

**THE FAT AND THIN OF IT: NEIGHBORHOOD ENVIRONMENT AND OBESITY
IN THE ALLEGHENY COUNTY HEALTH SURVEY**

by

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Submitted to the Graduate Faculty of
Department of Behavioral and Community Health Sciences
Graduate School of Public Health in partial fulfillment
of the requirements for the degree of
Master of Public Health

University of Pittsburgh

2014

UNIVERSITY OF PITTSBURGH
GRADUATE SCHOOL OF PUBLIC HEALTH

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ABSTRACT

Approximately 35.1% of American adults are obese. There are significant health inequities in the prevalence of obesity. African Americans, those with low incomes and low educational achievement are significantly more likely to be obese. Obesity is also a risk factor for the development of many debilitating chronic conditions; deaths due to obesity are second behind cigarette smoking. Obesity costs are also staggering. It is estimated that up to 20.6% of national health spending is used to treat obesity-related diseases. Obesity is a complex problem and neighborhood environments are increasingly being studied in relation to their impact on obesity and other health issues. This study analyzes neighborhood impacts on obesity in Allegheny County, Pennsylvania. Many neighborhoods in Allegheny County have historical patterns of immigration and deindustrialization which impact health. Using data from the 2009-2010 Allegheny County Health Survey (N=5,442), this study has two major aims. One is to analyze the relationship between the neighborhood environment and obesity in Allegheny County. To that end, bivariate and multivariate logistic regressions are performed to determine if perceived neighborhood walkability, social cohesion, and access to fresh fruits and vegetables and fast food are related to obesity. The second major aim is to determine how perceived social support moderates these relationships. Specifically, does the neighborhood environment have a greater or lesser effect on obesity among those who report greater levels of social support? Results indicate that perceived

neighborhood walkability is significantly associated with obesity in Allegheny County, while perceived neighborhood social cohesion and access to fresh fruits and vegetables and fast foods are not significantly associated with obesity. Additionally, perceived social support moderates the relationship between perceived neighborhood walkability and obesity, but not perceived neighborhood social cohesion. Additionally, results are interpreted through the lens of historical processes which have affected Allegheny County, such as immigration, urban renewal, and deindustrialization.

Public Health Significance: For those who perceive their neighborhoods to have low walkability, community development efforts to improve walkability as well as social support may help to lessen the probability of being obese.

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1.0 INTRODUCTION

Obesity is one of the most important causes of avoidable chronic disease and subsequent health care costs in this country.¹ Obesity is a risk factor for the development of many chronic conditions, including: diabetes,²⁻⁵ heart disease,³⁻⁵ high blood pressure,³⁻⁵ metabolic syndrome,⁵ osteoarthritis,^{3,5} sleep apnea,⁵ and certain forms of cancer.^{3,5} Obesity raises the risks for all of these conditions and makes treatment more complicated.² Deaths due to obesity are second behind cigarette smoking and are estimated to range between 112,000 and 300,000.⁶

Between 2011 and 2012, approximately 35.1% of American adults were obese.⁷ African Americans were significantly more likely to be obese (47.8%) as compared to whites (32.6%).⁷ Among women, there were also health inequities related to obesity. African American (56.6%) and Hispanic women (44.4%) were significantly more likely to be obese as compared to white women (32.8%).⁷ Additionally, among African Americans, women were more likely to be obese (56.6%) as compared to men (37.1%).⁷ Additionally, those with less income and education were more likely to be obese as compared to wealthier and better educated individuals.⁸

Annual medical costs related to obesity are estimated to be between \$147 billion⁹ and \$210 billion.¹⁰ If the latter is accurate, then 20.6% of national health spending is used to treat obesity-related diseases.¹⁰ If the prevalence of obesity decreased one percentage point from the expected trend, 2.9 million fewer adults would be obese by 2030. In addition, the United States

would save \$9.5 billion annually in excess medical costs. Thus, tackling the obesity epidemic would yield health and economic benefits.²

While poor diet and lack of exercise are often blamed for the obesity epidemic,^{11,12} interventions focused on these behaviors have not improved the situation.^{13,14} This focus on health behaviors may not be effective because people exist within physical and social environments.⁴ People develop behaviors through their interaction with the physical and social environments in which they live, work, and play.^{15,16} Ignoring these contexts can result in ineffective behavioral interventions.^{14,15} Therefore, environmental factors, such as neighborhood environments,^{13,14} transportation habits, and work environments, are being investigated in relation to their effects on obesity.¹⁴ Neighborhoods can conceivably impact health through their physical and social characteristics.¹⁷ Evidence increasingly indicates that neighborhood environments are associated with the prevalence of overweight/obesity.¹⁸⁻²¹ Neighborhood environments can affect people's access to healthful foods and safe locations in which to engage in physical activity.^{19,21} Access to stores with healthful foods, exercise facilities, and neighborhood safety are not only important for understanding disparities in obesity,^{19,21} but they are also distributed disadvantageously for racial/ethnic minorities and those with low socioeconomic status (SES).^{13,19} In addition to measures of access to healthful foods and safe places to exercise in the neighborhood, other neighborhood features have been measured in relation to obesity, physical activity, or diet. These include access to: health services,²² public transportation,²² monuments (historical or otherwise),²² and green space (such as parks).²² Other potential causes of soaring obesity rates include sedentary occupations,⁵ wide availability of processed foods,²³ and increased prevalence of devices²³ that decrease the need for physical

activity.⁵ Only with a broad view of the determinants of obesity can we hope to adequately address this epidemic.⁴

It may be more challenging to change isolated individual behaviors than to change environments that promote the unhealthy behaviors.¹⁵ An emphasis on environmental factors does not mean that behaviors are unimportant. Rather, researchers should use a more complete model for obesity causes that includes neighborhood characteristics, such as lack of sidewalk and poor access to food and green spaces, that make it more likely that individuals will develop these unhealthy habits.¹⁵

In this thesis, the importance of the relationship between neighborhood environments and obesity is described, as well as a review of the literature pertaining to the relationship between neighborhood walkability, social cohesion, access to healthful foods, and obesity. Furthermore, the potential moderating effect of social support on this relationship is discussed. Issues of the measurement of obesity and neighborhood environments as well as theories used to explain the observed relationship between neighborhoods and obesity (or the health behaviors related to obesity) are examined. Then, the proposed biopsychosocial mechanisms that may link neighborhood environment and obesity are discussed. The explanatory model developed by Diez-Roux and Mair¹⁷ is used to explain the pathways through which neighborhood environments affect obesity. Additionally, the historical and socio-political context of Allegheny County that may influence residents' current levels of obesity is considered.

Data for this study comes from the Allegheny County Health Survey.²⁴ The relationship between perceived neighborhood walkability, access to healthful foods, social cohesion, and obesity are analyzed. Analysis is conducted to determine if these relationships are moderated by individual-level social support. Specifically, does the neighborhood environment have a greater or

lesser effect on obesity among those who report greater levels of social support? The overarching goal of this study is to address how the perceived neighborhood environment is affecting obesity in Allegheny County.

2.0 RELATIONSHIP BETWEEN NEIGHBORHOOD ENVIRONMENT AND OBESITY

Neighborhoods can both foster and hinder healthy behaviors and experiences, such as engaging in physical activity in one's neighborhood,^{13,15} eating healthful foods,²⁵ and having friendly relations with neighbors.¹⁵ Below, I briefly discuss the connections between neighborhood walkability, social cohesion, and access to healthful foods and obesity.

2.1 NEIGHBORHOOD WALKABILITY AND OBESITY

Some of the many factors that can affect physical activity within the neighborhood are: presence of gyms or other recreational facilities,^{6,13,15} land use mix,^{13,15} the presence and quality of sidewalks^{6,13,15} and bicycle lanes,¹⁵ street connectivity,¹³⁻¹⁵ and the aesthetics of the neighborhood,^{13,15} including access to green spaces.^{14,15} Access to green spaces can improve individuals' physical activity levels, but it can also help to relieve stress and help individuals to recover more quickly from stressful experiences.¹⁵ This may be important in part because elevated stress levels can change the way a person eats. At least 40% of people increase and around 40% or less decrease their caloric intake when they experience stress.²⁶ Yet, stress leads to cortisol release, which often results in the concentration of fat in certain areas of the body,

such as the midsection.²⁷ This is especially true if eating and physical activity habits do not change.

People who live in neighborhoods with poor walkability are more likely to be overweight than those who live in walkable neighborhoods.¹³ Additionally, research has indicated that those who live in walkable neighborhoods walk significantly more than those who live in less walkable neighborhoods.¹³ While the cross-sectional evidence for an association between neighborhood walkability and obesity or physical activity behaviors is mixed, most research does show a relationship between low walkability and overweight/obesity.^{17,18,28}

2.1.1 SES and neighborhood walkability

Those who have a low SES are more likely to be inactive. However, lack of opportunities for physical activity in the neighborhood could contribute to this inactivity.²⁸ Poor neighborhoods tend to provide fewer opportunities for exercise than middle-class or wealthy neighborhoods. Furthermore, poor communities may be unpleasant or unsafe to walk in. This could lead residents of poor neighborhoods to be physically inactive.¹³

Interestingly, the neighborhood design of poor neighborhoods can promote walking better than in middle-class and wealthy neighborhoods,¹³ the latter of which often promote greater car use for transportation.²⁹ Walking is commonly reported in poor neighborhoods.¹³ Mixed land use³⁰ and high population densities in inner cities^{30,31} have been linked to greater levels of walking for transportation as compared to areas characterized by urban sprawl.^{30,31} Individuals with low SES rely on public transportation in general and to travel outside of their neighborhoods.^{13,31} Use of public transportation has been linked to greater walking. For

example, public transportation riders need to walk to and from transit stops and often between transit stops.³²

