical Fitness Test (PFT)," California Department of Education, Overview of the California Physical Fitness Test (PFT).
[127] "FITNESSGRAM® Healthy Fitness Zones," California Department of Education, http://www.cde.ca.gov/ta/tg/pf/documents/healthfitzone08.pdf (accessed April 22, 2009).

Given the requirements to release California Physical Fitness Test results publicly, several Santa Clara County high schools did not meet this threshold. In all cases, these schools were classified as "alternative" education facilities. As a result, all alternative schools classified as either continuation, alternative, or community day high schools were excluded from this analysis. Therefore, of the 81 public high schools, 50 percent, or 41 high schools, are included in this study. While only half of the schools are included, this represents over 97 percent of enrolled high school students in Santa Clara County.

Additionally, the open/closed campus policy for each school was obtained. The state of California grants school districts the authority to adopt open or closed campus lunch polices in California Education Code § 44808.5.[128] This section allows the school district to decide if students can leave the campus during the lunch period. Only three of eleven school districts had open campus lunch policies. Every high school within the Palo Alto Unified, Los Gatos-Saratoga Joint Unified, and Fremont Union High School districts allow students to leave campus during the lunch period. Thus, nearly 22 percent of high school students in Santa Clara County may be eligible to leave campus during the lunch period.

Fast Food Outlets

The site locations of all qualifying fast food outlets were acquired for Santa Clara County. In an effort to create a comprehensive list, data was obtained from Santa Clara County's Department of Environmental Health (SCCDEH).[129] All retail food facilities are routinely inspected by SCCDEH, and restaurant inspection records are available online. The SCCDEH list was cross-referenced with Yellowpages.com as online records only listed restaurants that had been inspected within the past year. Any outlets that were excluded from SCCDEH were added to the geodatabase. A total of 1,069 formula-based fast food outlets with a national footprint were included in this study. Each outlet was further classified by predominant type of food served (see Table 3). Hamburger, sandwich, and pizza outlets, respectively, represented the largest percentages of fast food outlets in Santa Clara County. Bagel outlets represented the smallest portion of fast food outlets with just 0.65% of the total.

[128] "California Codes Education Code Section 44800-44824," Legislative Counsel State of California, http://www.leginfo.ca.gov/calaw.html (accessed April 22, 2009).
[129] "Food Facility Inspections." Decade Software. http://www.decadeonline.com/main.phtml?agency=SCC (accessed April 22, 2009).

Table 3: Fast Food Outlets by Type

Type	Count	Percent
Bagel	7	0.65%
BBQ	15	1.40%
Chinese	23	2.15%
Coffee	136	12.72%
Convenience	99	9.26%
Dessert	88	8.23%
Fried Chicken	44	4.12%
Hamburger	240	22.45%
Hot Dog	23	2.15%
Mexican	92	8.61%
Pizza	138	12.91%
Sandwich	164	15.34%
TOTAL	**1,069**	**100.00%**

GEOSPATIAL ANALYSIS METHODOLOGY

Geosptial analysis was performed using ArcGIS 9.2 software (ESRI; Redlands, CA). Geospatial analysis, or geographic information systems (GIS), is a method of study that incorporates spatial arrangements and spatial relationships in order to analyze patterns of locations.[130]

The methodology can generally be summarized into six distinct processes. For a more detailed step-by-step geospatial methodology, see Appendix B. First, public schools and fast food outlets were geocoded by address using Batchgeocode.com, an online tool that converts address data to latitude and longitude coordinates. Second, using the ArcGIS Network Analyst extension, a network dataset was created to generate 400m and 800m service areas around each school. These distances have been used in several studies to approximate five-minute and ten minute walks, respectively.[131] In both Simon et al. and Austin et al., 400m and 800m buffer radii were created "as the crow flies." Their methodologies did not take into consideration land use roadway networks within respective study areas. By creating 400m and 800m service areas, rather than as the crow flies buffers, the present study is a more realistic representation of pathways that can reasonably be traveled by pedestrians within five and ten minutes of a school. Together, these service areas represent "close proximity" to schools, or the secondary school food environment.

Third, the density of fast food outlets within the 400m and 800m secondary school food environments was calculated to quantify the degree of fast food outlet concentration. Density was calculated as the number of outlets per acre within 400m and 800m service areas, respectively. Fourth, the nearest fast food outlet to each school was identified to assist with restaurant selection for ethnographic observation. Fifth, several spatial and tabular joins were performed to generate feature classes with fast food outlets and school obesity rates. In turn, these feature classes were used as inputs for spatial autocorrelation analysis.

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[130] Charisse Gulosino, "A GIS Analysis of Charter Schools and Community-based Organizations in New York City," ESRI, http://proceedings.esri.com/library/userconf/educ06/papers/educ_1638.pdf (accessed May 6, 2009).

[131] Simon, Paul A., David Kwan, Aida Angelescu, Margaret Shih, and Jonathan E. Fielding. "Proximity of Fast Food Restaurants to Schools: Do Neighborhood Income and Type of School Matter?" Preventive Medicine 47 (2008); and Austin, ScD, S. Bryn, Steven J. Melly, MS, Brisa N. Sanchez, ScM, Aarti Patel, BA, Stephen Buka, ScD, and Steven L. Gortmaker, PhD. "Clustering of Fast-Food Restaurants Around Schools:: A Novel Application of Spatial Statistics to the Study of Food Environments." *American Journal of Public Health* 95, no. 9 (September 2005).

Lastly, the Spatial Autocorrelation (Moran's I) Tool was used to determine if fast food outlets cluster near schools with higher obesity rates. This tool measures whether a spatial pattern is clustered, dispersed, or random and calculates a Moran's I Index value, a Z-score, and a p-value, and is a widely used and reliable method to test spatial clustering.[132] In order to accurately calculate a Moran's statistic, a projected coordinate system was used. For the purposes of this analysis, the null hypothesis is stated as follows:

$$\begin{aligned} H_0 &= m_1 < 0 \\ H_1 &= m_1 > 0 \end{aligned} \qquad (1.0)$$

where m_1 is the Moran's I Index value. A Moran's I value less than zero indicates the absence of clustering where a value greater than zero indicates the presence of clustering.[133] Stated simply, the null hypothesis is that there is no spatial clustering between fast food outlets and high school obesity rates in Santa Clara County. ESRI ArcGIS calculates the Moran's I statistical equation as follows:

$$I = \frac{n}{S_0} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j} z_i z_j}{\sum_{i=1}^{n} z_i^2} \qquad (2.0)$$

where z_i is the deviation of an attribute (% Not Within Healthy Fitness Zone) for feature *i* (fast food outlets) from its mean $(x_i - \bar{X})$, $w_{i,j}$ is the spatial weight (calculated adjacency) between the feature *i* and *j* (high schools), and *n* is equal to the total number of features. [134] S_0 is the aggregate of all the spatial weights, here distance from each fast food outlet to nearest high school.[135] To oversimplify, the spatial weights matrix assigns a value of 1 if point feature *i* (fast food outlet)and *j* (high schools) are neighbors, or adjacent to each other, and a value of 0 if the point features are not neighbors. [136] In GIS, either a Manhattan grid or Euclidean distance is overlaid on point features to determine adjacency.

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[132] "How Spatial Autocorrelation: Moran's I (Spatial Statistics) Works," ESRI, http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=How%20Spatial%20Autocorrelation:%20Moran%27s%20I%20%28Spatial%20Statistics%29%20works (accessed May 8, 2009); and Dale A. Moore and Tim E. Carpenter, "Spatial Analytical Methods and Geographic Information Systems: Use in Health Research and Epidemiology," *Epidemiologic Reviews* 21, no. 2 (January 1999): 149..

[133] "How Spatial Autocorrelation: Moran's I (Spatial Statistics) Works," ESRI, http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=How%20Spatial%20Autocorrelation:%20Moran%27s%20I%20%28Spatial%20Statistics%29%20works (accessed May 8, 2009).

[134] "How Spatial Autocorrelation: Moran's I (Spatial Statistics) Works," ESRI, http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=How%20Spatial%20Autocorrelation:%20Moran%27s%20I%20%28Spatial%20Statistics%29%20works (accessed May 8, 2009).

[135] Ibid.

[136] Jon Graham, "Moran's I and Geary's C Statistics (Bailey and Gatrell 7.4.5)," University of Montana, Missoula, http://www.math.umt.edu/graham/math544/moran.pdf (accessed October 23, 2009).

In summary, the Spatial Autocorrelation (Morans I) Tool uses the obesity rate as an input variable and seeks similar variables within close proximity to each other. Given that the study area is in an urban environment, proximity was calculated using the Manhattan Distance rather than Euclidian Distance method. Manhattan distance emulates a grid street pattern, and is more realistic than Euclidian distance, which measures the distance between two points as the crow flies.

ETHNOGRAPHIC STUDENT OBSERVATION

Ethnographic observation was chosen for this analysis because this type of research more accurately captures behavioral data than other qualitative behavioral studies due to its unobtrusive nature as participants are unaware that their behavior is under observation.[137] Further, qualitative behavioral data obtained through direct observation is more reliable than self-reporting methods.[138] The literature has consistently found errors of omission and errors of commission when individuals self-report their behavior(s).[139] By observing and recording behavior, more accurate results can be obtained.

To determine if high school students in Santa Clara County frequent fast food outlets in close proximity to their school, direct structured human observation was conducted. Although students may have access to fast food outlets, it does not mean that students will patronize these outlets. Only by observing behavior can one begin to understand the secondary school food environment and if/how this environment contributes to youth obesity rates in Santa Clara County. Further, it was also important to obtain data on the type/quantity of food actually purchased. This enriched the data collection process by not only examining proximity to fast food outlets, but also examining children's food choices. The following section describes the methodology undertaken to complete ethnographic observation.

School Selection Process

Due to resource constraints, only four secondary school food environments were selected for ethnographic observation. The following criteria were used to select the schools:

1. School obesity rate; and
2. Fast food outlets within 800m.

Each of the 41 schools included in this study were ranked by obesity rate and number of fast food outlets (see Appendix A for detailed tables). The mean density of fast food outlets within each 800m service area was 0.008 fast food outlets per acre. The mean number of fast food outlets was 1.927. The mean school obesity rate was 25.64 percent. Two campuses with the most fast food outlets and highest obesity rates were selected for observation, as shown in Table 4. An additional two campuses with the fewest fast food outlets and highest obesity rates were selected for observation, also shown in Table 4.

[137] H. Russell Bernard, *Research Methods in Anthropology: Qualitative and Quantitative Approaches*, 3rd ed. (Walnut Creek, CA: AltaMira Press, 2002), 411.
[138] Ibid.
[139] Ibid.

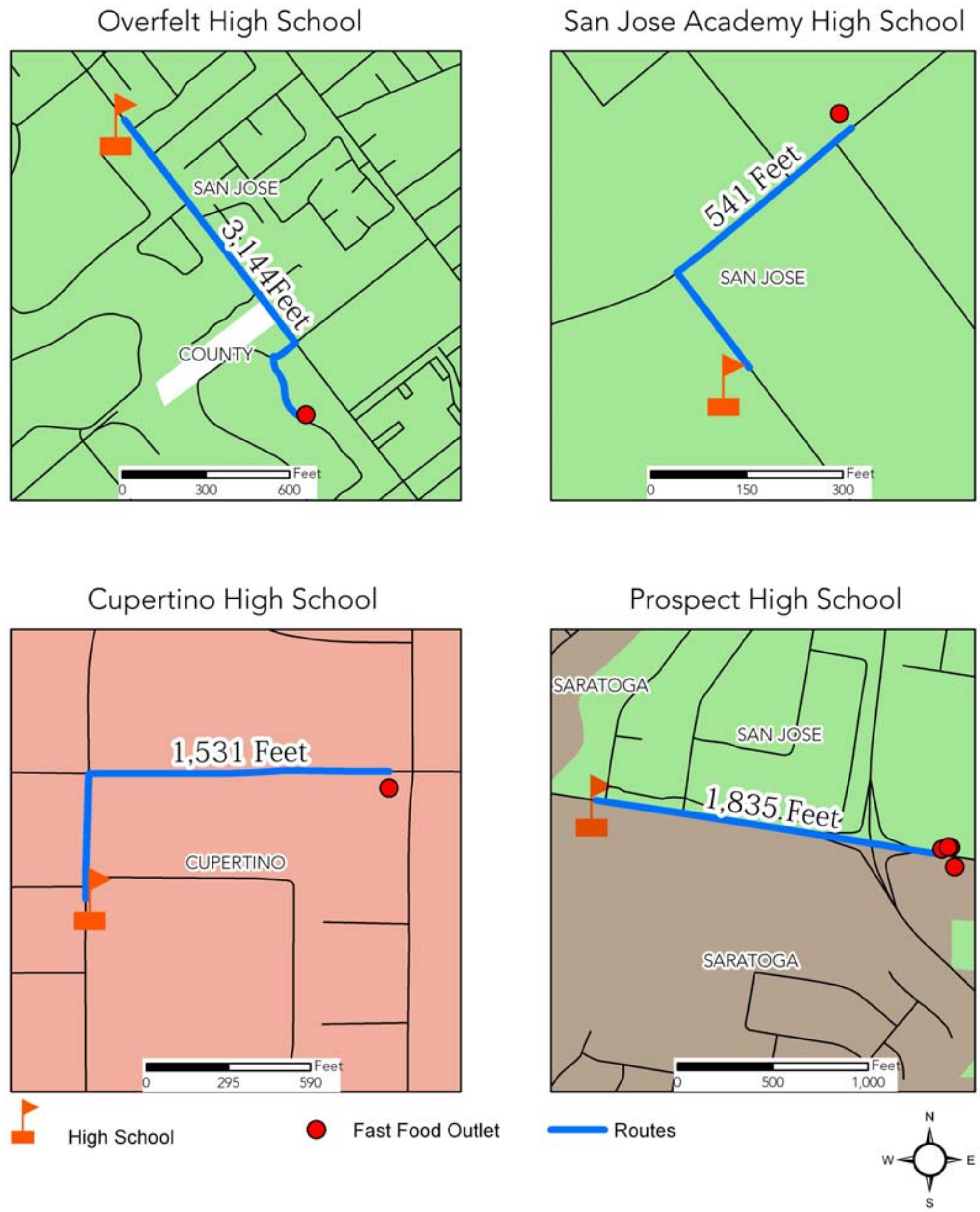
Table 4: Schools Selected for Ethnographic Observation

School	Location	School Obesity Rate	Fast Food Outlets (800m)
Prospect High School	Saratoga	27.40%	12
Cupertino High School	Cupertino	15.30%	9
San José High Academy	San José	47.30%	1
Overfelt High School	San José	38.40%	1

Fast Food Outlet Selection Process

A Closest Facility analysis was conducted in ArcGIS to facilitate the selection of fast food outlets for ethnographic observation (see the Geospatial Analysis Methodology section in Chapter III and Appendix B). Results of this analysis identified the closest fast food outlet to each school identified in Figure 2. Figure 2 also shows the location of each public high school as well as the shortest route to the nearest fast food outlet.

Figure 2: Fast Food Outlets Selected for Ethnographic Observation



Sources: Santa Clara County Department of Public Health, California Department of Education, Valley Transportation Authority, and U.S. Census TigerLINE as modified by Lauren Doud (July 2009).

Ethogram

In behavioral biology, ethograms are developed to qualitatively measure different behaviors in an attempt to answer a guiding question. The guiding question for this analysis is as follows: What are the afternoon snacking behaviors of high school students in the secondary food environment?[140] Due to time constraints and the unobtrusive nature of the ethnographic study, students were observed only once at a pre-selected outlet, also known as the "naturally occurring situation."[141] Ethnographic observation occurred during a weekday immediately following the end of the school day for a period of thirty minutes. The ethogram shown in Figure 3 was used to observe student behavior in the secondary school food environment.

Figure 3: Ethogram Observation Variables

Variable 1	**Variable 2**		**Variable 3**	
Number of Students Entering Restaurant	Food Purchased		Beverage Purchased	
	Main Dish	Side Dish	Type	Size
Count	Burrito	Chips	Coffee	Small
	Fried Chicken	Dessert	Hot specialty coffee beverage	Medium
	Hamburger	French Fries	Iced specialty coffee beverage	Large
	Hot Dog	Fruit	Juice	Extra Large
	Nachos		Milk	Bottle
	Pizza		Milkshake	
	Quesadilla		Slush	
	Salad		Smoothie	
	Sandwich		Soda	
	Taco		Water	

STATISTICAL METHODS

In an attempt to reject the null hypothesis that access to fast food in the secondary school food environment is not correlated with adolescent obesity, statistical analysis was undertaken and methods used are detailed in the following section. All statistical analyses were performed using SPSS Statistics 17 (SPSS; Chicago, IL). A significance level of $a = 0.05$ was also used. Since the variance inflation factor (VIF) can identify the presence of multi-collinearity, any variable with a VIF value greater than 10 was excluded from the final model.[142]

Linear Regression Analysis

For the purposes of this study, linear regression was undertaken to determine if school-related variables were predictors for school obesity. Here, school-related variables, or the independent variables, are

[140] Barbara Hall, "Guiding Questions in Ethnography," University of Pennsylvania, http://www.sas.upenn.edu/anthro/anthro/guidingquestions (accessed February 20, 2009).
[141] Randy Hodson, *Analyzing Documentary Accounts* (Thousand Oaks, CA: Sage Publications, Inc., 1999), 7.
[142] John Neter, Michael H. Kutner, Christopher J. Nachtsheim and William Wasserman, *Applied Linear Statistical Models*, 4th ed. (Chicago: Irwin, 1996), 385, 387, and 469.

listed in Table 5. The dependent variable is the school obesity rate. As stated previously, the percentage of students outside the HFZ was used as a proxy for the obesity rate of each school.
The following equation was used for linear regression analysis:

$$Y_i = b_0 + b_1 X_{i1} + b_2 X_{i2} + \cdots + b_2 X_{i2} + e_{i,} \quad i = 1,\ldots,n \qquad (3.0)$$[143]

where Y_i is the dependent variable (school obesity rate), and $X_{i,n}$ are the independent variables.

For this study, forty-one observations, or schools, were included $(n = 41)$. Nineteen independent variables were used initially to determine statistical significance (see Table 5).

Table 5: List of Variables for Linear Regression

Variable	Mean	Standard Deviation	Min	Max
Dependent				
School Obesity Rate	25.64%	9.65%	8.40%	47.30%
Independent				
Open/Closed Campus	0.220	0.419	0	1
Enrollment	1346	470	65	2664
African American (%)	3.54%	2.04%	0%	10%
American Indian (%)	0.41%	0.59%	0%	2%
Asian (%)	23.00%	18.72%	1%	75%
Filipino (%)	4.66%	5.16%	0%	22%
Hispanic (%)	35.88%	24.37%	2%	96%
Pacific Islander (%)	0.63%	0.70%	0%	2%
White (%)	30.41%	20.52%	1%	81%
NSLP (%)	26.43%	19.40%	0%	64%
Fast Food Density (400m)	0.010	0.017	0.000	0.063
Fast Food Density (800m)	0.008	0.013	0.000	0.062
Fast Food Outlets (400m)	1	1	0	3
Fast Food Outlets (800m)	2	3	0	12
Acres Parkspace (800m)	57.40	119.91	0.00	476.83
Avg. Parent Education	3.19	0.81	1.69	4.59
Attended Grad School (%)	22.02%	21.14%	1.00%	68.00%
College Grad (%)	24.37%	8.86%	6.00%	40.00%
API Score	770	83	632	928

The dependent variable, school obesity rate, was the percentage of children that fell outside the established healthy fitness zone threshold for body composition, aggregated to the school level. The

[143] John Neter, Michael H. Kutner, Christopher J. Nachtsheim and William Wasserman, *Applied Linear Statistical Models*, 4th ed. (Chicago: Irwin, 1996), 10.

predictor, or independent variables, are shown in Table 5. National School Lunch Program (NSLP) participation was used as a proxy for socioeconomic status. Fast food outlet density was calculated in ArcGIS as the number of fast food outlets per acre within 400m and 800m service areas. Counts of fast food outlets were also included. Acres of parkland within 800m services areas were used as a proxy for access to recreation areas for physical activity. Average Parent Education was obtained from the California Department of Education as an additional socioeconomic proxy. The values were calculated based upon a five-point scale, where 1represented "not a high school graduate" and 5 represented "graduate school." Academic Performance Index (API) scores were used as a proxy for the academic aptitude of children at each school.

CONCLUSIONS

The methodologies for geospatial analysis, ethnographic observation, and statistical analysis discussed in this chapter lay the foundation for the following chapter that discusses the results and findings of this study.

Chapter IV: Results and Findings

CHAPTER OVERVIEW

This chapter discusses the results and findings of the analyses undertaken as described in the methodology chapter, Chapter III. The chapter is divided into the following four sub-sections: GIS analysis, ethnographic observation, statistical analysis, and research limitations. The GIS analysis section analyzes the results found for this study while the ethnographic observation section is an analysis of student observations near Prospect High School, Cupertino High School, San José High Academy, and Overfelt High School. The statistical analysis section analyzes the results of the linear regression analysis. Lastly, the research limitations section discusses this study's inherent challenges and shortcomings.

GIS ANALYSIS

While the primary purpose for undertaking GIS analysis was to examine the spatial patterning of fast food outlets in close proximity to schools, GIS also laid the foundation for the ethnographic and statistical analyses completed in this study.

To establish geographic proximity, service areas were created for each school. Each of the 41 schools included in this analysis contained two service areas, one at 400m and another at 800m for a total of 82 service areas. Collectively, these service areas represented the secondary school food environment. The mean density of fast food outlets within the 400m Service Area was 0.61 outlets per acre. For the 800m service area, the mean density was 3.29 outlets per acre. Of the schools included in this analysis, nearly 59 percent had at least one fast food outlet within 800m of campus. This finding is comparable to existing research. Simone et al. found that 64.8 percent of schools in Los Angeles County had at least one fast food outlet within 800m.[144] Similarly, Austin et al. found that 78 percent of schools in the greater Chicago area had at least one fast food outlet within 800m of a campus.[145] Davis found that 55 percent of students were within 800m of at least one fast food outlet in California.[146] Additionally, Zenk and Powell found that 33 percent of schools had at least one fast food outlet within 800m of a school nationally.[147]

Given that nearly 59 percent of high school students were in close proximity to a fast food outlet in Santa Clara County, further GIS analysis was undertaken to examine whether a spatial pattern existed

[144] Paul A. Simon et al., "Proximity of Fast Food Restaurants to Schools: Do Neighborhood Income and Type of School Matter?" *Preventive Medicine* 47 (2008): 284.

[145] S. Bryn Austin, ScD et al., "Clustering of Fast-Food Restaurants Around Schools:: A Novel Application of Spatial Statistics to the Study of Food Environments," *American Journal of Public Health* 95, no. 9 (September 2005): 1575-81.

[146] Lawrence Brennan Davis, "Geographic Placement, Social Identification, and Consumption:: A Study of Fast-Food Placement around Schools and Youth Obesity" (PhD diss., University of California, Irvine, 2008), 18.

[147] Shannon N. Zenk and Lisa M. Powell, "US Secondary Schools and Food Outlets," *Health and Place* 14, no. 2 (June 2008): 336.

between fast food outlets and schools with higher obesity rates. Spatial clustering is one way to examine if built environment characteristics are correlated with obesity. The First Law of Geography as stated by Waldo Tobler in 1970 is that "everything is related to everything else, but near things are more related than distant things."[148] By examining the feature class point pattern, clusters can be statistically analyzed for the absence or presence of patterning.[149] Results from the Spatial Autocorrelation Moran's I analysis found that a geospatial relationship exists between fast food outlets and high school obesity rates. The Moran's I Index value can vary between -1 and +1.[150] A Moran's I Index value of 0 indicates no spatial patterning, while a value of +1 indicates that the variables are correlated.[151] For the 400m service area, the Moran's I Index value was 1.45. The null hypothesis for the Spatial Autocorrelation (Moran's I) Tool is that there is no clustering. At the 0.01 level of significance, the null hypothesis can be rejected with a z-score of 2.58. Here, the z-score is 3.84, indicating that it is very unlikely that the spatial patterning is random. Thus, there is less than a one percent chance that the spatial patterning of fast food outlets in close proximity to schools with higher obesity rates is due to random chance.

For the 800m service area, the Moran's I Index value was 0.37. At the 0.05 level of significance, the null hypothesis could be rejected with a z-score of 1.96. Here, the z-score is 2.13, indicating that it is unlikely that the spatial patterning is random. There is less than a five percent chance that fast food outlets locating near schools with higher obesity rates are due to random chance.

The results from the Autocorrelation (Moran's I) Tool indicates that there is geospatial clustering between obesity rates and the location of fast food outlets, especially within the immediate secondary school food environment, or 400m. A geospatial clustering relationship also exists within 800m of high schools; yet, this relationship is not as strong as within the immediate vicinity of schools. These results are similar to existing research in that stronger statistical relationships exist between fast food outlets and the immediate secondary school food environment.[152] These findings, although statistically significant, cannot determine why this geospatial pattern exists. Several studies have hypothesized that the level of commercialization in close proximity to schools, especially high schools, is the raison d'être.[153] Thus, schools located within or in close proximity to commercially zoned land uses, may exhibit a larger concentration of fast food outlets.

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[148] Waldo Tobler, "A Computer Movie Simulating Urban Growth in the Detroit Region," *Economic Geography* 46, no. 2 (June 1970): 236.
[149] Dale A. Moore and Tim E. Carpenter, "Spatial Analytical Methods and Geographic Information Systems: Use in Health Research and Epidemiology," *Epidemiologic Reviews* 21, no. 2 (January 1999): 145.
[150] "Spatial Autocorrelation (Morans I) (Spatial Statistics)," ESRI, http://webhelp.esri.com/arcgisdesktop/9.2/index.cfm?id=1907&pid=1904&topicname=Spatial_Autocorrelation_(Morans_I)_(Spatial_Statistics) (accessed May 15, 2009).
[151] Ibid.
[152] S. Bryn Austin, ScD et al., "Clustering of Fast-Food Restaurants Around Schools:: A Novel Application of Spatial Statistics to the Study of Food Environments," *American Journal of Public Health* 95, no. 9 (September 2005): 1575-81.
[153] Paul A. Simon et al., "Proximity of Fast Food Restaurants to Schools: Do Neighborhood Income and Type of School Matter?" *Preventive Medicine* 47 (2008): 284-88; and S. Bryn Austin, ScD et al., "Clustering of Fast-Food Restaurants Around Schools: A Novel Application of Spatial Statistics to the Study of Food Environments," *American Journal of Public Health* 95, no. 9 (September 2005): 1577.

ETHNOGRAPHIC OBSERVATION

While the aforementioned GIS analysis found that fast food restaurants concentrated near high schools with higher obesity rates, additional examination of the secondary school food environment was warranted to determine if children actually patronized these fast food outlets. Further, if children patronized these outlets, what was the nutritional content of their food purchases? As discussed in Chapter II, little research conducted to date has examined both proximity and food choices. Thus, ethnographic observation was undertaken at Prospect High School, Cupertino High School, San José High Academy, and Overfelt High School during the months of May and June 2009 (see Table 6).

Table 6: High Schools and Fast Food Outlet Selection

School	Location	Fast Food Outlet Type	Distance from School to Fast Food Outlet
Prospect High School	Saratoga	Hamburgers	1,835 ft.
Cupertino High School	Cupertino	Sandwiches	1,531 ft.
San Jose High Academy	San Jose	Pizza	540 ft.
Overfelt High School	San Jose	Coffee house	1,606 ft.

GIS analysis calculated that the mean distance from a fast food outlet to the nearest high school was 2,917 feet, or 889 meters. The shortest distance was 508 feet (Pioneer High School in San José), and the furthest distance was 11,103 feet (Dr. T. J. Ownes Gilroy Early College Academy in Gilroy). Given these findings, all schools selected for ethnographic observation fell below the average distance for Santa Clara County.

Prospect High School

Ground-truthing revealed that a hamburger outlet rather than the BBQ outlet selected by a GIS Closest Facility analysis was closest to Prospect High School. In this particular case, several pedestrian barriers existed (e.g. landscaping, fencing, and a six-lane expressway) that could not be accounted for in the GIS analysis. Therefore, the closer hamburger outlet was observed on Wednesday, May 27, 2009 between 3:55pm and 4:25pm instead. During the thirty minute observation period, seven high school subjects patronized the fast food outlet, identifiable by their high school logoed apparel and the presence of textbooks. Free wi-fi access was available, and two subjects appeared to use the space as a homework study area. One subject ordered food to go and as a result, food choices could not be observed. Six subjects predominantly consumed foods from the value menu and supplemented these item(s) with french fries and soda for onsite consumption. Given that the soda dispensing station was self-service and beverage containers were opaque, type of soda consumed could not be observed.

Food consumed by Prospect High students is shown in Table 7. The average after school snack purchased was 854 calories. The daily recommended caloric allowance for teenagers between 14 and 18 years of age is 2,200 calories.[154] As a result, the observed subjects were consuming 35.6 percent of their daily caloric allowance on one snacking occasion. Nearly every subject ordered french fries and a refillable soda. French fries were not on the value menu and cost more than either a hamburger or chicken sandwich. Most subjects ordered the least expensive items, also known as value items, from the menu for their entree.