2.2 ACCESS TO HEALTHFUL FOODS IN THE NEIGHBORHOOD AND OBESITY

Individual eating habits impact one's probability of becoming obese.²³ Consumption of adequate amounts of fresh fruits and vegetables is associated with lower body weight.³³ Additionally, regular consumption of fast foods is associated with higher body weight.^{3,34} The cost and availability of healthful foods and the marketing of food can impact dietary patterns and, subsequently, obesity.^{6,15} Individuals' ability to make healthful food choices is greatly improved when their environment provides access to affordable healthy foods.²³ Studies often analyze neighborhood access to healthful foods by measuring the presence – or lack thereof – of supermarkets and fast food restaurants.²² Both tend to be differentially located based on neighborhood SES.^{15,34,35}

2.2.1 Neighborhood access to fruits and vegetables

Poor neighborhoods often lack stores where individuals can purchase affordable and healthful foods.¹³ Neighborhood access to supermarkets may be related to healthier diets in general and more fruit and vegetable consumption in particular.^{23,25,33} As compared to other types of stores that sell food (e.g. small grocery stores and convenience stores), supermarkets sell a wide array of food at the most affordable price.²³ Greater access to supermarkets is associated

with lower odds of obesity and more access to convenience stores is associated with higher odds of obesity.³⁴

There are inequities in access to supermarkets, which are more common in wealthier, predominantly white neighborhoods than in poorer and African American neighborhoods.³⁴ Therefore, it is not surprising that those who live in poor neighborhoods tend to eat fewer fruits and vegetables and are more likely to be obese.²⁵

2.2.2 Neighborhood access to fast food

While they seem to be everywhere,³⁶ poor neighborhoods are more likely to have fast food outlets as compared to wealthier neighborhoods.^{34,35} Eating more fast food is likely related to obesity.³⁴ However, research analyzing neighborhood availability of fast food is mixed.³⁴ Several studies have shown that increased neighborhood access to fast food is associated with increased prevalence of obesity.^{3,22} Other studies found no relationship or a weak relationship between the number of fast food restaurants in a neighborhood and odds of obesity or an unhealthy diet.^{36,37} Caspi et al. suggested that this could be due to the fact that fast food restaurants are pervasive in the United States. Or, individuals' food preferences predict fast food consumption more than access to fast food restaurants.³⁶

2.3 NEIGHBORHOOD SOCIAL COHESION AND OBESITY

Chaix defines neighborhood social cohesion as “relationships characterized by the presence of interpenetrated networks of neighbors and feelings of attachment and belonging to

the neighborhood.”³² (p. 89) Interpenetrated networks are related to what Freudenberg termed the “density of acquaintanceship”,³⁸ (p. 29) the “average proportion of people in a community known by the community’s inhabitants.”³⁸ (p. 30) If the density of acquaintanceship is interpenetrated, then individuals in various parts of the community (e.g. residents, business owners, teachers, police officers, and others) will be acquainted with one another and will be able to provide support to one another.

Higher levels of neighborhood social cohesion are related to: lower obesity prevalence,¹⁴ lower stroke mortality,³⁹ and lower acute myocardial infarction (heart attack) mortality.⁴⁰ While neighborhood social cohesion in and of itself may not be directly related to individuals’ nutrition and physical activity habits that can lead to obesity, neighborhood context may give rise to or strengthen existing social norms concerning appropriate behavior.¹⁵ Neighborhood social cohesion may be indirectly related through the influences and habits of neighbors^{4,32} or through protective or harmful stress effects.^{14,15}

Social cohesion is related to the built environment. The pleasantness and attractiveness of public spaces, as well as home design, may impact the level of social cohesion within a neighborhood.¹⁵ Additionally, if residents have places where they can easily walk, they will be more likely to have social interactions with neighbors.³²

2.4 IMPORTANCE OF POTENTIAL RELATIONSHIP BETWEEN SOCIAL SUPPORT AND OBESITY

Social support appears to be related to general health,⁴¹ and integration in social networks has been associated with the prognosis of specific diseases, such as heart disease^{42,43} and

cancer.⁴² Social support may impact health through its impact on behaviors, emotions, and thoughts.⁴⁴ Those with high levels of social support tend to live longer and have less cognitive decline as they age⁴² and are less likely to die of all causes as compared to those with lower levels of social support. Kawachi et al. found that the impact of poor integration in social networks on total mortality may be similar to that of cigarette smoking on total mortality.⁴⁵

Diverse social networks improve the outcomes for those who have been diagnosed with, or are at risk of developing, chronic diseases.⁴² In the case of cardiovascular disease, for which obesity is an important risk factor,⁴⁶ the lack of social support is significantly related to increased mortality and morbidity, independent of other known risk factors for mortality in both short and long-term periods after having a heart attack.⁴⁷

Mookadam and Arthur found in their review of social support and its effect on mortality after a heart attack that there was a 2 to 3 times increase in excess mortality in those with the lowest levels of social support as compared to the highest. However, there was little difference in unnecessary mortality between those with moderate and high social support levels.⁴⁷

Obesity tends to cluster among people within a social network. The probability of obesity increases dramatically if a friend becomes obese.^{48,49} Therefore, weight loss interventions that focus only on individuals, without considering their social networks, tend to fail.⁴⁹

According to Thoits, social support may impact health through numerous mechanisms: “social influence/social comparison, social control, role-based purpose and meaning..., self-esteem, sense of control, belonging and companionship, and perceived support availability.”⁵⁰ (p. 145) Below is a general description of these proposed pathways. All descriptions are derived from Thoits.⁵⁰

Social influence/social comparison: People often compare their attitudes, beliefs, and behaviors to their peers and will often change their own if they do not match those of the group.

Social control: Peers can exert pressure on individuals to change behaviors. This pressure can be positive when peers are encouraging healthful activities, such as engaging in physical activity or eating healthful foods. However, this pressure can be seen as dominating. On the other hand, peer pressure can be used in an attempt to induce unhealthy behaviors.

Role-based purpose and meaning: This concept refers to the belief that one has a purpose and meaning in life not only for oneself but also to specific individuals - the feeling of being important to others.

Self-esteem: This refers to feelings of self-worth and competence.

Sense of control: This is the sense that one has the ability to accomplish tasks and that one has control of one's life generally.

Belonging and companionship: This refers to feeling accepted by one's family and/or peers. This relates to a sense of security that can be provided by the group. Additionally, one has others with which to spend time.

Perceived support availability: This refers to the perception that social support has been provided to one in the past and will likely be provided in the future.⁵⁰

While social support can be very beneficial, it can be detrimental. Recipients may feel indebted to those who help them. In addition, recipients may feel that they are incapable of solving their problems and have lowered self-esteem as a result.⁵¹ Social support can be seen as nagging.⁵² Nevertheless, social support is related to decreased morbidity and mortality.^{42,45,47}

Vitaliano et al. described an added value hypothesis of social support which argues that social support is more beneficial for health in individuals with low income as compared to those

with higher incomes.⁵³ They tested this hypothesis in a longitudinal study of older adults in relation to cardiovascular health. They found that emotional support was significantly related to cardiovascular health 15-18 months after the start of the study.⁵³

2.4.1 Social support and weight loss interventions

Social support is a major element of behavioral weight loss programs.⁵⁴ However, measurement of social support constructs in evaluations of weight loss programs is infrequent.⁵⁴ Obesity interventions that incorporate social support often impact structural support, which is the availability of individuals who could provide social support.⁵⁵ However, functional support appears to be more correlated with health than structural support is.⁵⁵ Functional support is the perceived availability of support for specific functions (such as physical assistance and affection) while structural support is the availability of individuals within one's social network who potentially could provide support (such as spouses and the number of individuals within one's social network).^{41,55} Verheijden et al. argue that, while functional social support is the most important for health, it is impractical for health interventions to be designed with a goal of attempting to improve individuals' perceived functional support. It is more feasible to improve structural social support by using peer support groups or health professionals.⁵⁵ Additionally, Cohen et al. suggest that perceived social support is likely more important to health outcomes than the actual receipt of social support.⁴⁴

Kumanyika et al. found in their study of a weight loss intervention for obese African Americans that the most successful participants had friends or family participating alongside them who were actively engaged in the intervention and also lost weight.⁵⁶ Ball et al. included a measurement of social support to engage in healthful behaviors (physical activity and nutrition)

in their study of low income women who were able to maintain a healthy weight.⁵⁷ They found that social support for physical activity and nutrition was positively associated with self-efficacy for healthful eating and physical activity.⁵⁷ Kiernan et al. found in their study that women who had the most regular support from family and friends for engaging in healthful behaviors were significantly more successful at weight loss as compared to those who never experienced support from family and friends.⁵⁴

Oliveira et al. used the nineteen question version of the Medical Outcomes Study Social Support Scale (MOS-SSS) to study the relationship between social support and leisure-time physical activity.⁵⁸ Oliveira et al. found that social support was more important for the commencement of a physical activity regimen as opposed to maintenance of physical activity behaviors.⁵⁸

Research has also been conducted to analyze the success of support groups in managing obesity. Livhits et al. determined in their literature review of post-bariatric surgery support groups that participating in support groups may be related with successful weight loss after bariatric surgery.⁵⁹

2.4.2 Perceived social support, obesity, and neighborhood environments

There is evidence that that individual-level social support is associated with overall health and prognosis of conditions, such as cardiovascular disease^{40,45,47} and stroke,³⁹ for which obesity is an important risk factor.⁴⁶ Additionally, obesity may spread through social networks.⁴⁸ Therefore, it is plausible that perceived social support could moderate the relationship between the neighborhood environment and obesity. Individuals' social networks can be geographically based. DeGuzman and Kulbok developed a model of the relationship between the built

environment and health, which posits that individual level characteristics, such as health behaviors and social support, are the links between neighborhood environments and health outcomes.⁶⁰ It is conceivable that individuals who perceive that their neighborhoods have poor walkability may be less likely to be obese if they also perceive that they have strong social support. They may be able to call on others who can babysit while they go out to walk. Or, they might have someone to walk with, which could make exercise more enjoyable. Exercising with others may make it more likely that individuals will meet the recommended physical activity guidelines.⁶¹ Additionally, if they have strong social support, they may be more aware of resources available in their communities, such as exercise facilities and pleasant places to walk in the neighborhood.⁶⁰

2.5 MEASUREMENT OF BODY FAT

The literature on neighborhood environment and health includes analyses of the effectiveness of different measurements of body fat, including: percentage body fat - measured by dual x-ray absorptiometry,⁶² Body Mass Index (BMI),⁶²⁻⁶⁴ waist circumference (WC),⁶²⁻⁶⁴ and waist-height ratio (WHTR).^{62,64,65}

Flegal et al. studied the correlation of different measures of body fat (BMI, WC, WSR, and percent body fat - measured by dual-energy X-ray absorptiometry) in the National Health and Nutrition Examination Survey (NHANES). While Dual-energy X-ray absorptiometry (DXA) is one of the most exact measures of total body fat, it requires special equipment,⁶² which makes it expensive and inconvenient to use in most studies of body fat. However, because of its precision and accuracy, it is a good method to compare the other measurements to in order to

determine their precision and correlation with the results of DXA. They found a gender difference. Percentage body fat was slightly, but significantly, more associated with waist circumference than BMI in men, but significantly more associated with BMI than waist circumference in women. While these differences were statistically significant, they were small. Flegal et al. argue that BMI, waist circumference, and weight to height ratio agree enough that they can all adequately classify people into broad categories that relate to categories of body fat.⁶²

Associations between BMI and percentage body fat varies by sex, age, and race/ethnicity. Health outcomes may be affected differently by body fat, waist circumference, and weight-to-height ratio. Results of analyses may differ based on study outcomes and the characteristics of study participants.⁶² Janssen, et al. compared WC and BMI in relation to their prediction of obesity-related diseases in the NHANES. They found that when WC was included in the model as a continuous variable, WC and not BMI, explained the health risks of obesity. However, BMI remained a significant indicator of health risks when WC was dichotomized into high and low.⁶³

Waist to height ratio has been offered as a good alternative to BMI as a measure of body fat. BMI categories may need to differ based on race/ethnicity in order to accurately measure overweight and obesity. It has been suggested that Asians and Caucasians need to have different BMI categories.⁶⁵ Waist to height ratio, however, applies equally well to all races and ethnicities. It is also relatively simple to measure. However, the measurement should take place with a researcher conducting the measurement of waist circumference in order to avoid incorrect waist measurements.⁶⁵ Therefore, it may not be practical for all research.

Bosy-Westphal et al. found that BMI, Waist Circumference, and percent body fat were equally predictive of obesity-related metabolic risks.⁶⁴ Therefore, while body fat estimates based

on BMI or waist circumference may be inaccurate for individuals, they both indicate body fatness at the population level.^{62,64}

BMI does have its critics. Booth, Pinkston, and Poston argue against using self-reported BMI in studies about obesity since individuals tend to underreport their weight, especially those individuals with low SES. They recommend directly measuring height and weight as well as incorporating waist circumference and other body measurements when possible.¹³ This is obviously only feasible in studies where measurements can be taken face-to-face. Many surveys are conducted via telephone because it is a quick way to gather information and it is less expensive than face-to-face interviews.⁶⁶ While some studies use measured height and weight to measure BMI,¹⁹ Spencer et al. argue that self-reported height and weight is accurate enough to be valid for use in epidemiological studies.⁶⁷

Several studies analyzing the relationship between neighborhood environment and obesity or behaviors that have been linked to higher odds of obesity (e.g. physical activity levels) have included both waist circumference and BMI.^{21,22,68} Others have solely used self-reported BMI in analyses.^{29,69}

2.6 MEASUREMENT OF NEIGHBORHOOD ENVIRONMENT

There is discussion about whether it is best to directly measure neighborhood environments through observer report or GIS systems or if measurements of perceptions are sufficient.^{32,70} All have been used in studies of the neighborhood environment and obesity or the health behaviors directly related to obesity (physical activity and eating habits).⁷⁰ Additionally, there are disagreements about the appropriate definition for neighborhoods.³²

2.6.1 Observations of neighborhood environment

Observations of neighborhood environments usually involve researchers directly observing neighborhood environments. Observers may walk or drive through a neighborhood in order to observe and quantify neighborhood characteristics such as presence of tree-lined streets, sidewalk width and condition, graffiti, and home and landscape maintenance.⁷⁰

Observation is time and resource-intensive. However, it may be an appropriate method to select if the look and feel of a neighborhood are important to the research questions.⁷⁰ However, it is more difficult for observation to capture intermittent evidence of social disorder (such as public drunkenness). Additionally, constructs such as neighborhood identity³² and social cohesion⁷¹ are not completely visible by observation.^{32,71} Researchers risk misinterpreting the importance of objective neighborhood observations if they do not also measure residents' perceptions of the neighborhood environment.⁷¹

2.6.2 Perceptions of neighborhood environment

Same-source bias can exist when individuals evaluate their own neighborhood environments.^{71,72} However, Chaix argues that perceptions of the neighborhood environment do not measure the same constructs as objective measures of environmental variables and are, therefore, important to measure in and of themselves. Perceptions are cognitive assessments of the neighborhood environment and influence individuals' behavior. For example, if individuals perceive their environment as unsafe, they may report lack of access to exercise facilities even if they are present in the neighborhood.³²

There is evidence that, while both objective and subjective perceptions of the neighborhood environment are associated with health when analyzed individually,²⁹ perceptions of neighborhood environment may be more strongly associated with health than objective measurements.^{29,73} Additionally, seeking individuals' perceptions of neighborhood environments can result in the measurement of quality, access, and appropriateness of neighborhood resources, which GIS systems and commercial listings cannot and objective measurements may not do adequately.

2.6.3 Geographic Information Systems (GIS) and other lists

GIS is the “integration of software, hardware, and data for capturing, storing, analyzing and displaying all forms of geographically referenced information.”⁷⁴ GIS is appropriate to use when analyzing neighborhood environments across very large areas.⁷⁰ GIS has been used to provide measurements of many variables, including: land-use mix, street patterns, public transportation, access to exercise facilities, and presence of sidewalks.⁷⁰

The use of GIS has several limitations. Like observational methods, use of GIS can be time and resource-intensive. Additionally, data may not be up-to-date or completely accurate. GIS can approximate the *quantity* of some neighborhood feature (e.g. parks or exercise facilities) but not the *quality* of these features. Finally, in many areas, there is limited access to GIS technicians.⁷⁰

2.6.4 Definitions of neighborhood

Studies have used different definitions of “neighborhood”.³² Neighborhood boundaries are subjective. Many researchers use boundaries that are used by common secondary sources, such as census tracts. This allows boundaries to be identified relatively easily and permits secondary data sources. However, neighborhood residents may not perceive the size of their neighborhoods to be consistent with census tract boundaries.⁷⁵

Some studies of the relationship between neighborhood environment and obesity or obesity-related health behaviors utilized census tracts,⁷⁶ which are portions of counties that include approximately 4,000 individuals;⁷⁶ neighborhood clusters,⁷⁶ which are groups of contiguous neighborhood blocks;⁷⁶ or census block groups.^{3,6} Block groups are divisions of census tracts that usually contain 660 to 3,000 individuals in a contiguous area.⁶ Others measured the environment at the county level²⁹ or zip code tabulation areas, which are census approximations of postal service zip codes.³⁷ Another used a one kilometer radius around participants’ addresses.⁷⁷

Studies provided participants with different definitions of neighborhood. Some asked participants to answer questions about their neighborhood in relation to a one mile radius^{18,76} and/or 20 minute walking distance from their home.¹⁸ Chaix, however, suggests that neighborhoods should be considered as exposure areas. In order to do this, Chaix advises defining neighborhood boundaries based on the ten local locations where study participants frequent. This will enable researchers to measure what individuals are exposed to in their local environments.³²

Several of Pittsburgh’s neighborhoods are composed of several different census tracts. Only about 25 of Pittsburgh’s 90 neighborhoods are made up of just one census tract. For

example, Bloomfield is made up of five census tracts, Brighton Heights three, East Liberty three, Highland Park three, Mount Washington four, and Shadyside five.⁷⁸ When asked, individuals will say that they are from Bloomfield, Highland Park, or Mount Washington. Pittsburgh residents understand where these neighborhoods are even though they may not know the exact census tract where the individual resides (P. Documét, MD, DrPH, oral communication, June 2014).

3.0 THEORIES USED FOR ANALYZING RELATIONSHIP BETWEEN NEIGHBORHOOD ENVIRONMENT AND OBESITY

Several theories have been used to try to understand the relationship between neighborhood environment and health and some researchers have utilized theoretical models developed specifically for the purpose of the study. Some of the literature pertains to neighborhood environments and healthy behaviors that impact obesity, such as healthful eating and physical activity. Not all of the articles that explicitly used established theory featured neighborhood environments prominently. They were included below if they included neighborhood food and exercise environments in any capacity.

Articles reviewed for this thesis which described studies that analyzed the theoretical linkages between neighborhood features and health include research on both adolescents^{68,79} and adults.⁸⁰ Research studies were conducted in many different locations: the Southern United States,⁷⁹ New Zealand,⁶⁸ and Korea.⁸⁰ The outcomes included: physical activity levels,^{68,80} nutrition,⁸¹ and obesity.^{79,82} Theories used in studies, as well as to guide literature reviews, include: social ecological models,^{79,82} models of the Life course perspective,⁸¹ embodiment theory,⁷⁹ and the Theory of Planned Behavior.^{68,80}

3.1 SOCIAL ECOLOGICAL MODELS

Social ecological models are based not on one theory per se but on an overarching multidisciplinary paradigm that connects fields including: ecology, psychology, sociology, and public health.⁸³ Stokols argued that there are at least five core principles of social ecological models. First, they posit that environments have multiple dimensions on physical, social, and cultural levels. These multiple environments act in an interactive fashion to impact health. Second, individuals' personal attributes, such as genes, psychological characteristics, and behaviors interact with the environment and affect health. Third, they incorporate concepts from systems theory, such as mutual influence. For example, people's health is impacted by the healthfulness of their environment. However, people can also impact the health of their environment by taking personal or collective action to improve the environment. Fourth, the models emphasize the interdependence of the environment within their own settings and with higher-level factors, such as laws and policies. Fifth, they are "inherently interdisciplinary".⁸³ (p. 286) They integrate: public health's community prevention strategies, medicine's patient-specific treatment strategies, and behavioral and social science's emphases on individuals' and groups' role in behavior change; theories of the relationship between individuals and their environments; and the importance of evaluating the return on investment and social effects of health interventions.⁸³

Below, I describe how social ecological models have been used in the literature that analyzes the relationship between neighborhood environments and obesity or the health behaviors that impact obesity.