Table 7: After School Snacking Consumption Observed Near Prospect High School

Subject	Choice 1	Choice 2	Choice 3	Choice 4	Total Calories*	Total Fat (grams)*
Subject 1	Cheeseburger	Small French fries	Medium Soda		830	30
Subject 2	Cheeseburger	Small French fries			620	30
Subject 3	Cheeseburger	Chicken Sandwich	Small French fries	Medium Soda	1,190	46
Subject 4		Could not observe (to-go order)			n/a	n/a
Subject 5	Cheeseburger	Small French fries	Medium Soda		830	30
Subject 6	Chicken Sandwich	Small French fries	Medium Soda		800	27
Subject 7		no food purchased			0	0
				Average Consumed	854	33
				% of Daily Recommended Allowance**	35.6%	45.3%

* Total number of calories for soda was average of all soda types offered by outlet.
** Based upon an average 2,400 calorie diet for 14-18 year olds. Source: "Adequate Nutrients within Calorie Needs," U.S. Department of Health and Human Services, http://www.health.gov/dietaryguidelines/dga2005/document/pdf/Chapter2.pdf (accessed May 28, 2009). Total daily allowance for fat should not exceed a median value of 30% of total calories per day, or 72 grams fat for children aged 4-18. Sources: "How do the Daily Values Found on Food Labels Compare to the Nutritional Recommendations for Children?" USDA/ARS Children's Nutrition Research Center at Baylor College of Medicine, http://www.bcm.edu/cnrc/consumer/archives/percentDV.htm (accessed May 28, 2009); and "Chapter 6: Fats," U.S. Department of Health and Human Services, http://www.health.gov/dietaryguidelines/dga2005/document/pdf/Chapter6.pdf (accessed May 28, 2009).

Cupertino High School

The secondary school food environment was observed on Thursday, May 28, 2009 between 2:55pm and 3:30pm. Given that the sandwich outlet was small in size, it was relatively easy to observe subject's food choices at this location. During this period, 35 student subjects were observed in close proximity to the fast food outlet. Out of 35 student subjects, twelve patronized the outlet. The majority of subjects arrived by foot and were identified by their school backpacks. All but two subjects purchased food for onsite consumption. Unlike Prospect High School, subjects from Cupertino High School did

[154] "Adequate Nutrients within Calorie Needs," U.S. Department of Health and Human Services, http://www.health.gov/dietaryguidelines/dga2005/document/pdf/Chapter2.pdf (accessed May 28, 2009).

not primarily purchase from the outlet's value menu. The majority of subjects bought large sandwiches and drank tap water. No observed subjects shared their sandwich with others. A few subjects also purchased chips. As a result, the average cost per order was slightly over $7, the highest observed in this study. In fact, several subjects had to borrow money from their friends to pay for their after school snack.

While students at Prospect High School ordered inexpensive hamburgers, french fries, and soda, Cupertino High School students ordered expensive sandwiches and water. The choices made by Cupertino High students were unhealthier in both calories and fat content than their hamburger and french fry consuming peers at Prospect High. The average after school snack consumed was 1,013 calories and 49 grams of fat as shown in Table 8. For one snacking occasion, observed student subjects were consuming 68.2 percent of their daily recommended fat intake and 42.2 percent of their daily caloric intake. Interestingly, very few subjects purchased side orders. This may be the result of the relatively high cost of each sandwich relative to student subject's budgets.

Table 8: After School Snacking Consumption Observed Near Cupertino High School

Subject	Choice 1	Choice 2	Choice 3	Total Calories*	Total Fat (grams)*
Subject 1	16.9 oz soda			200	-
Subject 2	Sandwich			1,085	39
Subject 3	Tap Water			-	-
Subject 4	Sandwich			1,215	70
Subject 5	Sandwich			1,375	86
Subject 6	Sandwich	Chips		1,615	81
Subject 7	Sandwich	Chips		1,345	54
Subject 8	Sandwich			1,355	66
Subject 9	Sandwich			785	35
Subject 10	Sandwich	Chips	Orange juice	1,420	54
Subject 11	Sandwich			955	40
Subject 12	Sandwich			808	60
			Average Consumed	1,013	49
			% of Daily Recommended Allowance**	42.2%	68.2%

* Total number of calories for soda was average of all soda types offered by outlet.
** Based upon an average 2,400 calorie diet for 14-18 year olds. Source: "Adequate Nutrients within Calorie Needs," U.S. Department of Health and Human Services, http://www.health.gov/dietaryguidelines/dga2005/document/pdf/Chapter2.pdf (accessed May 28, 2009). Total daily allowance for fat should not exceed a median value of 30% of total calories per day, or 72 grams fat for children aged 4-18. Sources: "How do the Daily Values Found on Food Labels Compare to the Nutritional Recommendations for Children?" USDA/ARS Children's Nutrition Research Center at Baylor College of Medicine, http://www.bcm.edu/cnrc/consumer/archives/percentDV.htm (accessed May 28, 2009); and "Chapter 6: Fats," U.S. Department of Health and Human Services, http://www.health.gov/dietaryguidelines/dga2005/document/pdf/Chapter6.pdf (accessed May 28, 2009).

San José High Academy

The secondary school food environment was observed on Monday, June 1, 2009 between 2:50pm and 3:20pm. All subjects either arrived by foot or skateboard. The pizza outlet was located across the street from the high school, less than a two minute walk. Unlike the hamburger and sandwich outlets near Prospect High and Cupertino high, this outlet served only takeaway food. As a result, no interior seating was available to conduct observations. Instead observations occurred from inside a car parked in front of the outlet. Although it was initially difficult to determine what each subject ordered, very detailed notes were taken based upon where pre-prepared foods were pulled by outlet employees behind the counter, and takeaway containers were carefully examined for type of food purchased, as takeaway containers were clearly marked with the contents purchased. Thirty-eight high school subjects were observed walking past the fast food outlet. Most, if not all, had either backpacks, book bags, or were carrying notebooks and textbooks. Several subjects were wearing San José High Academy t-shirts and several others had school logo markings on their backpacks. Seven subjects patronized the outlet. This particular outlet charges $5 for either a large pepperoni or cheese pizza. Although soda and other beverages were available for purchase from the fast food outlet, no subjects observed purchased beverages.

Given that the pizza outlet was takeaway only, several assumptions had to be made in order to estimate average calories consumed by each subject. With this type of food item and the manner in which it was purchased, it was assumed that the three subjects that made a collective purchase and shared one pepperoni pizza, to consume an average of 2.67 slices per person as the fast food outlet's website indicated that each pizza contain eight slices. One subject purchased three separate items. Given the total amount of food purchased, it is unlikely that the food purchased was for that student subject alone. However, given the methodology used for this research, it was assumed that this subject consumed all the food that was purchased. While this outlier clearly skewed the average calories and fat consumed, this may be indicative of some adolescent eating patterns. For this location, an average of 1,371 calories, or 57.1 percent of the daily allowance, and 54 grams of fat, or 75 percent of the daily allowance, were consumed by subjects observed near San José High Academy as shown in Table 9.

Table 9: After School Snacking Consumption Observed Near San José High Academy

Subject	Choice 1	Choice 2	Choice 3	Total Calories*	Total Fat (grams)*
Subject 1	Pizza			747	29
Subject 2	Pizza			747	29
Subject 3	Pizza			747	29
Subject 4	Pizza	Bread Sticks w/ Sauce	Chicken	3,245	128
			Average Consumed	1,371	54
			% of Daily Recommended Allowance**	57.1%	75.0%

* Total number of calories for soda was average of all soda types offered by outlet.
** Based upon an average 2,400 calorie diet for 14-18 year olds. Source: "Adequate Nutrients within Calorie Needs," U.S. Department of Health and Human Services, http://www.health.gov/dietaryguidelines/dga2005/document/pdf/Chapter2.pdf (accessed May 28, 2009). Total daily allowance for fat should not exceed a median value of 30% of total calories per day, or 72 grams fat for children aged 4-18. Sources: "How do the Daily Values Found on Food Labels Compare to the Nutritional Recommendations for Children?" USDA/ARS Children's Nutrition Research Center at Baylor College of Medicine, http://www.bcm.edu/cnrc/consumer/archives/percentDV.htm (accessed May 28, 2009); and "Chapter 6: Fats," U.S. Department of Health and Human Services, http://www.health.gov/dietaryguidelines/dga2005/document/pdf/Chapter6.pdf (accessed May 28, 2009).

Overfelt High School

The secondary school food environment was observed on Friday, May 29, 2009 between 3:10pm and 3:40pm. The GIS analysis undertaken indicated that a smoothie outlet was the closest fast food outlet to Overfelt High School. Ground-truthing revealed that several fast food outlets, both national chains, as well as regional chains, were co-located at the same address in a strip mall. Therefore, a new outlet was selected based upon its closest proximity to Overfelt High School. Many subjects patronized the coffee house outlet during the observation window. However, most of these subjects were Kipp Heartwood Academy middle school students, not Overfelt High School students. This school requires students to wear uniforms, so it was easy to identify each middle school aged subject. While these subjects were not the basis for ethnographic observation, it is interesting to note that each subject purchased frozen blended coffee drinks, with whipped cream, as an after school snack. There were seven high school aged subjects observed. It was impossible to identify whether these subjects attended Overfelt High School or other school(s) nearby. However, given the time period under observation, this was the only school in the immediate vicinity that was out of session. All high school subjects purchased large ice-blended coffee drinks for offsite consumption. Only one subject purchased a coffee beverage and a dessert.

Unlike the other three fast food outlets selected for ethnographic observation, the coffee house outlet predominantly sold snack items. Observed subjects consumed an average of 520 calories and 18 grams of fat on a coffee beverage as shown in Table 10. This represents 21.7 percent and 24.6 percent, respectively, of the daily recommended allowances established by the U.S. Department of Health and

Human Services. While this represents the lowest total calories and fat consumed by observed subjects for this study, it is important to overemphasize that the items purchased were beverages with little nutritional value. Subjects that purchased hamburgers, pizza, and sandwiches also consumed protein and vegetables, while Overfelt High subjects consumed almost a quarter of their daily caloric allowance on nutrition-less snack.

Table 10: After School Snacking Consumption Observed Near Overfelt High School

Subject	Choice 1	Choice 2	Total Calories*	Total Fat (grams)*
Subject 1	Coffee beverage		500	17
Subject 2	Coffee beverage		500	16
Subject 3	Coffee beverage		650	15
Subject 4	Coffee beverage		360	13
Subject 5	Coffee beverage		210	10
Subject 6	Coffee beverage	Dessert	770	38
Subject 7	Coffee beverage		650	15
		Average Consumed	520	18
		% of Daily Recommended Allowance**	21.7%	24.6%

* Total number of calories for soda was average of all soda types offered by outlet.
** Based upon an average 2,400 calorie diet for 14-18 year olds. Source: "Adequate Nutrients within Calorie Needs," U.S. Department of Health and Human Services, http://www.health.gov/dietaryguidelines/dga2005/document/pdf/Chapter2.pdf (accessed May 28, 2009). Total daily allowance for fat should not exceed a median value of 30% of total calories per day, or 72 grams fat for children aged 4-18. Sources: "How do the Daily Values Found on Food Labels Compare to the Nutritional Recommendations for Children?" USDA/ARS Children's Nutrition Research Center at Baylor College of Medicine, http://www.bcm.edu/cnrc/consumer/archives/percentDV.htm (accessed May 28, 2009); and "Chapter 6: Fats," U.S. Department of Health and Human Services, http://www.health.gov/dietaryguidelines/dga2005/document/pdf/Chapter6.pdf (accessed May 28, 2009).

The rationale behind selecting these four high schools was to examine if children in close proximity to many fast food outlets purchased unhealthier food than children not exposed to as many fast food outlets within the secondary school food environment. School campuses with the highest concentrations of fast food outlets and highest obesity rates, Prospect High School and Cupertino High School, as well as two schools with high obesity rates and low concentrations of fast food outlets, San José High Academy and Overfelt High School, were selected for ethnographic observation. The results from these observations did not reveal any such patterns. The results do, however, reveal that children consume a large percentage of their daily recommended caloric intake on snacking occasions. Nicklas et al. found that between 22 percent and 34 percent of total calories consumed daily by children were from snack foods.[155] This study reached similar conclusions whereby children consumed between 21.7 percent and 57.1 percent of their daily recommended calorie intake on a single snacking occasion. This finding implies that children are consuming an excessive number of calories on a snacking occasion

[155] Theresa A. Nicklas, DrPH et al., "Children's Food Consumption Patterns Have Changed over Two Decades (1973-1994): The Bogalusa Heart Study," *Journal of the American Dietetic Association* 104, no. 7 (July 2004): 1135.

within secondary school food environments, further indicating that Santa Clara County may be an obesogenic environment for children.

STATISTICAL ANALYSIS

Based upon the findings that fast food outlets cluster near schools with higher obesity rates and that children patronize these outlets, further investigation was warranted to determine if individual built environment and socioeconomic factors contribute to school level obesity. Linear regression was undertaken to examine these statistical relationships further. Given the aggregate nature of the data as well as the small sample size, the statistical analysis is more anecdotal in that it cannot generalize that the independent variables cause school level obesity.

The original regression model included 19 independent variables (see Table 5 and Chapter III). Several of these variables clearly measured the same outcomes. For example, there were three different variables that accounted for parent educational attainment including: college graduate, graduate school, and average education. The average educational attainment variable had the smallest VIF value and was therefore retained for the final model. After adjusting the regression model for additional multi-collinearity effects, the final model included only eight of the original nineteen independent variables (as shown in Table 11).

Table 11: Regression Analysis Model Summary

Variable	Co-efficient	T-Statistic
Open/Closed Lunch	-0.06	-0.589
African American (%)	0.02	0.225
American Indian (%)	0.314	3.802***
Filipino (%)	0.036	0.418
Pacific Islander (%)	-0.252	-2.547 **
Average Parent Education	-0.846	-8.648***
Acres Parkspace (800m)	-0.139	-1.689*
Fast Food Density (800m)	0.041	0.523

*p £ 0.10 ** $p < 0.05$ *** $p < 0.01$

$F = 20.595$

$R^2 = .915$

$df = 40$

Table 11 provides summary statistics for the regression model's fit. The R-square value was 0.837, meaning that 83.7% of the variance in the dependent variable, school obesity rate, was explained by the independent variables included in the final regression model. There were 40 degrees of freedom and the F-test value was 20.595.

Average parent education was the best predictor for the percentage of students outside the healthy fitness zone with a significance value of p<0.01. As parent education increases, the school obesity rate decreases. Literature to date has found mixed results with respect to correlations between parent educational attainment and childhood obesity. Since the data used for this study is aggregated, it is impossible to compare the findings from this study with other existing literature that predominantly focused on individual level data. Further, given the study's small sample size, further research should be conducted to gain a deeper understanding of how parent educational attainment contribute to obesity.

Two additional socioeconomic factors were also predictors for obesity, percent American Indian and percent Pacific Islander. However, as the percent Pacific Islander increased, obesity rates decreased, which was an unexpected result. While none of the existing research has focused specifically on American Indian and Pacific Islander populations, several studies have examined minority status and obesity with consistent results. Ethnic minorities exhibit a higher prevalence for overweight and obesity.[156]

The acres of parkspace within 800m of a school was marginally significant at $p \leq 0.10$. Two other larger studies found that access to green space was positively correlated with childhood obesity. Liu et al. found that vegetation was a significant predictor of childhood obesity in regions with high population density.[157] Bell et al. found that irrespective of residential density, greenness was significantly associated with lower childhood obesity rates.[158]

While several variables were predictors for school level obesity, there were also several that were not. None of the measures of fast food outlet density within the secondary school food environment were statistically significant. This result differs from Powell et al.'s study that found a relationship between fast food outlet density and obesity.[159] Similarly, Maddock found that fast food outlet density was positively correlated with adult obesity prevalence.[160] Morland and Evenson and Li et al. also found that as availability of fast food outlets increased, obesity prevalence also increased.[161] All of the aforementioned studies had significantly larger sample sizes and only examined adult overweight and obesity prevalence. The results from this study cannot confirm a correlation between fast food outlet density and overweight. This is a reminder that obesity is a complicated public health and planning issue that will require additional research to determine causality.

Additionally, open/closed lunch policy status was not correlated with school-level obesity rate either. To date, no studies have examined if a relationship exists between this policy and prevalence for overweight. However, several studies have suggested that schools adopt closed campus policies as a policy intervention to curb childhood overweigh and obesity.[162] These studies examined the level of

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[156] Youfa Wang and May A. Beydoun, "The Obesity Epidemic in the United States - Gender, Age, Socioeconomic, Race/Ethnic, and Geographic Characteristics: A Systemic Review and Meta-Regression Analysis," *Epidemiologic Reviews* 29 (May 17, 2007): 6-28.
[157] Liu et al., (2007): 321.
[158] Bell et al., (2008): 551.
[159] Lisa M. Powell et al., "Access to Fast Food and Food Prices: Relationship with Fruit and Vegetable Consumption and Overweight among Adolescents," *University of Illinois at Chicago* (April 2006): 11.
[160] Jay Maddock, "The Relationship Between Obesity and the Prevalence of Fast Food Restaurants: State-Level Analysis," *The Science of Health Promotion* 19, no. 2 (November/December 2004): 137-43.
[161] Kimberly B. Morland and Kelly R. Evenson, "Obesity Prevalence and the Local Food Environment," *Health and Place* 15, no. 2 (June 2009): 491-95; and Fuzhong Li et al., "Obesity and the Built Environment: Does the Density of Neighborhood Fast-Food OUtlets Matter?" *The Science of Health Promotion* 23, no. 3 (January/February 2009): 203-9.
[162] Roland Sturm, "Disparities in the Food Environment Surrounding US Middle and High Schools," *Journal of the Royal Institute of Public Health* 122, no. 7 (July 2008): 681-90; and Dianne Neumark-Sztainer et al., "School Lunch and Snacking

access to and consumption of fast food, but did not, in turn, also examine obesity prevalence. This further exemplifies the need to examine a multitude of variables and their relationship with childhood overweight and obesity.

RESEARCH LIMITATIONS

While this research identifies several relationships between built environment and socioeconomic factors with childhood obesity, there are noteworthy limitations that may limit the conclusions that can be drawn from this study. In fact, several limitations were identified with all three methodologies.

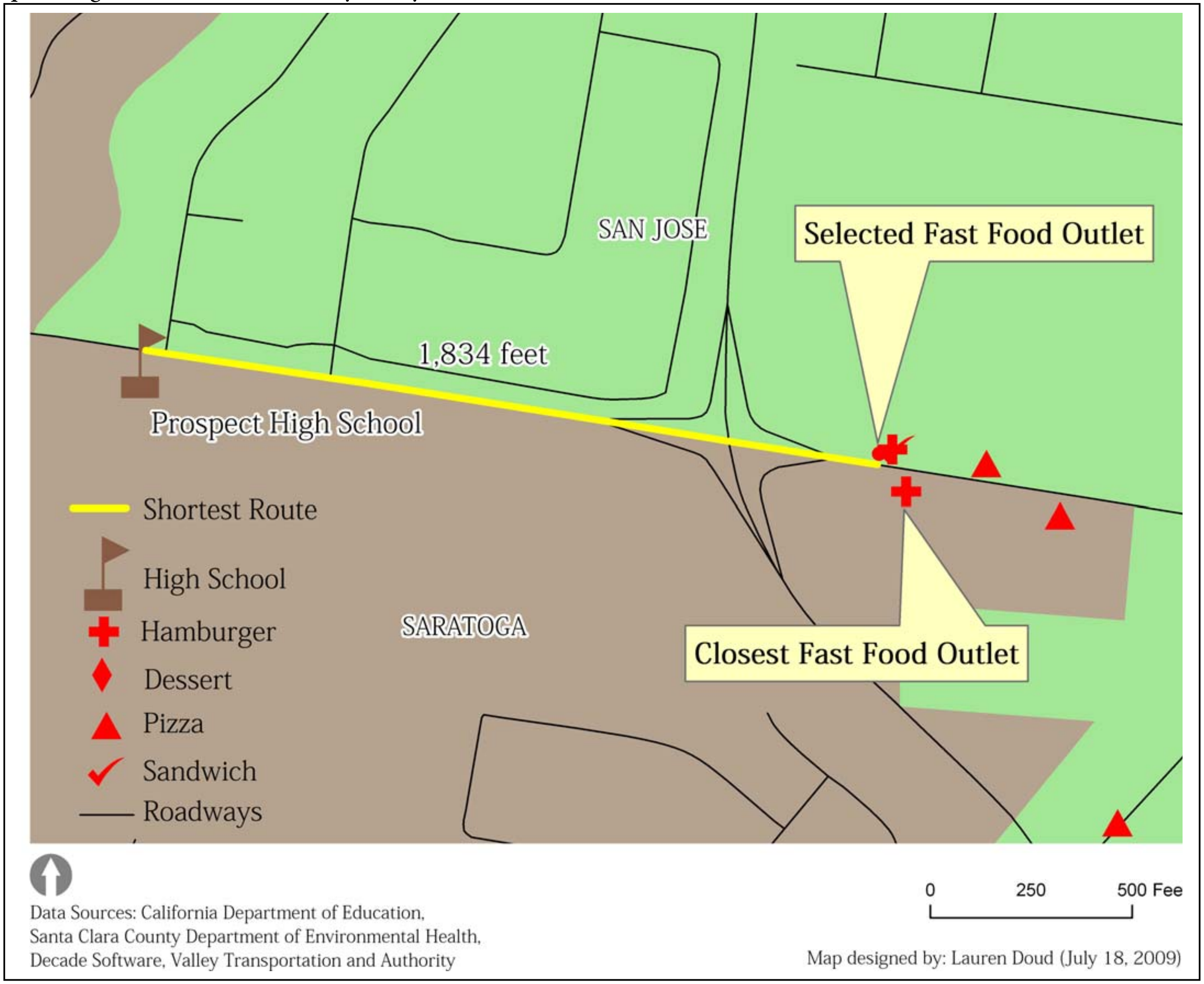
GIS Analysis

There were several limitations found with the GIS analysis. As discussed in greater detail in Chapter III, the Closest Facility analyses calculated the shortest distance, based upon input parameters, from point A to point B. Physical barriers can be added to this analysis to identify areas that cannot be traversed either by foot or vehicle. Given this study's large geographic area, it was not feasible to identify pedestrian barriers for the entire county. As a result, ground-truthing was required for all fast food outlets selected for ethnographic observation. In two instances, new fast food outlets were selected based upon ground-truthing. For example, the outlet selected for Overfelt High School was located in a strip mall with several other fast food outlets, all of which had the same numeric address but different suite numbers. ESRI ArcGIS cannot differentiate addresses based upon suite numbers, and therefore locates all addresses at the same coordinates on a map. As a result, the site selected by the Closest Facility Analysis was not the closest outlet to the high school. Therefore, the fast food outlet at that address that was closest to the high school was instead selected for observation.

Several fast food outlets were located across the street from Prospect High School. GIS analysis selected an outlet that was closest to the high school based upon the roadway network. However, based upon pedestrian access barriers, this outlet was actually further from the high school than another fast food outlet. Figure 4 shows the results of this analysis for Prospect High School. From the figure, it appears that the analysis is technically accurate, as the closest facility to the school was identified using a straight-line approach along the roadway network. However, ground-truthing revealed that this facility was across the street from the school and pedestrian access was blocked by a fence and landscaping. As a result, a facility that appears further from the school was actually closer and on the same side of the street. In this example, the roadway contained six traffic lanes and was a major expressway for vehicles. To reach the outlet identified by this analysis, a pedestrian would need to use a cross walk, and walk around pedestrian barriers, thus increasing the distance traveled from origin to destination.

Patterns Among High School Students: Associations with School Food Environment and Policies," *The International Journal of Behavioral Nutrition and Physical Activity* 2, no. 14 (2005 October 6).

Figure 4: Prospect High School Closest Facility Analysis



Further, a limitation was identified for the GIS Service Area analysis. Service areas were created as proxies for the distance that a child can walk within five and ten minutes of a school. Set at 400m and 800m, respectively, these service areas were an estimation of the secondary school food environment. Here, only the official school address was used to generate each service area. Schools often, however, have several entry/exit points. Resources permitting, identifying each entry/exit point for the 41 schools included in this study would have increased the geographic size of each service area, in effect capturing a more realistic proxy for the secondary school food environment. Therefore, this study may have actually underestimated the number of fast food outlets within the secondary school food environment.

Ethnographic Observation

Given resource constraints, only four fast food outlets were selected for ethnographic observation. Observing more than four fast food outlets within the secondary school food environment would have strengthened this study's results. Although the results were based upon a non-representative sample size, clearly children patronized these outlets. However, only children that walk home from school were observed. Thus, children that were picked up or took the bus were excluded from this study. This may lead to some self-selection issues. Further, this limitation may imply that the secondary school food environment may actually be much larger than the area in closest proximity to high schools. Children that take the bus, for example, may patronize a fast food outlet in close proximity to a bus stop rather than near a school. Additional research should examine children's routes to schools as a proxy for the secondary school food environment, rather than just walking distance from a school. This is especially true when studying high schools which have a much larger catchment area, drawing children from distances much farther than typical for elementary schools, for example.

Linear Regression Analysis

Several limitations are noteworthy with regard to the linear regression analysis. Ultimately, the statistical results do not reveal a statistical relationship between the concentration of fast food outlets in the secondary school food environment with childhood obesity. First, when using observational data, as-is the case in this analysis, it can be challenging to determine cause and effect relationships because other variables not contained within the regression model may better explain these relationships.[163] As consistently documented in the literature, the causes of obesity are complex and remain a major focus of public health research. Further, the built environment's role in the obesity epidemic is not yet well understood. The concentration of fast food within the secondary school food environment may not be a statistically significant contributor to determining childhood obesity in Santa Clara County. Children that take the bus, drive, or are driven to school may patronize fast food outlets outside of the secondary school food environment given their additional mobility. Thus, the secondary school food environment may be much larger than the proximity values of 400m and 800m for high school aged children.

[163] John Neter, Michael H. Kutner, Christopher J. Nachtsheim and William Wasserman, Applied Linear Statistical Models, 4th ed. (Chicago: Irwin, 1996), 14-15.

Second, given that children are a protected class in human subject research as well as resource limitations, aggregate data rather than individual survey data was used for this analysis. Here, the unit of analysis was the school, rather than the children. As a result, findings from the regression analysis cannot be used to infer individual behavior. Therefore, even if a statistically significant correlation had been found between the concentration of fast food in the secondary school food environment and school obesity rate, the analysis could not conclude that a decrease in concentration of fast food outlets would have resulted in a decrease in obesity for each child. The rationale for this generalization is that a population, as a whole, is never homogeneous.[164]

Lastly, the sample size used for this analysis was small, with just 41 observations. With a small sample size, the model's variability can become unpredictable and less precise. On the other hand, large sample sizes increase the model's precision which leads a higher degree of confidence that the results reflect a larger population.[165] Thus, using a larger dataset, perhaps high schools throughout California, may have resulted in a statistical correlation between the density or number of fast food outlets and school obesity rate.

CONCLUSIONS

While this study reveals that fast food outlets cluster near schools with higher school obesity rates, the statistical analysis concludes that neither fast food outlet density nor the number of fast food outlets within the secondary school food environment are correlated with school level obesity. Only average parent education attainment, acres of parkland, and percent Pacific Islander showed statistically significant correlations with the expected signs. Based upon ethnographic observation, it is clear that children patronize fast food outlets within the secondary school food environment. Further, these children are consuming highly caloric and fattening foods for snacking occasions.

This study also reveals that obesity is a complex public health issue that is not yet clearly understood. The bulk of existing health promotion research has focused predominantly on individual obesity interventions. As the rate of overweight and obesity increases, it is becoming clearer that individual interventions are not effective enough to combat this epidemic. This conclusion has led researchers to begin examining other potential causes for obesity. This growing body of research is examining the affect of the built environment and obesity. From results found to date, it is clear that each municipality has a unique built environment whereby obesogenic factors in one municipality may not affect another municipality. Therefore, it is unlikely that one land use policy framework will work effectively to combat all obesogenic environments. The next chapter will discuss potential programs and policies that municipalities can implement to better understand the health of their community as well as promote the healthfulness of its residents.

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[164] Thomas A. Garrett, "Aggregated vs. Disaggregated Data in Regression Analysis: Implications for Inference," The Federal Reserve Bank of St. Louis, http://research.stlouisfed.org/wp/2002/2002-024.pdf (accessed September 26, 2009).
[165] "Sample Size Calculator," Creative Research Systems, http://www.surveysystem.com/sscalc.htm#one (accessed September 26, 2009).

Chapter V: Conclusions and Policy Recommendations

CHAPTER OVERVIEW

While there are a myriad of policy tools available to reduce health disparities in communities, this chapter will first provide context for the policies that will be discussed by providing a summary of the results from this study. Then, several tools that municipalities can utilize to better understand current health disparities as well as policies that may reduce identified disparities to better inform the decision-making process will be presented. Lastly, this chapter poses the challenges in implementing land use policies that are promotive of public health.

RESULTS

The geospatial analysis clearly shows that fast food outlets cluster near high schools with higher obesity rates in the secondary school food environment, and ethnographic observation confirms that children patronize fast food outlets and make poor nutritional decisions. While the linear regression analysis did not find a statistical significance between fast food outlet density and high school obesity rate, results did show that access to green space was correlated with school level obesity. Numerous socioeconomic factors were also statistically significant. The statistical results for fast food outlet density and school obesity levels are inconsistent with results from other studies. However, in combination with other findings from this study, it is clear that complex public heath and planning relationships exist and, further, that Santa Clara County may be an obesogenic environment.