3.1.1 Ecological theory

Sweat and Denison developed ecological theory in order to hypothesize how best to reduce HIV in developing countries.⁸⁴ This theory posits that multiple upstream and downstream levels interplay to influence an individual's risk of HIV. These levels include:

- Superstructural (e.g. class and race relations)
- Structural (policies and laws)
- Environment (e.g. the built environment)
- Relational (e.g. family support)
- Individual (e.g. personal knowledge and attitudes)⁷⁹

This theory has been used to study obesity/overweight among African American adolescents in a rural town in Georgia.⁷⁹ In this qualitative study, Scott and Wilson found that there was a perception that the upstream factors of racial and socio-economic tensions as well as poor access to healthful foods and low-cost exercise and recreational facilities where youth could be physically active contributed to the African American adolescents' higher prevalence of obesity. Even if recreational centers existed in the area, there were fees in order to use the facilities. These fees put participation out of the youths' reach.⁷⁹ The authors argued for more research on how racial and class tensions, as well as the environment, become embodied as obesity. In addition, they argued for interventions that incorporate multiple ecological levels in order to have maximum impact.⁷⁹

3.1.2 Ecological Systems Theory

Galvez, Pearl, and Yen utilized Ecological Systems Theory to guide their literature review of the strength of the association between the built environment and childhood obesity.⁸² Ecological Systems Theory (EST) is based on the work of Bronfenbrenner.⁸⁵ As with other social ecological models, EST emphasizes the importance of taking the environmental context into account when considering human health.⁸⁶ Bronfenbrenner argued that many different contexts impact child health, either through direct impact on the child or indirectly by impacting parents, who then impact their children. These contexts that affect children directly include: hospital and medical care, day care, the children's peers, and school. Those that primarily impact the parents are: the workplace, the state of un/employment, maternal employment, parental support networks, and the community within which the family lives.⁸⁵

Galvez, Pearl, and Yen reviewed articles that focused on: diet, physical activity, active commuting, neighborhood walkability, obesity, and neighborhood safety in relation to childhood obesity. Results of the studies reviewed were mixed. However, they concluded that evidence was sufficiently strong to recommend that EST be used in future studies of childhood obesity.⁸²

3.2 LIFE COURSE PERSPECTIVE

The Life Course Perspective explains patterns in health, especially inequities, throughout the life course, as well as through multiple generations. It acknowledges broad social ecological factors as underlying causes of health inequities for a variety of diseases.⁸⁷

Key concepts of the Life Course Perspective are: pathways/trajectories, early programming, critical or sensitive periods, cumulative impact, and risk and protective factors. All of the following descriptions were derived from Fine and Kotelchuck.⁸⁷

Pathways/Trajectories refer to the health patterns of populations based on exposures, both positive and negative, throughout the life course.

Early Programming refers to the notion that experiences that occur early in life (in utero and early childhood) have profound implications for health throughout the lifespan.

Critical or sensitive periods are periods in which the impact of experiences on health may be the greatest. These may occur throughout the lifespan, but are often thought of as occurring early in life.

Cumulative Impact is the hypothesis that many negative exposures or experiences over a period of time can impact health, health behaviors, or “health service seeking changes.”

Risk and Protective Factors are those factors that may protect or endanger an individual’s or a community’s pathways/trajectories. These factors include those on all levels of the social ecological model: individual, family, neighborhood/community, and policy.⁸⁷

While there is substantial evidence and support for the Life Course Perspective,⁸⁸ there are critiques of the theory.⁸⁷ It could lead to misguided fatalism through the thought that those who experience negative exposures have no hope of achieving optimal health and to an excess of interventions during early life and few interventions for those at older ages.⁸⁷

As a result, Fine and Kotelchuck suggest adding two additional concepts, interactive processes and lifelong development/lifelong intervention. Interactive processes suggest that health develops over a lifetime through the interactions of one’s genes, behaviors, and the

environment. Lifelong development/lifelong intervention refers to the belief that risk and protective factors can be reduced or enhanced throughout life in order to improve health.⁸⁷

3.2.1 Timeline, Timing, Equity, Environment (T2E2) Model

The T2E2 is a model that was developed by Fine and Kotelchuck⁸⁷ and is based on the Life Course Perspective. The main constructs of this model are: timing, timeline, equity, and environment.⁸¹ *Timeline* refers to the fact that exposures an individual encounters at one point in time can affect the health of that person in the future. *Timing* refers to the critical periods of exposure. While harmful or beneficial exposures are important for health during all periods of life, there are certain periods of time when the effects may be magnified. These times include: preconception and pregnancy, infancy, and adolescence. *Equity* refers to the fact that inequality is not caused solely by genetics and personal choice. *Environment* refers to the broader environment (including factors such as policies and the neighborhood environment) that affects people's ability to be healthy.⁸⁷

Herman and colleagues used T2E2 to examine the effects of nutrition on individuals throughout their life span.⁸¹ While much of their article focused on how specific nutrients relate to the model, they discussed the neighborhood food environment during their explanation of the constructs of *equity* and *environment*. Inequitable access to healthful foods includes the existence of food deserts and food swamps, which are often located in poor areas. Food deserts are areas where there are few, if any, grocery stores while food swamps are areas where individuals *can* purchase food, but it is unhealthy food.⁸¹

3.3 EMBODIMENT THEORY

The study conducted by Scott and Wilson,⁷⁹ mentioned above, incorporated embodiment theory. Embodiment is defined by Krieger as “how we...literally incorporate, biologically, the world in which we live, including our societal and ecological circumstances.”⁸⁹ (p. 351) Scott and Wilson found in their study that the racial and socio-economic tensions rampant in the town added a large amount of stress to the African American adolescents’ lives. Chronic stress has been shown to impact physiological systems that can then lead to disease.^{8,20,21,90-95} Scott and Wilson found evidence that the community perceived that racial and class tensions were related to the African American youths’ high prevalence of overweight and obesity through the stress that these factors caused. This coincides with embodiment theory, since stress is a key component in how social disadvantage becomes embodied.^{79,96}

3.4 THEORY OF PLANNED BEHAVIOR

Lee and Shepley studied the social, personal, and perceived environmental factors associated with recreational walking among Korean adults by utilizing the Theory of Planned Behavior. They measured four Theory of Planned Behavior constructs: attitude (towards walking), subjective norms, intention to walk, and perceived behavioral control. Their measures of the neighborhood environment included items regarding: presence of exercise facilities, aesthetics, traffic safety (such as the presence of sidewalks), and feelings of safety. They measured individuals’ intention to engage in leisure time physical activity. Consistent with the Theory of Planned Behavior, the TPB constructs attitude towards walking during leisure time,

subjective norms, and perceived behavioral control were associated with intention to walk. In turn, intention to walk had a direct effect on walking behavior.⁸⁰ These results are important because it gives further evidence of potential mechanisms linking neighborhood environments and the healthy behaviors that impact obesity. A knowledge of such mechanisms can provide insight into how to design effective obesity interventions.⁸⁰

Maddison et al. incorporated measures of perceived and actual built environment features and individual features with the Theory of Planned Behavior in order to study adolescents' physical activity behaviors in two high schools in Auckland, New Zealand.⁶⁸ In this study, they measured the same Theory of Planned Behavior concepts as Lee and Shepley - attitude (towards physical activity), subjective norms, perceived behavioral control, and intention. They measured the neighborhood physical activity environment by measuring participants' perceptions of the environment. They also used Global Information Systems (GIS) to map neighborhood walkability and access to exercise facilities. Finally, they measured perceived and actual physical activity (actual physical activity was measured by using actigraph accelerometers which participants wore for four consecutive days, including two weekend days).

They found that, as compared to perceived environmental features, the Theory of Planned Behavior constructs were the most proximal determinants of both perceived and objectively measured physical activity. Among these constructs, intention and perceived behavioral control were most strongly related to both perceived and objectively-measured physical activity. These findings were consistent with the Theory of Planned Behavior.⁶⁸

3.5 POTENTIAL PATHWAYS LINKING NEIGHBORHOODS AND OBESITY

Perceptions of the neighborhood environment may significantly contribute to the association between neighborhood environment and obesity.²¹ Perceptions of the quality of the neighborhood environment could suggest stress responses to the neighborhood.²¹ There is evidence that perceived neighborhood environment is related to obesity.^{21,76}

While it is important to determine that there is likely a relationship between neighborhood environments and obesity, it is also important to understand the social and physical causal pathways which may link them. It is likely that neighborhood environments affect health through biopsychosocial mechanisms, although these are poorly understood.²¹ In this section, I seek to integrate some of the research about the pathways linking neighborhood environments and obesity. It may be that they reflect the embodiment of early experiences⁹³ and the effects of neighborhood disadvantage, racism, and low SES.⁹⁰ It is necessary to understand these mechanisms through a lifecourse perspective.^{90,97,98} Some articles discuss the relationship between neighborhood environment and health in general, while others link SES and health. SES may be a proxy for neighborhood poverty,²¹ and was therefore included.

First, I will discuss some of the behavioral and psychological pathways that can link neighborhood environments and obesity. While these are important to understand, it is important to determine how these connections may be biologically plausible. These physical pathways provide further evidence to support the theory of embodiment.

3.5.1 Health behaviors

Health behaviors, such as physical activity and eating healthful foods, have been connected with obesity.^{11,12} Neighborhood environment can promote or deter healthy behaviors.^{19,21} Greater neighborhood walkability has been connected to increased walking in the neighborhood.¹³ Additionally, individuals' ability to make healthful food choices is greatly improved when their environment provides access to affordable healthy foods.²³

3.5.2 Socio-economic status (SES)

SES is a construct used to measure access to physical and social resources, social rank, or both.⁹⁷ SES can refer to both the individual- and community-level SES. Neighborhood and individual SES may interact to impact health.⁹⁷ For example, both neighborhood and individual SES are related to health, but the pathways linking each to health may be different. For example, those who live in low-SES neighborhoods tend to have less access to safe exercise facilities and healthful foods as compared to those who reside in wealthier neighborhoods. Neighborhood SES is likely associated with health above and beyond individual SES.⁹⁷

3.5.3 Chronic stress

The most commonly cited potential pathway is exposure to chronic stress.^{8,19-21,90-95,97} While the stress response is vital for survival (it served our ancestors well as they outran saber-toothed tigers), damage can be done when the stress response is prolonged.⁹⁴ The poor and minorities are more likely to experience chronic stress^{90,93,97} from traumatic events, perceived

stress, and daily frustrations.⁹⁷ Exposure to chronic stress can cause changes in a number of brain chemicals, some of which are described in more detail below.

While most articles reviewed found that stress was an important mechanism, Matthews and Gallo found that the literature connecting SES and health through stress and distress is mixed. They did point out, however, that this may be due to measurement limitations.⁹⁷ Stress may be important, but might “not be the primary mediator of SES-physical health associations.”⁹⁷ Chronic stress affects many potential pathways that can link neighborhood environments and obesity. These include: serotonin functioning, hyperactivity of the HPA Axis, cortisol hyper- and hypo-secretion, changes in feeding behavior, and a reduction in sleep quality. These are discussed below.

3.5.4 Psychosocial resources

Unlike stress, there is more support in the literature for a connection between psychosocial resources and health.⁹⁷ Psychosocial resources include: feeling personal control, self-esteem, optimism, and social support.⁹⁷ Those with low SES tend to perceive that they have fewer psychosocial resources.^{97,99} Psychosocial resources can contribute to health inequities. The reserve capacity model of Gallo and Matthews⁹⁹ gives a good indication of this.

Neighborhoods with low SES are proposed to provide more exposure to frequent and chronic stressors and threats and little exposure to beneficial situations. In addition, those with low personal SES are purported to have a smaller resource bank (reserve capacity) than those with high SES. This may be because: they are exposed to more stressful situations throughout their lifetime that require resources and their environments do not offer many opportunities to replenish the resources in their reserves.⁹⁷

3.5.5 Hypothalamic pituitary-adrenal (HPA) Axis

The HPA Axis is a neuro-endocrine axis that is important in regulating the stress response. It also regulates cortisol secretion.¹⁰⁰ It can become hyperactive when exposed to chronic stress.^{21,94} Chronic activation of the HPA Axis can promote fat storage in the abdomen, thereby increasing the risk of obesity.⁹⁴ HPA Axis activity resulting from chronic stress exposure can lead to excretion of serotonin,¹⁰¹ cortisol,¹⁰² changes in food preference,¹⁰⁰ and poor sleep quality,^{27,103} all of which are described in more detail below.

Human and animal studies show that stress and low SES can impact the functioning of serotonin, a neurotransmitter. Serotonin modulates many different biological and behavioral systems, including the emotional interpretation of experiences, behavioral motivations (including motivations to live a healthy lifestyle), and cardiovascular regulation.⁹⁰ HPA axis hyperactivity has been linked with changes in serotonin receptors.¹⁰¹ People with low responsiveness to serotonin release have an elevated risk for many conditions including central adiposity, which is an excess of fat in the midsection.⁹⁷ Those with lower SES or who live in an area with low community SES have reduced responsiveness to serotonin,⁹⁷ which may help to partially explain the economic inequities observed in the prevalence of obesity.

Higher cortisol levels increase the odds of developing obesity and seem to indicate a stress response to adverse neighborhood characteristics, such as deprivation and poor aesthetics.²¹ Personal SES in childhood influences excretion of cortisol and this may impact obesity in mid- to late-adulthood.^{21,104} There is evidence that abused children and adolescents, and boys who had occasionally been verbally bullied, have cortisol hypersecretion.⁹⁸ There appears to be a significant increase in obesity in individuals exposed to interpersonal violence as children.⁹⁸

Tryon et al. studied self-reported chronic stress, cortisol levels over a testing day, and brain activation patterns of a sample of women in response to images of low and high calorie foods. The latter will be discussed in the section on changes in feeding patterns. Women with high levels of chronic stress had significantly lower levels of cortisol throughout the day as compared to women with less chronic stress.⁹⁵ Both elevated and blunted cortisol levels have been linked with poor health.⁹⁷ Taken together, the evidence seems to point to a connection between cortisol and obesity.

Chronic stress (and the resulting activation of the HPA Axis) changes food preference, food intake patterns, and the rewards of food consumption.^{94,105} Excess cortisol motivates intake of food when it is not physiologically necessary. Over time, regular consumption of high fat and high calorie comfort foods may suppress HPA axis activation, thereby reducing feelings of stress.^{105,106}

Tryon et al. found that women with high levels of self-reported chronic stress had more activity in the reward and pleasure centers of the brain, as well as areas implicated in habitual eating and reduced behavioral control, in response to viewing images of high calorie foods. Likewise, those with low levels of chronic stress had brain activity that indicated that they wanted to eat the high calorie foods. However, they also had activation of areas in the brain related to behavioral inhibition. Chronic stress exposure may lead some individuals' brains to adopt consumption of high fat/high calorie food as a coping mechanism.^{95,100} This, of course, could translate into an increased likelihood of being obese.^{95,100}

Animal studies provide evidence that social stress from having a subordinate role in a social hierarchy can lead to obesity through changes in eating behavior.^{94,107} A similar process may occur in the poor and minorities. Subordinate animals often exhibit physical and behavioral

symptoms of stress.⁹⁴ Subordinate rodents consume more calories and gain more weight as compared to those dominant in the social hierarchy.^{94,107} There is evidence that subordinate rodents eat throughout the day even when they are supposed to be resting, while dominant rodents eat only during their waking hours.⁹⁴ In humans, eating at night increases obesity risk.¹⁰⁷

HPA axis activation affects sleep-wake cycles and stimulates awakening during sleep.²⁷ Sleep quality has been identified as another potential pathway between neighborhood environment / SES and obesity.^{11,12,20,91,92,107} A decrease in the amount of night-time sleep is associated with obesity, potentially because of metabolic changes leading to an increase in appetite, decrease in energy expenditure, and modifications of fat metabolism. All of these are related to obesity.¹¹

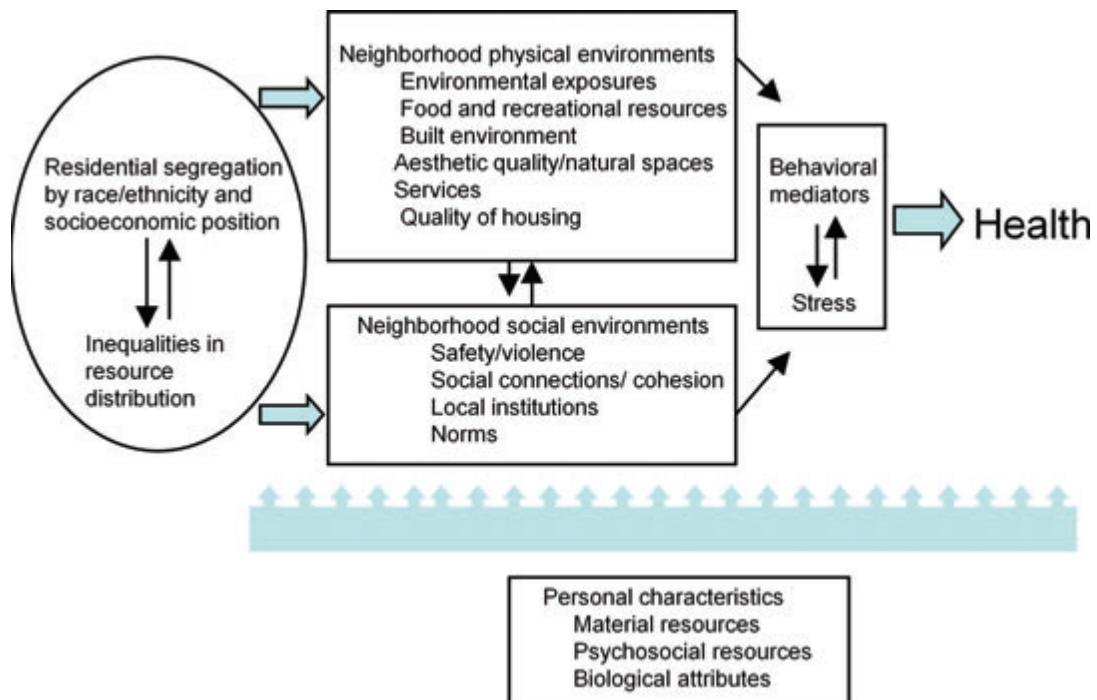
Other factors related to sleep quality include SES and race. African Americans and poor whites are more likely to have sleep issues as compared to wealthier whites.⁹² Those who live in poor and urban neighborhoods tend to have poorer sleep quality and decreased sleep duration as compared to those who live in wealthier and suburban areas.²⁰ Characteristics of neighborhoods within which disadvantaged people live are not conducive for sleep. For example, these environments often have a significant amount of noise, light pollution, and/or crime, which makes sleeping more difficult.²⁰

Sleep is also impacted by exposure to chronic stress and, especially, rumination about stressors.⁹¹ Racism-related vigilance may be an important factor for non-whites in the US.⁹¹ Racism-related vigilance is the anticipation of, and preparation for, racial discrimination. Hicken et al. found in their study that African Americans reported significantly more sleep difficulty than whites. Income and education slightly attenuated the relationship, but adjustment for racism-related vigilance made the relationship non-significant.⁹¹ Racism related vigilance was

more important to the relationship than most other chronic stressors, including actual experiences of racial discrimination.⁹¹ HPA axis activation then leads to additional disruption of sleep.¹⁰³ Decreased sleep can increase cortisol secretion, too.¹²

3.6 EXPLANATORY MODEL USED FOR THIS STUDY

There are several models that hypothesize the relationship between neighborhood environment and health.^{28,32,108,109} The explanatory model developed by Diez-Roux and Mair¹⁷ was utilized and is depicted in Figure 1. It succeeds where many others fail; it is comprehensive, yet comprehensible. It also includes health inequities. Neighborhoods contribute to inequities in the distribution of obesity and other diseases in the population.⁶



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Figure 1. Schematic Representation of the Contribution of Neighborhood Environments to Health

Inequalities

The goal of this model, as originally intended, is to help visualize how objectively-measured qualities of neighborhoods, segregation, and resource distribution inequalities may impact health inequities (in this case, obesity). The behavioral mediators and stress components of this model could include how individuals perceive and interact with their neighborhoods. However, the model is meant to illustrate actual constructs and not perceived measures. (C. Mair, Ph.D., conversation May 2014).