One result that is indicative of the existence of an obesogenic environment is that fast food outlets cluster within both 400m and 800m of schools in Santa Clara County. Thus, as the school's obesity rate increases, the number of nearby fast food outlets also increases, or vice versa. Similar research has suggested that the degree of commercialization in the secondary school food environment may be the cause of clustering near schools.[166] Academic and popular literature often postulates that fast food outlet chains intentionally target locating within close proximity to youth even though no studies published to date have ever proven this theory. Causality cannot be determined from this non-longitudinal study either. There is, however, a basis for this argument. Ray Kroc, founder of McDonald's, is quoted in his book Grinding It Out: The Making of McDonald's that "back in the days when we first got a company airplane, we used to spot good locations for McDonald's stores by flying over a community and looking for schools and church steeples."[167] Kroc, however, also stated that a McDonald's could be successful in almost any metropolitan or suburban location.[168] The fact remains,

[166] S. Bryn Austin, ScD et al., "Clustering of Fast-Food Restaurants Around Schools:: A Novel Application of Spatial Statistics to the Study of Food Environments," *American Journal of Public Health* 95, no. 9 (September 2005): 1575-81; Paul A. Simon et al., "Proximity of Fast Food Restaurants to Schools: Do Neighborhood Income and Type of School Matter?" *Preventive Medicine* 47 (2008): 286; and Shannon N. Zenk and Lisa M. Powell, "US Secondary Schools and Food Outlets," *Health and Place* 14, no. 2 (June 2008): 343.

[167] Ray Kroc, *Grinding It Out: The Making of McDonald's* (New York: St. Martin's Paperbacks, 1992), 166.

[168] Kroc, 168.

however, that school proximity is desirable to McDonald's, and the chain spent $635 million on advertising in 2001.[169] It is unknown how much of this advertising budget was allocated specifically for children's advertising, however. In Santa Clara County, only six of ninety McDonald's outlets were located within 800m of a school. However, in this predominantly suburban car dependent area, McDonald's franchises were located within 1.66 miles of any Santa Clara County high school included in this analysis.

Fast food franchise, CKE Restaurants, the parent company of both Carl's Jr. and Hardee's, claims that it does not market actively towards children; it's primary demographic is adult men.[170] However, the franchise did sign a promotional agreement with the animated film *Igor* to promote the film in its 3,000 outlets.[171] Further, this franchise has taken the opposite position on the healthfulness of its menu options. Rather than offering healthier alternatives, their outlets arguably offer the most fattening and caloric foods in the fast food industry, including the 900 calorie Country Breakfast Burrito and the 1,520 calorie Double Six Dollar burger.[172] The highly successful "meat as a condiment" and "if it doesn't get all over the place it doesn't belong in your face" campaigns helped to increase corporate sales by 31 percent between 2000 and 2008, higher than any other fast food outlet chain.[173] These gluttonous advertising campaigns may not air on the Disney Channel, but older high school aged children are likely not immune from this advertising. Walton et al. found that children exposed to fast food outlets and fast food advertising billboards along their route to school were more likely to make unhealthy food choices at school.[174] Thus, limiting access to fast food outlets and restricting advertising billboards within this larger secondary school food environment may provide important health benefits for children.[175]

One measure of access to healthful food is the Retail Food Environment Index (RFEI) that measures the proportion of fast food restaurants and convenience stores to supermarkets and produce vendors.[176] A study produced by the California Center for Public Health Advocacy found that California's RFEI was 4.0 in 2005.[177] An RFEI value of four indicates that there are four times the amount of unhealthful food options as healthful options across the state. A study by Maddock concluded that as the density of fast

[169] Mary Story and Simone French, "Food Advertising and Marketing Directed at Children and Adolescents in the US," *International Journal of Behavioral Nutrition and Physical Activity* 4, no. 1 (2004 February 10): 2.
[170] Joe Keohane, "Fat Profits," *bizjournals*, January 13, 2008. http://www.portfolio.com/news-markets/national-news/portfolio/2008/01/13/CKE-Hardees-Profile/?TID=advert/drudge/Hardees (accessed November 9, 2009).
[171] Ibid.
[172] Ibid.
[173] Ibid.
[174] Mat Walton, Jamie Pearce and Peter Day, "Examining the Interaction between Food Outlets and Outdoor Food Advertisements with Primary School Food Environments," *Health and Place* 15, no. 2 (June 2009): 1-8.
[175] Ibid.
[176] "Searching for Healthy Food: The Food Landscape in California Cities and Counties," California Center for Public Health Advocacy, http://www.publichealthadvocacy.org/RFEI/policybrief_final.pdf (accessed March 8, 2009).
[177] Ibid.

food restaurants increased, obesity rates also increased.[178] Mehta et al. similarly concluded that as density of unhealthful restaurants increased, BMI also increased.[179] As a result, as zoning increases opportunities for fast food, the likelihood of overweight and obesity also increases.

Legal Precedence to Regulate Fast Food Retail

While many argue that patronizing a fast food outlet is a personal choice, there are neighborhoods whereby the only choice is a fast food outlet. Further, given the current economic climate, fast food outlets offer inexpensive calories for struggling families. A principle tenet of city planning is to protect the public's health; and therefore, there is legal precedence to regulate the fast food industry. Since 1892, municipalities have repeatedly enacted land use regulations to protect public health. Historically, public health regulations were primarily aimed to regulate noise exposure, sanitation, and overcrowding. Only recently, however, have municipalities begun to acknowledge that land use patterns impact a principle public health concern, obesity. The built environment impacts the public's ability to safely bicycle and walk throughout a community. Further, access to healthy and unhealthy food impacts the nutritional choices available to a community. Community land use patterns that do not support physical activity and healthful eating are 'obesogenic environments.'[180] Academic research to date concludes that where obesogenic environments exist, these environments are a contributing factor for obesity.[181]

Cities throughout the country have adopted ordinances that limit the density, location, and/or type of fast food restaurants in their communities. However, none of these ordinances, on their face, justify the ordinance based upon public health to date. The courts have also upheld these ordinances. For example, the Supreme Court has upheld laws that allow the Federal Communications Commission (FCC) to regulate the amount of fast food advertising allowed during children's programming.[182] The federal government has also regulated the use of specific additives in food. Zoning laws restricting fast food outlets have also been upheld by the courts based upon traffic concerns, pedestrian and public safety, economic conditions, and preserving neighborhood characteristics.[183] The Supreme Court has

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[178] Jay Maddock, "The Relationship between Obesity and the Prevalence of Fast Food Restaurants: State-Level Analysis," *The Science of Health Promotion* 19, no. 2 (November/December 2004): 137-43.

[179] Neil K. Mehta, MSc and Virginia W. Chang, MD, PhD, "Weight Status and Restaurant Availability: A Multilevel Analysis," *American Journal of Preventive Medicine* 34, no. 2 (February 2008): 127-33.

[180] M. White, "Food Access and Obesity," *Obesity Reviews* 8, no. 1 (19 February 2007): 99-107.

[181] M. White, "Food Access and Obesity," *Obesity Reviews* 8, no. 1 (19 February 2007): 99-107; Jennifer L. Black and James Macinko, "Neighborhoods and Obesity," *Nutrition Reviews* 66, no. 1 (January 2008): 2-20; Steven C.J. Cummins, PhD, Laura McKay, MA and Sally MacIntyre, PhD, "McDonalds Restaurants and Neighborhood Deprivation in Scotland and England," *American Journal of Preventive Medicine* 29, no. 4 (2005): 308-10; Steven Cummins and Sally Macintyre, "REVIEW Food environments and obesity Neighborhood or Nation?" *International Journal of Epidemiology* 35 (2006): 100-4; Jay Maddock, "The Relationship between Obesity and the Prevalence of Fast Food Restaurants: State-Level Analysis," *The Science of Health Promotion* 19, no. 2 (November/December 2004): 137-43.

[182] James G. Hodge, Jr., J.D., LL.M., "The Use of Zoning to Restrict Access to Fast-Food Outlets: A Potential Strategy to Reduce Obesity," Public Health Law, http://www.publichealthlaw.net/Zoning%20and%20Fast%20Food%20-%20Hodge.ppt#358,1,Slide 1 (accessed November 25, 2008), 31.

[183] Ibid.

also upheld zoning regulations that promote public health in two landmark planning cases. The Court found in both *Jacobson v. Massachusetts* and *Village of Euclid v. Ambler Realty* that zoning to promote public health was a legitimate exercise of the police power.[184] Therefore, zoning to promote public health is neither arbitrary nor capricious.

TOOLS FOR POLICY IMPLEMENTATION

This study found that several built environment factors are correlated with childhood obesity in Santa Clara County. Although more research should be undertaken, it would behoove local municipalities to gain a better understanding of the current healthfulness of their municipality. One method that can be used to establish this baseline is the Health Impact Assessment (HIA). The World Health Organization defines a HIA as a "combination of procedures, methods and tools by which a policy, program or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population."[185] HIAs identify health inequalities that a policy or project may have on a population.[186] These impacts can be then be eliminated or mitigated by implementing policies that are promotive of public health.

As of June 2009, several dozen HIAs have been conducted throughout the United States.[187] Locally, the City and County of San Francisco adopted the Eastern Neighborhoods Community Health Impact Assessment (ENCHIA) in September 2007.[188] The ENCHIA is one of the first examples of collaborative community health planning in the United States.[189] As progressive municipalities begin to critically examine the health of their community, model guidelines and policies can be adopted. Human Impact Partners, for example, developed a Toolkit for Community Based Planning to assist municipalities in identifying health inequities. The toolkit provides a step-by-step methodology for assessing public health impacts of land use development as well as analytic tools, case studies, and training exercises.[190] Several additional HIAs have been completed in the Bay Area, predominantly in the cities of Oakland and San Francisco and include the following:

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[184] Julie Samia Mair, Matthew W. Pierce, and Stephen P. Teret "monograph entitled, The Use of Zoning to Restrict Fast Food Outlets: A Potential Strategy to Combat Obesity," The Centers for Law & The Public's Health, http://www.publichealthlaw.net/Zoning%20Fast%20Food%20Outlets.pdf (accessed November 28, 2008), 26.
[185] "Health Impact Assessment (HIA)," World Health Organization, http://www.who.int/hia/about/defin/en/index.html (accessed September 28, 2009).
[186] "Glossary of Terms Used in HIA," UCLA Health Impact Assessment Clearinghouse Learning and Information Center, http://www.ph.ucla.edu/hs/hiaclic/methods/glossary.htm#hia (accessed September 28, 2009).
[187] "HIA Archive," UCLA Health Impact Assessment Clearinghouse Learning and Information Center, http://www.ph.ucla.edu/hs/hiaclic/archive.htm (accessed September 28, 2009).
[188] "Eastern Neighborhoods Community Health Impact Assessment," City and County of San Francisco Department of Public Health, http://www.sfphes.org/enchia/2007_09_05_ENCHIA_Final_Report.pdf (accessed September 28, 2009).
[189] Ibid.
[190] "HIA Toolkit for Community Planning: Introduction and Overview," Human Impact Partners, http://www.humanimpact.org/HIPHIATK_Section1.pdf (accessed September 28, 2009).

- Oak to Ninth Avenue (City of Oakland);[191]
- Mac Arthur BART (City of Oakland);[192]
- Jack London Gateway Senior Housing Project (City of Oakland);[193]
- Executive Park Subarea Plan (City and County of San Francisco); and[194]
- Mission District Area Plan (City and County of San Francisco).[195]

While HIAs are useful in assessing the traditional determinants of health that include: biological factors, behavior and lifestyles, physical and social environment, and access to healthcare,[196] these assessments rarely place an emphasis on access to both healthy and unhealthy food. To bridge this gap, a Community Food Survey (CFS) may be a useful supplement to a HIA. The United States Department of Agriculture Economic Research Service created a Community Food Security Assessment Toolkit in 2002 to assist municipalities as well as non-governmental organizations to assess six basic tenets of community food security that include: community socioeconomic and demographic characteristics, food resources, food resource accessibility, food availability and affordability, and production resources.[197] Interestingly, the toolkit does not address community sources of unhealthy food. Therefore, to complete a CFS, a fast food outlet assessment should also be completed. The Center for Public Health Policy developed a measurement tool, the Retail Food Environment Index (RFEI) to measure the ratio of fast food outlets/convenience stores to the number of grocery stores, produce stores, and farmers markets.[198] The City of New York recently implemented its own version of the RFEI, FoodStat, to "improve New York City's approach to public health, city planning, and the urban environment."[199] Together, a HIA and a CFS can identify the existing conditions of a municipality's public health environment.

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[191] "Oak to Ninth Avenue Health Impact Assessment," UC Berkeley Health Impact Group, http://ehs.sph.berkeley.edu/hia/O2N.HIA.FullDraft.pdf (accessed September 30, 2009).
[192] "MacArthur Transit Village," City of Oakland, http://www.oaklandnet.com/government/ceda/revised/planningzoning/majorprojectssection/macarthur.html (accessed September 30, 2009).
[193] "Jack London Gateway Rapid HIA: A Case Study," The Association of Public Health Observatories, http://www.apho.org.uk/resource/item.aspx?RID=61072 (accessed September 30, 2009).
[194] "Case Studies," Healthy Development Measurement Tool, http://www.thehdmt.org/case_studies.php (accessed September 30, 2009).
[195] "Impacts on Community Health of Area Plans for the Mission, East SoMa, and Potrero Hill / Showplace Square: An Application of the Healthy Development Measurement Tool," Healthy Development Measurement Tool, http://www.thehdmt.org/etc/HDMT_Application_Eastern_Neighborhoods_Area_Plans.October_2008.pdf (accessed September 30, 2009).
[196] "Glossary of Terms Used in HIA," UCLA Health Impact Assessment Clearinghouse Learning and Information Center, http://www.ph.ucla.edu/hs/hiaclic/methods/glossary.htm#hia (accessed September 28, 2009).
[197] Barbara Cohen, "USDA Community Food Security Assessment Toolkit," U.S. Department of Agriculture Economic Research Service, http://www.ers.usda.gov/publications/efan02013/efan02013.pdf (accessed September 30, 2009).
[198] "Searching for Healthy Food: The Food Landscape in California Cities and Counties," California Center for Public Health Advocacy, http://www.publichealthadvocacy.org/RFEI/policybrief_final.pdf (accessed March 8, 2009).
[199] Scott M. Stringer, "FoodStat: Measuring the Retail Food Environment in NYC Neighborhoods," Office of Manhattan Burough, http://mbpo.org/uploads/Food_Stat_FINAL.pdf (accessed September 30, 2009).