This model could be seen as a social-ecological model in that it hypothesizes that different levels of the social and ecological environment impact health. Upstream factors are to the left of the model, downstream to the right and below the bulk of the model. This model includes many mechanisms which reinforce one another. Neighborhood racial/ethnic segregation and inequalities in resources reinforce and can impact the other. Segregation could impact resource inequalities which can then reinforce segregation. Segregation and resource inequities impact neighborhood physical and social environments, which reinforce each other. For example, walkable neighborhoods with adequate green space provide opportunities for neighborhood residents to mingle and have social interactions. These social interactions may lay the groundwork for the ability to effectively advocate for built environment improvements. The physical and social neighborhood environments affect personal behaviors and stress levels. Stress can lead to unhealthy coping behaviors (e.g. stress eating)^{95,105,106} as well as healthy coping behaviors (physical activity has been shown to reduce stress.)¹⁷ Stress and health behaviors then impact health. Underlying all of this are personal characteristics (such as material and psychosocial resources and genetic and biological characteristics.)¹⁷ This model was developed to understand how actual (as opposed to perceived) neighborhood environments are related to health. (C. Mair, Ph.D., conversation May 2014). To my knowledge, this is the first

time that this model has been used in research that involves *only* perceptions of neighborhood walkability, social cohesion, and access to healthful foods. It is interesting and useful to use this model with perceived measures, as research has indicated that perceptions of neighborhood environment^{29,73,110} and social support⁵⁵ may be more strongly associated with health than objective measurements.

3.7 GAPS IN THE LITERATURE

There are several gaps in the literature. I do not address each of these in my thesis. Nevertheless, they deserve to be mentioned. First, few studies reviewed for this thesis include length of residence in the neighborhood as a potential confounder.¹¹¹ Powell-Wiley et al. conducted the longitudinal Dallas Heart Study and found that, for those participants who lived in their neighborhoods for the longest period of time, low neighborhood SES was associated with more weight gain over the follow-up period. Powell-Wiley et al. hypothesize that longer length of residence equates to a greater exposure to the neighborhood's low SES, which may then increase the likelihood of overweight and obesity.¹¹¹ However, since health impacts mobility, it is difficult to disentangle whether individuals who live in their neighborhoods for a long period of time have a greater exposure to the deleterious health effects of the neighborhood or whether healthier people are more able to move to a better neighborhood as compared to those who are unhealthy to begin with. Second, most studies treat gender, race, and class as covariates that are separately controlled. This may reflect an assumption that they operate in different ways in relation to the outcome of interest. However, it is important to analyze how gender, race, and class *interact* to impact people's experiences and their health.⁸

4.0 HISTORICAL AND SOCIO-POLITICAL CONTEXT

It is important to situate public health issues, especially those that relate to neighborhoods and SES, within their historical and socio-political context.^{72,112-114} Most research on health inequities focuses on contemporary risk factors and often neglects the complex environments within which people exist.¹¹⁵ This is in spite of the fact that health inequities are derived from historical events and processes.¹¹⁶ Popay et al. call the neglect of historical, philosophical, and anthropological perspectives on class, well-being, and identity “an unfortunate outcome of the tendency to work within narrow disciplinary or subdisciplinary boundaries.”¹¹⁵ (p. 621) When historical influences are excluded from explanatory models, public health practitioners and researchers are unlikely to consider why disease patterns exist and shift over time.¹¹⁷

Popay et al. argue that a comprehensive framework that includes exploration of the history of place is necessary to understand how social structures and environments affect individuals’ actions (and vice versa) and how they all relate to health inequities.¹¹⁵

Research on health inequities has found time and time again that health conditions and outcomes tend to differ depending on one’s SES, which includes social class. Thompson argued that class is an historical phenomenon. It is not merely a category, as researchers often define it. Rather, “the notion of class entails the notion of historical relationship... Class is defined by men as they live their own history, and, in the end, this is its only definition.”¹¹⁸ (p 11)

The prominent social epidemiologist, Nancy Krieger, argues passionately for the use of social ecological models in order to understand health inequities. However, it is important to understand *how* social and built environments, which are external to individuals, can nonetheless impact human health. This is hypothesized to occur through embodiment, which Krieger defines as:

a concept referring to how we literally incorporate, biologically, the material and social world in which we live, from conception to death; a corollary is that no aspect of our biology can be understood absent knowledge of history and individual and societal ways of living.^{96 (p. 672)}

Therefore, a strictly statistical analysis of the relationship between perceived neighborhood walking environments, social cohesion, and access to healthful foods and obesity in Allegheny County would be incomplete without a basic understanding of the historical processes that led to the development of neighborhoods as they exist today.

The identity of a neighborhood (historically in Pittsburgh, this would most likely be an ethnic identity) may impact health behaviors of the residents of the neighborhood. This identity can be a source of pride or shame, admiration or stigma.³²

In this historical section, I will focus on the impact that immigration, urban renewal, and deindustrialization had on neighborhoods in Pittsburgh, although this would likely be applicable to most neighborhoods in Allegheny County.

4.1 PERIODS OF IMMIGRATION

Immigration is a very important part of Pittsburgh's history and it impacted the development of neighborhoods. A basic understanding of the history of immigration to Pittsburgh and Allegheny County will help us to understand part of how local neighborhoods came to be in the condition that they are today. It may also help to shed light on the existence – or lack thereof – of neighborhood social cohesion as well as sources of social support for individuals in Allegheny County.

Immigration, fueled by the steel industry, made Pittsburgh a fine example of the melting pot image of the United States. By 1920, more than 120,000 immigrants lived in the city.¹¹⁹ The Civil War led to a sharp increase in demand for steel and iron. When Pittsburgh fulfilled this need, it earned the title of “the hearth of the nation”.^{119(p. 292)} The population continued to grow with the steel industry; between 1890 to 1910, the population grew from 343,904 to 533,907.¹¹⁹ Pittsburgh enabled much of the country's expansion during the industrial revolution.¹²⁰

Most immigrants moved to the poorest neighborhoods and created ethnic enclaves, where there were horrendously inadequate utilities and services.¹¹⁹ Nevertheless, not all ethnic communities were exactly the same in terms of their social and economic situations.

Bodnar, Simon, and Weber conducted a study of the experiences of groups of African American, Italian, and Polish immigrants to Pittsburgh between 1900 and 1960.¹²¹ There were important similarities and differences between the immigrants and their neighborhoods that led to different ways of living. These experiences influenced neighborhood development and may be playing a role today in the health of those in the greater Pittsburgh region. The qualities of neighborhoods that developed for the Italians, Polish, and African Americans differed partly because of their own differing histories, their work experiences in the city, and the nature of their

family and other social relationships. While there were many other ethnic groups that immigrated to Pittsburgh (e.g. Irish, German, and Croatian¹¹⁹) I focus on the Italians, Polish, and African American racial/ethnic groups because the most comprehensive analysis of immigration to Pittsburgh was conducted on these three immigrant groups. Additionally, while all ethnic groups had different experiences when they arrived in Pittsburgh, arguably the largest difference in experiences was between European Americans' and African Americans' experiences. The European immigrants did not face the same amount of discrimination for as long as African Americans did.¹²¹

Bodnar, Simon, and Weber argue that discrimination, tradition, industrialization, and the city's structure exerted pressure onto the diverse immigrant workers and their families who arrived in the city. All of these forces interacted at specific times as the immigrants tried to live their lives. We must be aware of this milieu in order to understand the very different experiences that these groups had and how these experiences affect Pittsburgh today.¹²¹

4.1.1 The immigrants' histories

It is important to recognize that Italians, Poles, and Southern-born African Americans all had strong family ties before immigrating to Pittsburgh.¹²¹ On the other hand, they had different histories of homeownership which impacted the nature of neighborhood development in Pittsburgh.

Poles had a long history of homeownership in Europe. In fact, one of the reasons that Poles immigrated was because of losing their opportunities to maintain homeownership in their native land. This history, combined with the stability offered by owning a home in Pittsburgh,

ensured that many Poles owned their own homes.¹²¹ This homeownership led to even further commitment to their neighborhoods.¹²¹

Prior homeownership was not as common for the Italian immigrants. Yet, they saw that it would provide stability. They wanted to be near their families in the ethnic communities, as well. Pittsburgh continually had problems with lack of housing.¹²¹ Homeownership helped ensure the Italians and the Poles had places for newly immigrant family members to live. The immigrants' kinship systems made homeownership and the establishment of strong communities possible.¹²¹

One reason that African Americans did not establish many strong neighborhoods or owned their own homes was because they did not frequently own their own homes in the Southern United States, from where most of them had come. Yet, the biggest reason they did not own their own homes in Pittsburgh was because they could not obtain stable work and rentals were more widely available in the neighborhoods in which they lived.¹²¹

4.1.2 The immigrants' work experiences

The Italians and Poles enjoyed strong ethnic neighborhoods partly because they tended to work close to home and they depended on their families, who lived nearby. Homeownership was a prized value and provided an essential source of stability in a chaotic atmosphere.

When Italians, Poles, and Southern-born African Americans first began to come to Pittsburgh in large numbers, there were plenty of low-skilled jobs in the city's booming iron and steel industries. White foremen were the central figures in obtaining employment in industry. They held deeply racist views and preferred to employ European immigrants as opposed to African Americans in these low-skilled positions. The foremen saw Southern African Americans

as “‘inefficient, unsuitable, and unstable’ for the heavy pace of mill work.”¹²¹ (p. 59) Eastern European immigrants, on the other hand, were preferred because they were seen to be docile, submissive, and disciplined. They were willing to work long hours without complaint.¹²¹ Similarly, the Italians arrived in Pittsburgh with extensive experience in skilled blue collar work, which helped them to secure gainful employment fairly quickly in the steel industry.¹²¹ Poles and Italians also experienced discrimination. However, the discrimination against African Americans was more deeply rooted and lasted longer than discrimination against white immigrants did.¹²¹

The racism of those in charge of hiring allowed the Italians and the Poles to form kinship networks in the mills. When foremen needed more workers, the Italians and Poles recommended friends or family members for the positions, who were then usually hired. They often worked alongside relatives and friends and they helped each other to adjust to new jobs and life in a new city in a foreign land.¹²¹ On the other hand, African Americans were forced to take work anywhere they could, which were often the worst, most menial and low paying jobs that did not offer stable employment opportunities. They often worked alone or in small groups and, therefore, did not have the same support or steady employment as they acclimated to their new surroundings.¹²¹

African Americans were largely barred from joining unions because of the racism of the union members and leaders. Therefore, they did not have any protection that union membership could have provided.¹²¹ This exclusion lasted into the 1960s. As the strength of labor unions grew, the exclusion from union membership translated into exclusion from many jobs.¹²¹

Immigrants formed strong ethnic neighborhoods in Bloomfield, Lawrenceville, and the Southside, among other neighborhoods. However, due to poor career prospects, African

Americans had to live in areas with poor and fragmented services and where they could not easily attain homeownership. As if that weren't enough, they had to remain mobile geographically to be able to go where the work was. They did not have many strong neighborhoods or high amounts of homeownership in Pittsburgh through 1960.¹²¹

Many employers left town after the 1920s and the economy suffered greatly. Between 1920 and 1960, the African American population in Pittsburgh increase tremendously. However, since they did not have a strong community base built by the previous generation, they largely kept their poor and urban status.¹²¹

During the 1930s, Italians, Poles, and African Americans had stagnant careers. However, the former two groups relied upon their solid ethnic neighborhoods and the benefits they provided. After 1940, additional differences began to appear. Italians joined the ranks of skilled labor and small business ownership. The Poles, largely maintained their blue-collar jobs, but more gained skilled labor and supervisory roles. African Americans still had unstable employment. However, during World War II, they did obtain more stable work in the industries than their predecessors had been unable to break into.¹²¹

After World War II, the number of African American inhabitants increased and their economic and social standing improved dramatically. However, new racial segregation and racist housing policies, including urban renewal, threatened this improvement.¹²⁰ The next section of the thesis will discuss this in more detail.

A few educated and highly skilled African Americans accepted leadership positions and moved out of the city to the mostly white suburbs. However, deindustrialization and the intensification of class and racial inequality diminished the remaining African American community. Urban African American poverty spread throughout the city's neighborhoods

during the latter part of the twentieth century. Many young people left Pittsburgh to find jobs. However, most African Americans stayed “and worked to create their own renaissance to counteract some of the destructive impacts of Pittsburgh’s predominantly white urban revival.”¹²⁰

4.1.3 The immigrants’ family and social relationships

Family members already living in the city provided a great deal of help to all three groups in finding housing and, to some extent, work. In part due to deeply ingrained racism, African Americans were unable to make inroads into Pittsburgh’s industries, which could have provided them with more stable, long term employment opportunities. As a result, African American parents taught their children to be self-reliant. On the other hand, Polish and Italian immigrants, who were able to use familial connections for their own benefit regarding employment and housing, raised their children to maintain strong relationships with their families.¹²¹

The social milieu of limited opportunity, racism, and economics in the city impacted the immigrants’ familial relations. African Americans had strong family relations before immigrating to Pittsburgh. Yet, the socio-economic structure of the city prevented them from establishing kin networks in workplaces that would have enabled them to help future African American immigrants, as well as their own children to attain some level of economic security. As a result, African Americans had to change the way they raised their children. ¹²¹

On the other hand, racism helped to keep Polish familial relations strong. They had strict parenting styles and yet the children remained loyal. The social and economic forces at play reinforced the necessity of their traditional family networks for obtaining work and enjoying relative security.¹²¹

As the immigrants' Pittsburgh-born children grew up, they had strong familial ties to their neighborhoods and their places of employment. Therefore, many of them remained in the same neighborhood in which they were raised. Young African Americans, however, could not rely on the assistance of their parents and, so they often moved out of the neighborhood in which they grew up. The result was that white immigrants and their children had the benefit of strong neighborhood social ties that provided a great deal of assistance. The African Americans had little to no social cohesion within their neighborhoods.¹²¹

4.2 THE CHANGING NATURE OF PITTSBURGH NEIGHBORHOODS

Pittsburgh neighborhoods were not static. They changed and, often, not for the best. In this section, I describe the effects of urban renewal and deindustrialization on Pittsburgh's neighborhoods. While urban renewal occurred in several Pittsburgh area communities, including McKeesport, Wilkesburg, Pittsburgh, and Carnegie,¹²² I focus on the experiences of those in the Hill District. Mindy Thompson Fullilove's book *Root Shock* describes urban renewal across the United States and includes a comprehensive study of urban renewal in the Hill District, but not other Pittsburgh neighborhoods.

4.2.1 Urban renewal

Between 1949 and 1973, the American government pursued the urban renewal program. This federal program gave money to cities in order to clear 'blight'.¹²³ (p. 20) One of the stated goals of the program was to prepare for a postwar economy. The U.S. no longer needed to

produce massive amounts of weaponry and needed to switch industries to reflect new forms of productivity. During the 1950s, urban renewal and “progress”¹²³ meant the same thing.¹²³ (p. 57) New jobs, technology, and land uses were part of this progress. It was problematic politically for any politician to publicly oppose urban renewal. Most people did not want to be seen as opposing progress.¹²³ Businessmen, eager to make more money, used urban renewal as their tool to achieve that end. Blight, and beauty are subjective judgments and usually, “the part of the city the businessmen thought was blighted was the part where black people lived.”¹²³ (p. 20)

In order to obtain federal funds for urban renewal, a city had to identify the blighted areas it wanted to revitalize. It then had to develop a plan for new uses for the land. This plan had to be approved by the federal government. If approved, the government used its power of eminent domain to seize the land. The government gave the displaced residents and business owners a small amount of money in compensation. The buildings were bulldozed and then construction companies redeveloped the land for use by wealthier residents, for whom homes, businesses, and cultural and educational institutions were built.¹²³

The government and developers could have provided improved housing and neighborhoods for low income residents, but they did not. A housing crisis ensued. By mid-1967, urban renewal programs destroyed 400,000 low-income residences nationally while they built less than 11,000 public housing units on the land.¹²³

This program led to the destruction of 2,500 neighborhoods in nearly 1,000 cities and the dispossession of a million people across the nation.¹²³ It also destroyed huge parts of the jazz community. Locally, urban renewal destroyed the vibrant African American community in the Hill District of Pittsburgh in order to build the Civic Arena.¹²³ I will discuss this in more detail

below. The loss of the Hill District, and other African American communities across the country, marked the destruction of African Americans' way of life.¹²³

The crises in current African American neighborhoods (e.g. disintegration of African American families, drug use, and the imprisonment of many African American men) have many causes, including de-industrialization. However, these issues can only be understood within the context of urban renewal and the resulting root shock. Fullilove argues that we must understand and consider the magnitude of the many losses that resulted from the destruction of so many neighborhoods, which included. emotional, economic, cultural, and social losses.¹²³

Our neighborhoods, their buildings and social connections, are a very important part of who we are and we are not wholly separate from them.¹²³ We have bodily systems to maintain systemic internal balance. Fullilove argues that humans developed ways to maintain balance between themselves and their environments. This process maximized the likelihood of survival from external threats such as predation and harsh elements. It enabled them to find sufficient food sources and to live peaceably with neighbors and relatives, as well.¹²³

This balance and reliance on the neighborhood environment leads to serious emotional and physical problems if and when the neighborhood and, therefore, one's way of being is destroyed. Fullilove argues that the result is root shock, "the traumatic stress reaction to the destruction of all or part of one's emotional ecosystem."¹²³ (p.11) It is similar to the physiological shock resulting from a serious bodily injury.¹²³

The effects of root shock remain with victims throughout their lives. Root shock can also impact the lives of subsequent generations.¹²³ It changes people's outlook on life and impacts their remaining social relationships. Individuals with root shock will often be less trusting, more anxious about perceived threats to loved ones, and have less stable relationships in

general. They have less emotional and financial reserve capacity to handle the social and economic upheaval occurring around them. These compounding experiences leads to stress which increases the risk of developing a wide range of conditions, from heart attack to depression.¹²³

Since urban renewal affected so many neighborhoods across the country, root shock had a massive impact on both the individuals who lost their neighborhoods and on all of Black America. African Americans had interconnections with other African Americans across the country. Urban renewal and root shock led to the destruction of important African American community processes which, if left intact, could have improved African Americans' ability to compete in an era of increased globalization. In reality, African Americans were in a very disadvantageous position in the global marketplace.¹²³

4.2.2 Promotion of urban renewal

The proponents of urban renewal argued that the program would clear blight and help to make room for postwar prosperity. An area could be deemed blighted if it was a slum or had many dilapidated buildings that may or might or might not have been vacant. These areas could have a commercial, industrial, or residential use.¹²⁴ Proponents fed fears that these blighted areas would quickly spread.¹²⁴ Not only did blighted areas have dilapidated buildings, but they were seen as “economic liabilities to local government”^{124 (p. 303)} since the cost of services used (e.g. welfare, police, and fire departments) exceeded the tax revenues produced by the areas.¹²⁴

Nationally, wealthy individuals with businesses and property interests in cities led the charge.¹²³ Locally, the Allegheny Conference on Post-War Community Planning, formed in 1943 to make a plan to ensure prosperity, led urban renewal efforts. Wealthy white male

industrialists, presidents of powerful companies in the city, prominent bankers, and other similar individuals formed the committee's executive committee. African Americans, the poor, and women had no input into the committee's decisions.¹²³

I focus the following discussion of urban renewal on the Hill District in Pittsburgh. Mindy Thompson Fullilove's book *Root Shock* is the product of extensive study of urban renewal nationally. The Hill District features prominently in her book.