POLICY FRAMEWORKS

As previously discussed, there is a legal precedence to regulate a municipality's retail food environment. The cities of Calistoga and Carmel by the Sea have banned fast food outlets entirely. Banning additional fast food outlets in other communities, especially in Santa Clara County, may be politically challenging. For example, a moratorium on fast food restaurants lacked political support in City of San José, in Santa Clara County, while the City of Los Angeles successfully adopted a fast food moratorium for a specific neighborhood with an excessive concentration of fast food outlets. Municipalities may, however, find more political support for encouraging healthy food retail. By adopting conditional, incentive-based, and/or performance zoning, municipalities can encourage the development of full-service grocery stores and restaurants.[200] Conditional zoning defines specific uses permissible for a specific parcel.[201] For example, a zoning ordinance could expand its retail zone to specifically zone for and identify land for supermarket retail or farmers markets while prohibiting fast food outlets. Additionally, incentive zoning can provide development incentives to developers that build healthy food retail. Lastly, performance zoning sets use restrictions for specific parcels.[202] For example, a performance zoning ordinance could require a fast food outlet to provide a variety of healthy foods.[203] While performance zoning has typically applied to industrial uses, courts will uphold ordinances that show a reasonable relationship to the police power.[204]

Another policy framework that can be used to promote public health is the general plan. Several cities in the Bay Area have incorporated health elements into their general plan including the cities of Richmond, Benicia, Watsonville, and Marin County.[205] Cities that incorporate public health policies into their general plan incorporate many facets of the built environment from walkability to bikeability to complete streets to public transit. Thus, healthy policies can be implemented into nearly all of the seven required general plan elements. Municipalities can opt to create a standalone optional public health element or incorporate public health goals and policies into the existing required elements. Several examples of model general plan policies are listed in Appendix D.

While the aforementioned policy frameworks can help to foster an overall healthier community, they do not specifically address childhood obesity. Targeting overweight and obesity interventions for children may have a longer lasting public health impact by, in turn, reducing the prevalence of adult obesity. Local governments can be effective agents for change in this regard. One such goal is to reduce

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[200] James G. Hodge, Jr., J.D., LL.M., "The Use of Zoning to Restrict Access to Fast-Food Outlets: A Potential Strategy to Reduce Obesity," Public Health Law, http://www.publichealthlaw.net/Zoning%20Fast%20Food%20Outlets.pdf, p. 24 (accessed September 29, 2009).
[201] Ibid.
[202] Ibid.
[203] Ibid.
[204] Ibid.
[205] "Peer Review Sessions: Healthy Planning Research and Tools," Prevention Institute, http://www.preventioninstitute.org/hpcToolsResearch.html (accessed September 30, 2009).

or eliminate unhealthy snacks in city-operated after-school programs.[206] Another goal is to require that regulated childcare facilities provide healthy food as part of its licensing requirements.[207] An additional nutrition-based goal is to remove barriers that restrict or prohibit breastfeeding in public.[208] Local municipalities can require that government facilities include lactation rooms as well as provide incentives for developers to do the same. Lastly, the city's municipal code should require that water drinking fountains are readily available to the public.[209]

In addition to adopting nutrition-related goals, local governments can also adopt goals and policies that encourage children to engage in physical activity. One such policy is to adopt a pedestrian and bicycle master plan.[210] In higher crime areas, allocating resources to provide adequate public safety enforcement can reduce the occurrence and perception of crime. Municipalities can also implement a *Safe Routes to School* program.[211] This program identifies routes that are safe for children to walk and/or bicycle to schools within a community. If a municipality provides public transportation, discounts for children to encourage the use of public transportation should also be supported.[212] Additionally, parks and playgrounds should be built and maintained in close proximity to residential neighborhoods.[213] Lastly, municipalities should work with local school districts to allow joint use of school facilities when schools are closed.[214]

Another policy framework that can be addressed at the school district level is the open/closed campus policy. Although only 22 percent of schools in Santa Clara County allow students to leave campus at lunch, further limiting access to unhealthful foods in the secondary school food environment during school hours should be encouraged. Additionally, if political support for banning fast food outlets is lacking, municipalities can consider banning fast food outlets within the secondary school food environment, much like existing regulations that restrict the location of businesses that sell alcohol for offsite consumption. Lastly, schools that provide meals to children should be required to provide only healthy food. Contracts with fast food vendors and beverage companies should be eliminated.

IMPLEMENTATION CHALLENGES

While the goals and policies described in the previous section and Appendix D are praiseworthy, there are numerous barriers to implementing these goals and policies by municipalities, school districts, and individual schools. Given the current fiscal constraints that are affecting nearly every government-funded organization, the human capital and financial resources may simply not be available to change

[206] "Local Government Actions to Prevent Childhood Obesity," Robert Wood Johnson Foundation, http://www.rwjf.org/files/research/20090901iomreport.pdf (accessed September 30, 2009).
[207] Ibid.
[208] Ibid.
[209] Ibid.
[210] Ibid.
[211] Ibid.
[212] Ibid.
[213] Ibid.
[214] Ibid.

existing policies and develop new programs. Furthermore, many of these goals and policies, especially food-related goals and policies, may be cost prohibitive even in better economic times. Healthy food simply costs more than calorie-dense pre-prepared items.

Another implementation challenge is the ability to measure progress once policies and programs are implemented. Obesity data is readily available only at the county-level. Local municipalities may not have the resources available to regularly conduct expensive individual surveys to obtain and track obesity metrics. Without the ability to easily track programs' progress on combating both childhood and adult obesity, it may be difficult to justify implementing the program at the outset.

Lastly, with little definitive evidence-based research that has found causal relationships between the built environment and obesity, local municipalities may be challenged to provide viable evidence-based rationales for costly public health programs and policies. It would, however, behoove local agencies to take a proactive approach to implementing policies and programs based upon the current best available information, including conclusions that may be drawn from this research project.

Appendix A: Ethnographic Observation Selection Criteria

Table 12: Schools Ranked by Number of Outlets and Obesity (High to Low)

High School	School District	Open/ Closed[a]	Location	Obesity Rate[b]	Enrollment	Fast Food Outlets[c]	Density[d]
Prospect High	Campbell Union High	Closed	Saratoga	27.40%	980	12	0.062
Cupertino High	Fremont Union High	Open	Cupertino	15.30%	1,230	9	0.041
Homestead High	Fremont Union High	Open	Cupertino	25.70%	1,675	7	0.031
Pioneer High	San Jose Unified	Closed	San Jose	27.20%	1,143	6	0.023
Downtown College Preparatory	San Jose Unified	Closed	San Jose	34.60%	336	4	0.013
Andrew P. Hill High	East Side Union High	Closed	San Jose	29.60%	1,672	4	0.016
Branham High	Campbell Union High	Closed	San Jose	25.90%	1,080	4	0.015
Silver Creek High	East Side Union High	Closed	San Jose	24.70%	1,849	4	0.015
Del Mar High	Campbell Union High	Closed	San Jose	28.80%	1,847	3	0.014
Santa Teresa High	East Side Union High	Closed	San Jose	27.40%	1,810	3	0.012
Palo Alto High	Palo Alto Unified	Open	Palo Alto	11.10%	1,281	3	0.012
Los Gatos High	Los Gatos-Saratoga Joint Union High	Open	Los Gatos	8.40%	1,337	3	0.015
James Lick High	East Side Union High	Closed	San Jose	40.10%	892	2	0.008
Fremont High	Fremont Union High	Open	Sunnyvale	35.40%	1,489	2	0.009
Abraham Lincoln High	San Jose Unified	Closed	San Jose	33.20%	1,923	2	0.007
Milpitas High	Milpitas Unified	Closed	Milpitas	23.20%	2,171	2	0.007
Piedmont Hills High	East Side Union High	Closed	San Jose	20.80%	1,659	2	0.008
San Jose High Academy	San Jose Unified	Closed	San Jose	47.30%	732	1	0.003
William C. Overfelt High	East Side Union High	Closed	San Jose	38.40%	1,314	1	0.003
Mt. Pleasant High	East Side Union High	Closed	San Jose	34.00%	1,396	1	0.004
Oak Grove High	East Side Union High	Closed	San Jose	30.00%	1,889	1	0.004
Santa Clara High	Santa Clara Unified	Closed	Santa Clara	29.60%	1,406	1	0.004
Gunderson High	San Jose Unified	Closed	San Jose	15.40%	832	1	0.005
Monta Vista High	Fremont Union High	Open	Cupertino	10.90%	1,865	1	0.005
Willow Glen High	San Jose Unified	Closed	San Jose	43.50%	1,068	0	0.000
Ownes Gilroy Early College Academy	Gilroy Unified	Closed	Gilroy	35.50%	65	0	0.000
Gilroy High	Gilroy Unified	Closed	Gilroy	33.90%	1,919	0	0.000
Yerba Buena High	East Side Union High	Closed	San Jose	32.90%	1,272	0	0.000
Independence High	East Side Union High	Closed	San Jose	28.40%	2,664	0	0.000
Leigh High	Campbell Union High	Closed	San Jose	26.90%	1,270	0	0.000
Adrian Wilcox High	Santa Clara Unified	Closed	Santa Clara	25.80%	1,444	0	0.000
Westmont High	Campbell Union High	Closed	Campbell	25.60%	1,224	0	0.000
Leland High	San Jose Unified	Closed	San Jose	25.10%	1,373	0	0.000
Ann Sobrato High	Morgan Hill Unified	Closed	Morgan Hill	24.60%	1,206	0	0.000
Live Oak High	Morgan Hill Unified	Closed	Morgan Hill	24.00%	987	0	0.000
Evergreen Valley High	East Side Union High	Closed	San Jose	22.10%	1,968	0	0.000
Los Altos High	Mountain View-Los Altos Union High	Closed	Los Altos	14.40%	1,281	0	0.000
Lynbrook High	Fremont Union High	Open	San Jose	12.60%	1,440	0	0.000
Mountain View High	Mountain View-Los Altos Union High	Closed	Mountain View	11.10%	1,344	0	0.000
Saratoga High	Los Gatos-Saratoga Joint Union High	Open	Saratoga	10.60%	1,021	0	0.000
Henry M. Gunn High	Palo Alto Unified	Open	Palo Alto	9.80%	1,412	0	0.000

Sources: California Department of Education and California Department of Education Physical Fitness Test Results (2008).

[a] Open or closed campus lunch policy by school. Policy is determined at the district rather than school level.
[b] Obesity rate is measured as the percentage of children that are fall outside of the Healthy Fitness Zone for "Body Composition" as aggregated to the school level.
[c] Number of fast food outlets within 800m of each high school.
[d] Density is measured at the number of fast food outlets per acre within 800m of each school.

Table 13: Schools Ranked by Number of Outlets and Obesity (Low to High)

High School	School District	Open/ Closed[a]	Location	Obesity Rate[b]	Enrollment	Fast Food Outlets[c]	Density[d]
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Sources: California Department of Education and California Department of Education Physical Fitness Test Results (2008).

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[c] Number of fast food outlets within 800m of each high school.
[d] Density is measured at the number of fast food outlets per acre within 800m of each school.

APPENDIX B: GEOSPATIAL ANALYSIS DETAILED METHODOLOGY

METADATA

This section provides detailed metadata for all data sources used to complete the geospatial analysis for this study. For each data layer, the data source, URL (if applicable), data description, access restrictions, and coordinate system are summarized.

Data Layer: schools_Export_Output.shp
Sources: California Department of Education and Local School District Websites/Offices for Open/Closed campus policies
URLs: http://api.cde.ca.gov/reports/page2.asp?subject=API&level=School&submit1=submit, and http://data1.cde.ca.gov/dataquest/page2.asp?Level=District&submit1=Submit&Subject=FitTest
Data Description: The attribute table contains a list of all public high schools in Santa Clara County with available physical fitness data. There are numerous additional attribute fields including: school district, address, enrollment, API test score, open/closed campus policy, NSLP participation rates, socioeconomic data, parent educational attainment, and healthy fitness zone percentages.
Access Restrictions: The data is freely available to the public for download.
Coordinate System: GCS_North_American_1983

Data Layer: fast_food_projected.shp
Source: Santa Clara County Public Health Department's Environmental Health Program, Decade Software and Yellowpages.com
URLs: http://www.decadeonline.com/main.phtml?agency=SCC; http://www.sccgov.org/portal/site/scc/chlevel3?path=%2Fv7%2FSCC%20Public%20Portal%2FLiving%20and%20Working%2FConsumer%20Rights%20and%20Protection%2FRestaurant%20Inspection%20Records; and http://www.yellowpages.com
Data Description: The Santa Clara County Department of Public Health provided a list of fast food outlets for analysis. This list was merged and compared with Department of Health data made available online through Decade Software. This data source was also cross-referenced with Yellowpages.com, an online phone "book" that contains listings of retail businesses throughout the United States. The point feature class contains outlet name, address, latitude, longitude, and food type.
Access Restrictions: None
Coordinate System: NAD_1983_StatePlane_California_III_FIPS_0403_Feet

Data Layer: scc_roads_good_data.shp
Source: Valley Transportation Authority (VTA)
URL: N/A
Data Description: The attribute table contains polylines of the roadway network for the Bay Area.
Access Restrictions: Data obtained from Jason Tyree at VTA. Data can only be used for educational purposes while enrolled in GIS classes at San José State University.
Coordinate System: NAD_1983_StatePlane_California_III_FIPS_0403_Feet

Data Layer: cities.shp
Source: Valley Transportation Authority (VTA)
URL: N/A
Data Description: The attribute table contains a polygon shape for each city in Santa Clara County. A few county pockets are also contained in this feature class.
Access Restrictions: Data obtained from Jason Tyree at VTA. Data can only be used for educational purposes while enrolled in GIS classes at San José State University.
Coordinate System: NAD_1983_StatePlane_California_III_FIPS_0403_Feet

Data Layer: county.shp
Source: The California Spatial Information Library (CASIL)
URL: http://gis.ca.gov/meta.epl?oid=21384
Data Description: The attribute table contains a single polygon shape for Santa Clara County.
Access Restrictions: None
Coordinate System: NAD_1983_UTM_Zone_10N

Data Layer: SJCityBound.shp
Source: Valley Transportation Authority (VTA)
URL: Not applicable
Data Description: The attribute table contains a polygon shape for each city in Santa Clara County.
Access Restrictions: Data obtained from Jason Tyree at VTA. Data can only be used for educational purposes while enrolled in GIS classes at San José State University.
Coordinate System: PCS NAD 1983 StatePlane California III FIPS 0403 Feet

Data Layer: highways_scc_clipped.shp
Source: U.S. Census TigerLine Data
URL: http://www.census.gov/geo/www/tiger/tgrshp2007/tgrshp2007.html
Data Description: The attribute table contains polylines representative of the major highways in Santa Clara County.
Access Restrictions: None.
Coordinate System: North_America_Lambert_Conformal_Conic

Data Layer: urban_land_cover Raster Dataset
Source: Berkeley/Penn Urban & Environmental Modeler's Datakit
URL:
http://dcrp.ced.berkeley.edu/research/footprint/index.php?option=com_content&task=view&id=17&Itemid=31
Data Description: The raster file displays urban land cover for the entire United States.
Access Restrictions: None
Coordinate System: Lambert's Conformal Conic NAD83

Data Layer: scc_hillshade_new Raster Dataset
Source: Berkeley/Penn Urban & Environmental Modeler's Datakit

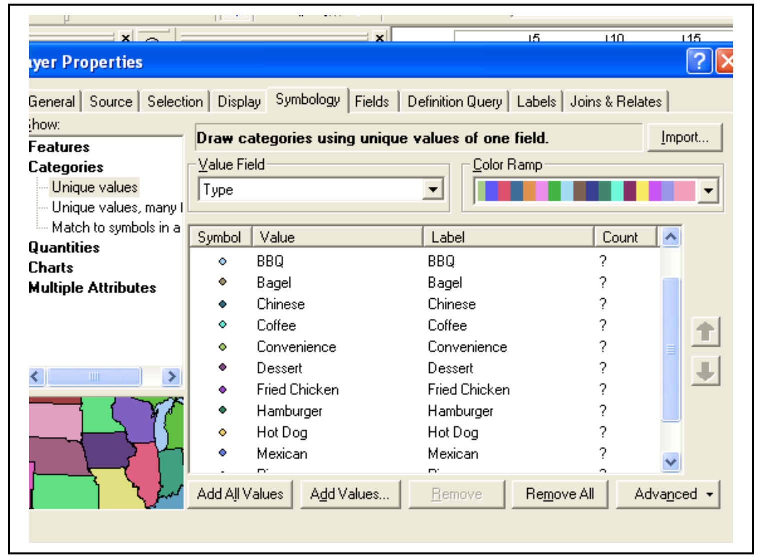
URL:
http://dcrp.ced.berkeley.edu/research/footprint/index.php?option=com_content&task=view&id=17&Itemid=31
Data Description: The raster file displays a digital elevation model (DEM) for the western United States.
Access Restrictions: None
Coordinate System: Lambert's Conformal Conic NAD83

Data Layer: parks_800m_service_Join_Output_8.shp
Source: Valley Transportation Authority (VTA)
URL: Not applicable
Data Description: This feature class contains lands designated as parklands/open space in Santa Clara County's General Plan.
Access Restrictions: Data obtained from Jason Tyree at VTA. Data can only be used for educational purposes while enrolled in GIS classes at San José State University.
Coordinate System: NAD_1983_UTM_Zone_10N

GEOSPATIAL PROCESS

This section summarizes the step-by-step process undertaken to complete the geospatial analysis for this study.

Figure 1: Fast Food Outlet Categories



1. **Fast Food Outlets:** To create the fast food feature class, fast food data was obtained from three different data sources. These data sources were merged into one Excel spreadsheet and filtered for unique values using IF statements and auto-filters. All local restaurants were omitted. For example, Togo's, Mr. Chau's Chinese Fast Food, and Fosters Freeze were omitted because these restaurants only operate within California. Next, each restaurant was manually categorized into the following fast food types: bagel, BBQ, Chinese, coffee, convenience, dessert, fried chicken, hamburger, hot dog, Mexican, pizza, or sandwich (as shown in Figure 5). The final spreadsheet was geocoded using BatchGeocode.com to obtain x,y coordinates (latitude, longitude). The spreadsheet was added as a new map layer and the x,y coordinates were displayed as events. The events were exported as a feature class and added to the map as a new map layer.

2. **Public High Schools:** To create the public high schools feature class, schools data was obtained from several sources. These data sources were merged into Excel using IF statements, VLookup, and auto-filters to create one master list of public high schools in Santa Clara County. All private schools as well as elementary and middle schools were omitted. Schools without Healthy Fitness Zone data were omitted as well. The resultant spreadsheet was geocoded using BatchGeocode.com to obtain x,y coordinates (latitude, longitude). The spreadsheet was added as a new map layer and the x,y coordinates were displayed as events on the map (see Figure 6). The events were exported as a feature class and added to the map as a new map layer.

3. **Network Dataset:** To create a shapefile based network dataset, roads data was obtained from the Valley Transportation Authority (VTA). The Network Analyst Extension must be enabled and licensed for use in both ArcMap and ArcCatalog. Network attributes

control navigation through the network dataset. Attributes can include one-way street restrictions, time, and u-turns. For this analysis, the roadway network needed to be structured for pedestrian traffic, rather than vehicular traffic. As a result, only one network attribute was added to this network dataset, a length impedance measured in meters (as shown in Figure 7). Again, as a pedestrian-based network dataset, global turns were not modeled. The network dataset was built and added to the map as a new map layer.

Figure 2: X,Y Coordinate Data

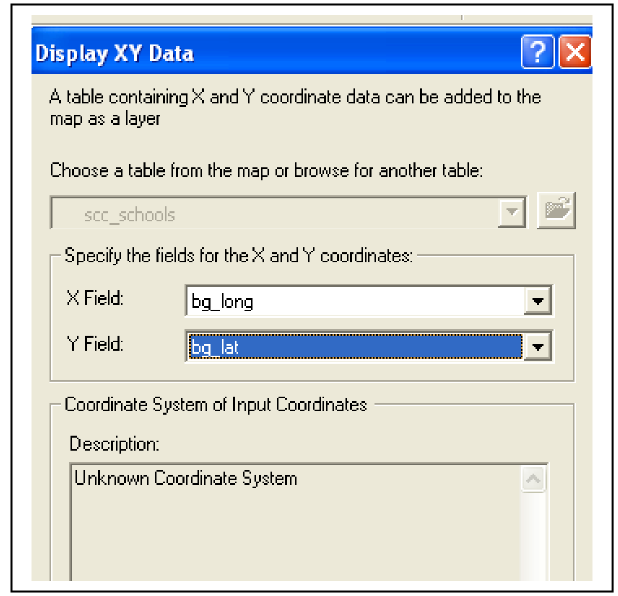
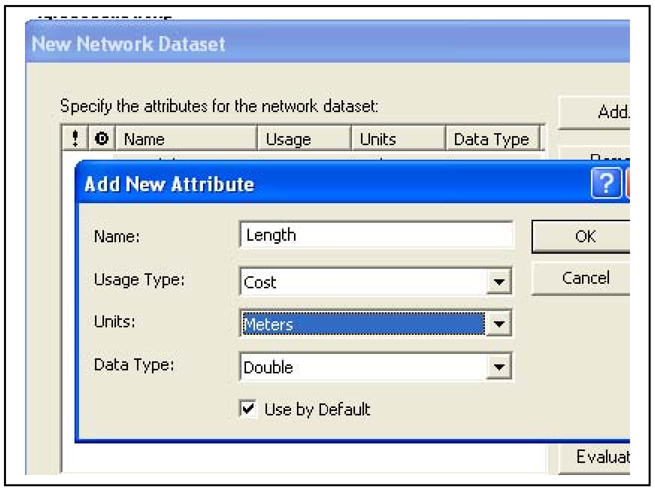


Figure 3: Cost Impedances



4. **400m Service Areas:** A 400m service area was created around each school location as a proxy for the secondary school food environment. This distance represents the distance that could be walked within five minutes along the county's roadway network. Using the Network Analyst Extension, a new service area was created using the network dataset generated from Step 3 above. Schools were added as Facilities as shown in Figure 8. The impedance value was set to 400m. U-turns were also allowed because the network dataset was a pedestrian-based model. To create one non-overlapping service area for each school, the Not Overlapping option was selected for polygon generation. It was important to create individual service areas, rather than joined service areas, so that each school's secondary school food environment could be analyzed separately.

Figure 4: Secondary School Food Environment (400m)

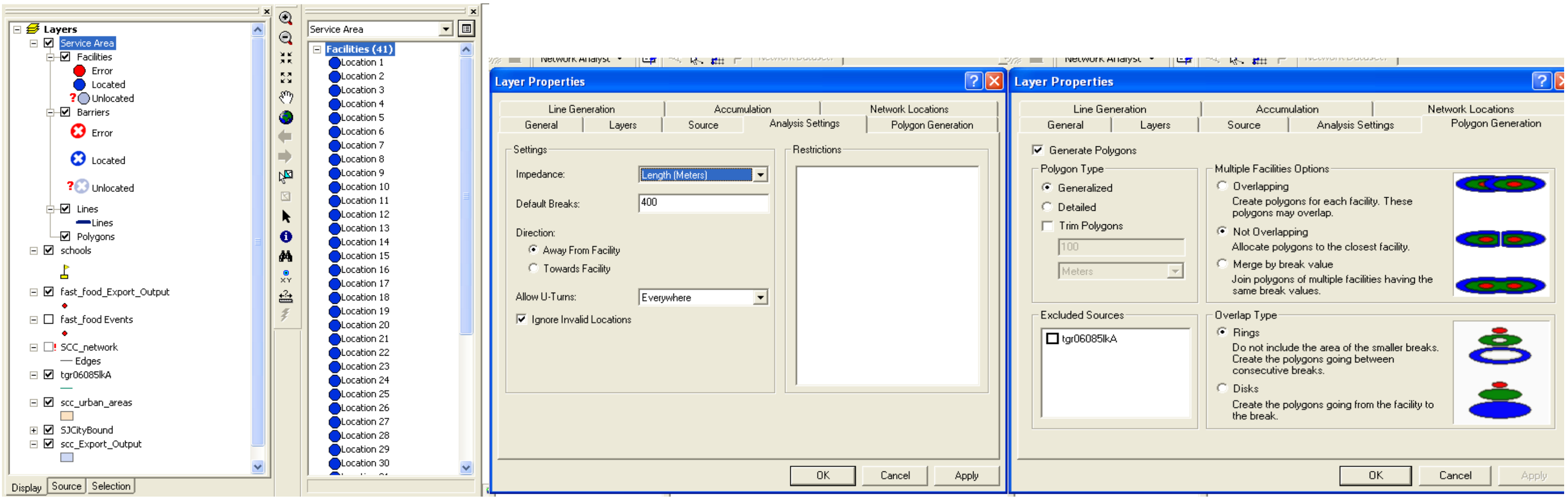
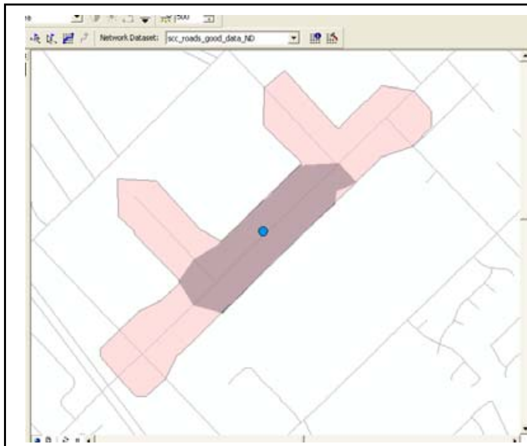


Figure 5: 800m Service Area

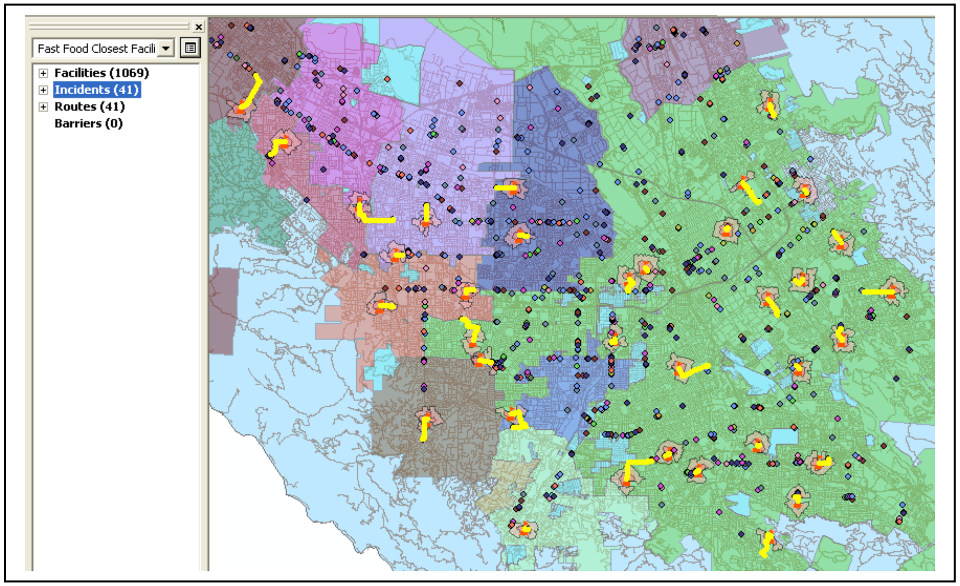


5. **8800m Service Areas:** A second service area was created at an 800m impedance level. This service area represents the distance that can be walked within ten minutes along the roadway network. An example of a resultant service area is shown in Figure 9. All other settings were set as described for the 400m service areas in Step 4.

6. **Nearest Facility Analysis:** A Nearest Facility Analysis was undertaken to find the nearest fast food outlet to each high school. The process utilizes the network dataset created in Step 3 to find the shortest route from a Facility (here fast food outlets) to an Incident (here schools). Utilizing the Network Analyst Extension, Facilities and Incidents were added as Locations. The travel pathway was modeled from school to

fast food outlet with no impedance value. This ensured that a fast food outlet would be identified for each school regardless of the distance between the two points. The analysis created a route feature class that contained the route's distance, school, and fast food outlet. The data obtained from this analysis was used to identify fast food outlets for ethnographic observation. The yellow lines in Figure 10 show the shortest route from each school to the closest fast food outlet.

Figure 6: Shortest Route



7. **Service Area Acreage:** With the 400m and 800m service areas created around each school, the acreage of each service area had to be calculated for future analysis. A new long integer field was added to the 400m and 800m polygon feature classes and the acreage was calculated, as shown in Figure 11.

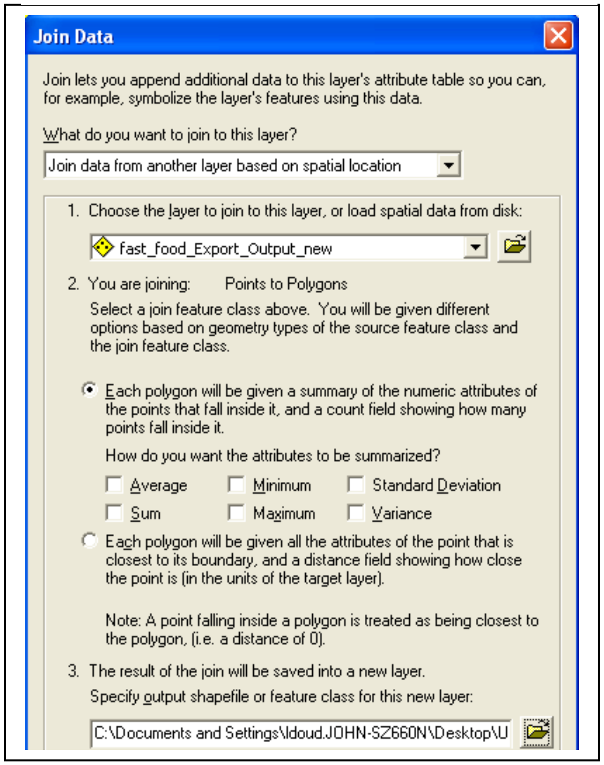
8. **Fast Food Density in Service Areas:** ArcGIS calculates point density as the number of points that fall within a specified neighborhood. For this step, the neighborhoods were defined as 400m and 800m service areas, respectively. A Spatial Join was used to join fast food outlets with each service area polygon feature class. The settings selected for both Spatial Joins are shown Figure 12. The resultant new feature class contained the following attribute data: Facility Name, Facility Acreage, and Count. The Count field calculated the number of point features within the specified service area. To calculate density, a new field was added to the feature class attribute table, density. Density was calculated with the Field Calculator as shown in Figure 13.

Figure 7: Service Area Acreage

Attributes of Polygons

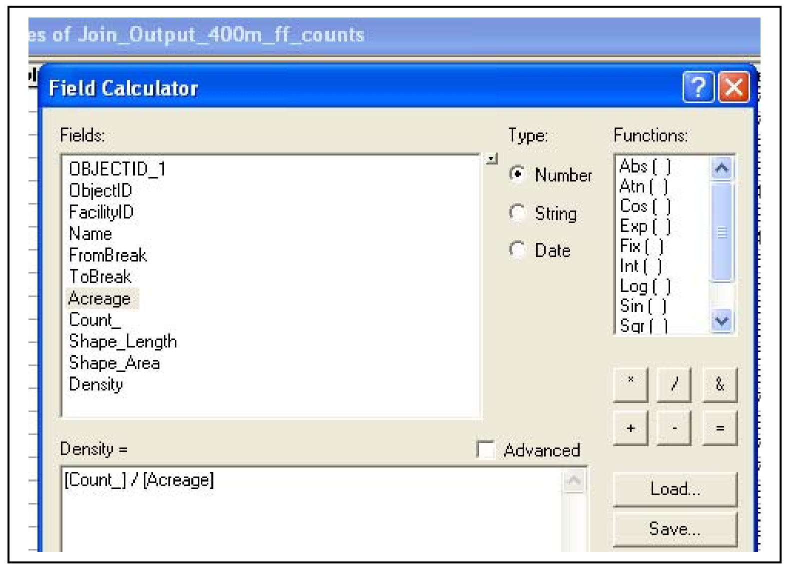
Shape	FacilityID	Name	FromBreak	ToBreak	Acreage
Polygon	1	Location 1 : 0 - 1312.33595800525	0	1312.335958	77
Polygon	2	Location 2 : 0 - 1312.33595800525	0	1312.335958	74
Polygon	3	Location 3 : 0 - 1312.33595800525	0	1312.335958	38
Polygon	4	Location 4 : 0 - 1312.33595800525	0	1312.335958	60
Polygon	5	Location 5 : 0 - 1312.33595800525	0	1312.335958	49
Polygon	6	Location 6 : 0 - 1312.33595800525	0	1312.335958	66
Polygon	7	Location 7 : 0 - 1312.33595800525	0	1312.335958	48
Polygon	8	Location 8 : 0 - 1312.33595800525	0	1312.335958	53
Polygon	9	Location 9 : 0 - 1312.33595800525	0	1312.335958	68
Polygon	10	Location 10 : 0 - 1312.33595800525	0	1312.335958	65
Polygon	11	Location 11 : 0 - 1312.33595800525	0	1312.335958	64
Polygon	12	Location 12 : 0 - 1312.33595800525	0	1312.335958	58
Polygon	13	Location 13 : 0 - 1312.33595800525	0	1312.335958	68
Polygon	14	Location 14 : 0 - 1312.33595800525	0	1312.335958	73

Figure 8: Spatial Join Process



9. **Closest Facility Analysis for Distance Values:** Two additional Closest Facility Analyses were undertaken to determine the distances from each fast food outlet to the closest school within 400m and 800m service areas, respectively. The analysis calculated the distance, measured in feet, from each fast food outlet to the nearest school along the roadway network. To obtain only fast food outlet values within the 800m service area, for example, the Default Cutoff Value was set to 2,624.671916 feet, or 800m. By establishing an impedance value, the network analysis only located fast food outlets within 800m of the closest school. The resultant distance values (Total_Length) were used as an input variable for autocorrelation analysis.

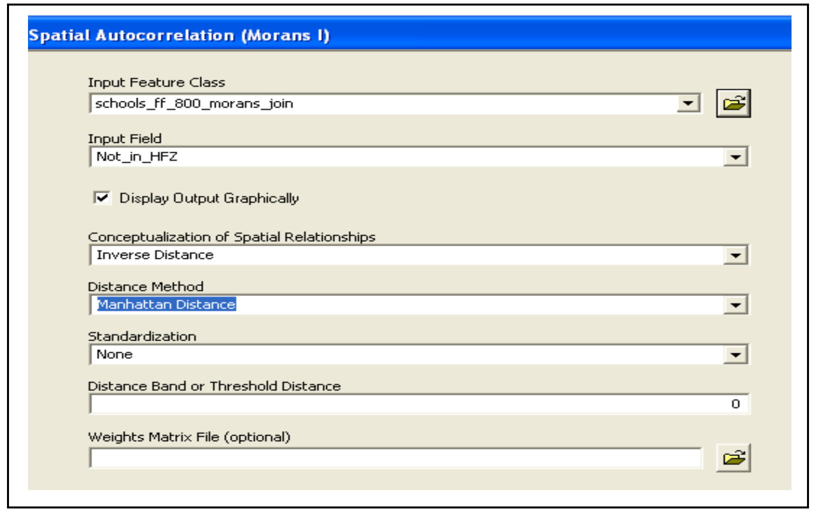
Figure 9: Service Area Acreage



10. **Spatial Autocorrelation (Moran's I Tool):** The Autocorrelation Tool was used to determine if fast food outlets cluster near schools with higher obesity rates. Two Moran's I tests were run, one for the 400m service areas and a second for the 800m service areas. Several spatial joins and table joins were used to create an attribute table with fast food outlets and the % Not Within the Healthy Fitness Zone. Spatial autocorrelation was calculated from the location of fast food outlets and measured by the % Not Within the Healthy Fitness Zone as shown in Figure 14. The Inverse Distance was used for conceptualizing spatial relationships between fast food outlets. With this setting, the spatial relationships between features decrease with distance. The Manhattan

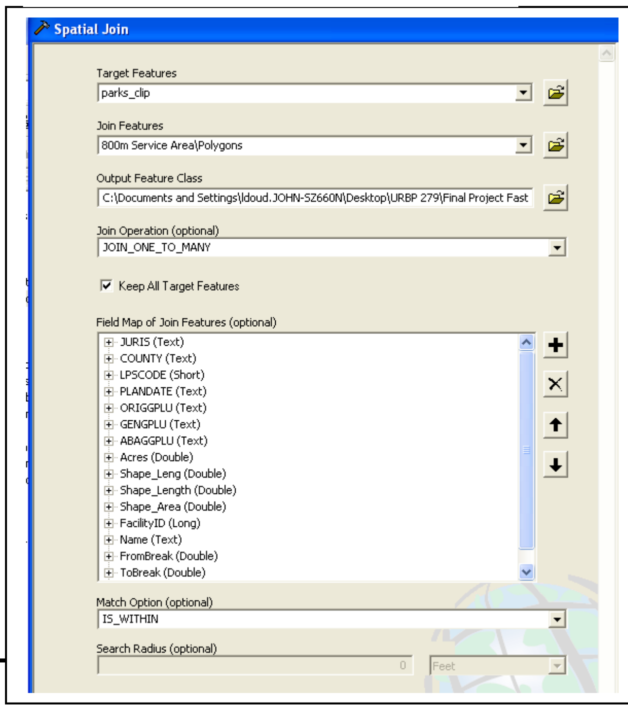
Distance method was used to measure autocorrelation. This distance method overlays a city block grid over the study area rather than using a straight line Euclidean approach. The resultant output displays a cluster matrix as well as provides the following statistics: Moran's I Index value, expected index Z-score, significance level, critical value, and variance.

Figure 10: Spatial Autocorrelation (Moran's I) Tool



11. **Parkspace Acreage:** To determine the amount of park space available within 800m of a high school, parkspace acreage had to be calculated. Santa Clara County's General Plan's Parks/Open Space designation was used as a proxy for available parkspace. The Parks/Open Space designation was selected as an attribute and exported as a new feature class. The Clip Tool was used to extract parkspace within 800m of each high school. The Spatial Join Tool was used to join parkspace with 800m school service areas as shown in Figure 15. The resultant new feature class was exported to Excel to calculate the total acreage of parkspace within the 800m service area.

Figure 11: Spatial Join for Parkspace



Appendix C: Body Composition Data for 9th Graders: Santa Clara County High Schools (2007-2008) Academic Year

School	School District	Total Tested	% in HFZ	% Not in HFZ	NSLP Participants**	Enrollment
Camden Community Day*	Campbell Union	5	*	*	53%	40
San Jose High Academy	San Jose Unified	203	52.70%	47.30%	64%	732
Willow Glen High	San Jose Unified	329	56.50%	43.50%	43%	1,068
James Lick	Eastside Union	309	59.90%	40.10%	57%	892
William C. Overfelt High	Eastside Union	456	61.60%	38.40%	64%	1,314
Fremont High	Fremont Union	486	64.60%	35.40%	33%	1,489
Downtown College Prep	Downtown College	130	65.40%	34.60%	*	*
Mt. Pleasant High	Eastside Union	467	66.00%	34.00%	42%	1,396
Gilroy High	Gilroy Unified	640	66.10%	33.90%	50%	1,919
Abraham Lincoln High	San Jose Unified	391	66.80%	33.20%	47%	1,923
Yerba Buena High	Eastside Union	414	67.10%	32.90%	60%	1,272
Oak Grove High	Eastside Union	550	70.00%	30.00%	35%	1,889
Andrew P. Hill	Eastside Union	533	70.40%	29.60%	49%	1,672
Santa Clara High	Santa Clara Unified	402	70.40%	29.60%	35%	1,406
Del Mar High	Campbell Union	323	71.20%	28.80%	4%	1,847
Independence High	Eastside Union	842	71.60%	28.40%	43%	2,664
Prospect High	Campbell Union	296	72.60%	27.40%	24%	980
Santa Teresa High	Eastside Union	669	72.60%	27.40%	14%	1,810
Pioneer High	San Jose Unified	287	72.80%	27.20%	19%	1,143
Leigh High	Campbell Union	435	73.10%	26.90%	1%	1,270
Branham High	Campbell Union	375	74.10%	25.90%	12%	1,080
Adrian Wilcox High	Santa Clara Unified	422	74.20%	25.80%	34%	1,444
Homestead High	Fremont Union	517	74.30%	25.70%	10%	1,675
Westmont High	Campbell Union	407	74.40%	25.60%	14%	1,224
Leland High	San Jose Unified	422	74.90%	25.10%	7%	1,373
Silver Creek High	Eastside Union	611	75.30%	24.70%	39%	1,849
Ann Sobrato High	Morgan Hill Unified	341	75.40%	24.60%	18%	1,206
Live Oak High	Morgan Hill Unified	296	76.00%	24.00%	25%	987
Milpitas High	Milpitas Unified	678	76.80%	23.20%	28%	2,171
Evergreen Valley	Eastside Union	673	77.90%	22.10%	13%	1,968
Piedmont Hills	Eastside Union	568	79.20%	20.80%	19%	1,659
Gunderson High	San Jose Unified	259	84.60%	15.40%	50%	832
Cupertino High	Fremont Union	437	84.70%	15.30%	6%	1,230
Escuela Popular	Escuela Popular	40	85.00%	15.00%	89%	314
Los Altos High	Mountain View - Los Altos	438	85.60%	14.40%	19%	1,281
Lynbrook High	Fremont Union	443	87.40%	12.60%	22%	1,440
Mountain View High	Mountain View - Los Altos	459	88.90%	11.10%	9%	1,344
Palo Alto High	Palo Alto Unified	398	88.90%	11.10%	5%	1,281
Monta Vista High	Fremont Union	570	89.10%	10.90%	1%	1,865
Saratoga High	Los Gatos-Saratoga Joint Unified	321	89.40%	10.60%	0%	1,021
Henry M. Gunn High	Palo Alto Unified	441	90.20%	9.80%	5%	1,412
Los Gatos High	Los Gatos-Saratoga Joint Unified	367	91.60%	8.40%	0%	1,337

Sources: "California Physical Fitness Test." California Department of Education. http://data1.cde.ca.gov/dataquest/page2.asp?level=School&subject=FitTest&submit1=Submit (accessed February 20, 2009); and "API School Level Reports." California Department of Education. http://api.cde.ca.gov/reports/page2.asp?subject=API&level=School&submit1=submit (accessed February 20, 2009).

* No data available

**National School Lunch Program 2007-2008 Data.

APPENDIX D: MODEL POLICY LANGUAGE FOR HEALTHY CITIES

The policy language below was compiled by Public Health Law & Policy as model language that can be used to implement policies that effect healthful changes within and around schools in California.[215]

- Work with school boards to encourage walkable school sites; encourage reuse of existing school sites; work to develop a proximity standard for student access to school facilities (e.g., half- to one mile).
- Pursue joint-use agreements to share facilities with schools, especially in neighborhoods that suffer a disproportionate lack of recreational facilities.
- Prioritize attention to transportation traffic around schools (funding available through the CalTrans Safe Routes to School program).
- Supplement funding for "complete streets" or Safe Routes to School program with additional funding mechanism (e.g., portion of sales tax).
- Establish a walkability standard (e.g., a quarter- to half-mile) for access to retailers/sources of fresh produce (e.g., grocery stores, green grocers, farmers' markets, community gardens).
- Utilize existing economic development incentives and/or create new incentives to encourage stores to sell fresh, healthy foods such as produce in underserved areas (e.g., tax breaks, grants and loans, eminent domain/land assembly, conditional use zoning, dedicated assistance funds for infrastructure improvements such as refrigeration and signage).
- Serve only food consistent with dietary guidelines (e.g., Dietary Guidelines for Americans) in government-owned buildings/hospitals and at government organized events.
- Encourage or require restaurants to post nutrition information for menu items.
- Offer incentives/publicity for restaurants that adopt menus consistent with dietary guidelines and/or serve locally grown foods.
- Encourage restaurants to participate in a voluntary ban on trans fats.
- Consider restricting outdoor advertisements (e.g., limiting location, size, or density) throughout the jurisdiction or in certain geographic areas (e.g., around schools).
- Consider charging stores a fee for the privilege of selling low-nutrient foods; the fee would fund activities aimed at mitigating the harmful health effects of these foods.
- Prioritize healthy food development incentives in areas with a high ratio of convenience, fast food, and liquor stores.
- Consider limiting the number or concentration of "formula" restaurants via zoning ordinance.
- Ban or limit drive-through food outlets, or those within certain geographic areas (e.g., around schools).
- Identify fast food restaurants, liquor, and convenience stores as "conditional uses" only; instate conditional use review upon lease renewal or at point of business sale.

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[215] "Model Health Language," Public Health Law and Policy, http://www.phlpnet.org/sites/phlpnet.org/files/HealthyGP_SectionIV.pdf (accessed November 2, 2009).

- Identify and inventory potential community garden/urban farm sites on existing parks, public easements and right-of-ways, and schoolyards, and prioritize site use as community gardens in appropriate locations.
- Assess and plan for local food processing/wholesaling/distribution facilities to connect local agriculture to markets such as retailers, restaurants, schools, hospitals, and other institutions.

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