4.2.3 Urban renewal and the Hill District

“Among the truly magic places on earth is the Hill District in Pittsburgh. I believe that, pound for pound, the Hill District was the most generative black community in the United States.”¹²³ (p. 29) – Mindy Thompson Fullilove

George Evans, Pittsburgh City Councilman, wrote an article in 1943 article that argued in favor of razing the Hill District as part of urban renewal since it would involve “no social loss”.¹²⁵ He argued that the Hill District's housing was substandard (which it was) and that it was an example of neighborhood deterioration. The housing and buildings and had “long outlived their usefulness, and so there would be *no social loss* if they were all destroyed.”¹²⁵ (emphasis added) He called the Hill “one of the most outstanding examples in Pittsburgh of neighborhood deterioration.”¹²⁵ He argued that at least a third of the 650 acres of the Hill District was taken up by tiny and “unnecessary” crisscrossed streets.¹²⁵

Despite the fact that he mentioned substandard housing, he did not argue for providing higher quality housing for the residents. Rather, he saw that this space could make a lot of

money. The Hill District was on the other side of the then proposed cross-town boulevard and near the downtown triangle and the office buildings on Grant Street.¹²⁵

He envisioned the ability to “widen Fifth Avenue and make it into a fine thoroughfare.”¹²⁵ He argued:

if properly planned and landscaped it should make one of the most desirable residential sections in the City of Pittsburgh. It is difficult for one to estimate what the increase in land values would be when the project would be completed... Probably no other city in the country has an area so well adapted for such an improvement. *There would be no displacement of manufacturing plants or important industries; practically the whole area being residential.*¹²⁵ (emphasis added)

Apparently, poor African American residents were not as important as industries. This belief system completely negated the views of the residents of the Hill and all those who had called it home. It was the first place where many of African American migrants to the city lived. For them, the Hill’s tiny streets were not a waste but rather were essential to creating strong neighborhood relationships.¹²³

The Hill District did have dilapidated buildings, but that helped bind the residents together. Sala Udin, a city councilman, grew up in the Hill. He said:

We all lived in similar conditions and had similar complaints about [the housing]...But that kind of common condition bound us together more as a community. I knew everybody on my block, and they knew me...And so, I think there was a very strong sense of community.¹²³ (p. 61)

Hill residents did live in dilapidated housing, but they were held together by their strong sense of community. They formed many community organizations and began to build political power.¹²⁰ It had a vibrant community life with neighborhood relationships that ensured everyone had the food and clothing they needed and made sure that the youth behaved well.¹²³ It was also a nationally renowned center for jazz music and dancing. The Hill had dozens of clubs where young men's talents could be nurtured.¹²³

The threat to their way of life made African Americans in Pittsburgh and around the country fearful. They began to use the expression "Urban Renewal is Negro Removal."¹²³ (p. 61) Planners largely controlled where residents moved after the destruction of their neighborhoods. Planning professionals' publications explicitly described ways to hide and marginalize the poor. "Their tools included using highways, massive buildings, parking lots, and open space as barriers; eliminating connecting streets to inhibit travel in and out; and housing people in public housing projects that were cut off from the flow of the city."¹²³ (p. 64)

In the late 1950s, local white officials won their fight for urban renewal in the Hill District and the Civic Arena replaced the Lower Hill. It would eventually become the arena for the local hockey team, as well as a venue for other events. A substantial area around the civic arena had been razed as well, but was not developed. The African American community became alienated from the city partly because their homes were destroyed in order to create space between African American neighborhoods and downtown and for the land to be used for whites' pleasure while much of the land remained undeveloped.¹²³ The former residents moved to other sections of the Hill or to other African American neighborhoods in the city, such as East Liberty and Homewood. However, most of the businesses never reopened, including most of the beer gardens and jazz clubs.¹²³ Many would say that this did indeed have a grave social loss.

Sala Udin argued that urban renewal helped to weaken the African American community within Pittsburgh. It “contributes to a broken culture, broken values, and a broken psyche, and weakness in this city. And it all resulted from the blowup of the community into different pieces, scattered around the city.”¹²³ (p. 176)

4.2.4 Deindustrialization

Between the 1940s and late 1970s, Pittsburgh’s steel mills offered thousands of residents living-wage jobs. Many communities in the greater Pittsburgh region depended primarily on the steel but also railroad equipment, barge-building, and electrical industries for their identities and livelihood.¹²⁶ Steel mills and other industries began to slow plant operations during the early 1980s.^{126,127} Steel mills were no longer economically viable. Energy costs had increased, large amounts of recyclable scrap steel existed, and lighter substitutes to steel, such as aluminum alloys, had been developed.¹²⁷ The international steel market contracted and steel restructuring occurred. Recycling of scrap steel became much more common. This recycling could be done at smaller plants that were near large amounts of scrap steel. Previous steel mills were enormous and needed to be located near limestone, coal, and iron ore sources.¹²⁷

Male unemployment skyrocketed as a result of deindustrialization, but African American and working class neighborhoods surrounding Pittsburgh were the most affected by the loss of jobs.¹²⁷ More African Americans became unemployed and stayed unemployed longer than whites.¹²⁰ Unemployment occurred both in the steel industry as well as the industries that supplied materials to steel mills. Between 1979 and 1987, the greater Pittsburgh region lost 127,500 manufacturing jobs.¹²⁰ In the 1980s, the unemployment of those in manufacturing was so high that it increased overall unemployment in the Pittsburgh region.¹²⁷

Additional community hardship arose when steel mills closed and the land lay vacant. Due to Environmental Protection Agency hazardous waste regulations concerning liability for remediating former mill sites, companies had no incentives to redevelop former industrial sites.¹²⁷ Former mill towns then had limited capital circulating, many local businesses closed, and property values decreased while social disorder and crime increased.¹²⁷ Additionally, between 1974 and 1986, inflation increased by approximately 50 percent while per capita income increased only 8 percent.¹²⁰ Young adults moved out of the city in order to find work.¹²⁰

The Pittsburgh region is still struggling with the economic and social consequences of de-industrialization. Many of the local neighborhoods with the worst poverty and crime rates are old mill towns (e.g. Homestead, Duquesne, and Rankin).¹²⁸

Through public-private partnerships, the city reinvented itself and has transitioned to high tech industries. However, social and economic inequalities continued to exist. African Americans lost their neighborhoods and are dispersed throughout the city in other segregated neighborhoods such as Garfield, Homewood, East Liberty, Manchester, Beltzhoover, Glen Hazel, and Penn Hills.^{120,129} Employment discrimination was rampant. African Americans did not have much access to profitable employment in many of these new industries, which offered higher paying jobs.¹²⁰ Even today, communities in the greater Pittsburgh region are largely segregated, which puts African Americans at many disadvantages, including access to jobs, quality schools, and public safety issues.¹²⁹ Additionally, African Americans continue to be moved around the city by the Housing Authority. (P. Documét, MD, DrPH, oral communication, June 2014).

5.0 OBJECTIVES

There is evidence that neighborhood environments, including walkability,^{13,17,18,28} access to healthful foods,^{3,22,23,25,33,60} and social cohesion,^{14,39,40} are related to obesity and/or health conditions for which obesity is a risk factor. Additionally, social support is related to general health as well as specific diseases.⁴¹⁻⁴³ It is also an integral component of obesity interventions.^{54,59} The broad question this study attempted to address was how the perceived neighborhood environment is affecting obesity in Allegheny County, Pennsylvania. To my knowledge, no study has been conducted to test this relationship in Allegheny County.

Data from the 2009-2010 Allegheny County Health Survey are analyzed to address the study's objectives and a-priori hypotheses.

First objective: To determine if there is a relationship between perceived neighborhood environment and obesity among Allegheny County adults.

- *Hypothesis 1:* Allegheny County residents who perceive that they live in neighborhoods with high walkability are less likely to be obese compared to those who perceive that they live in neighborhoods with low walkability.
- *Hypothesis 2:* Residents who perceive that they live in neighborhoods with high social cohesion are less likely to be obese as compared to those who perceive that they live in neighborhoods with less social cohesion.

- *Hypothesis 3:* Residents who perceive that they live in neighborhoods with high access to healthful foods are less likely to be obese compared to those who perceive that they live in neighborhoods with low access to healthful foods.

Second objective: To determine if the relationship between perceived neighborhood environments (walkability, social cohesion, and access to healthful foods) and obesity is moderated by social support.

For the second objective, I had one hypothesis, broken up into 3 segments.

- *Hypothesis 4:* Perceived social support moderates the relationship between perceived neighborhood environments (walkability, social cohesion, and food access) and obesity such that those residents with high levels of perceived social support are less likely to be obese, even if they perceive their neighborhood environment to be poor.

6.0 METHODS

This is a cross-sectional, population-based study. The section that follows describes the methods undertaken in conducting this study. First, the Allegheny County Health Survey (ACHS), which provides the data for analyses, is described. The reasons the ACHS was conducted are discussed, as well as its target population, sampling methods, data collection, data weighting, and descriptions of the final ACHS sample. Next, the coding of the independent, dependent, and moderating variables, as well as covariates, is discussed. Finally, the statistical analysis of the data is reviewed.

6.1 DATA

The Allegheny County Health Survey (ACHS) of 2009-2010 provided the data for this analysis. It is a population-based landline telephone survey of Allegheny County adults over the age of 18, representative of the county, and modeled after the Behavioral Risk Factor Surveillance System (BRFSS).¹³⁰ The dataset includes 5,442 interviews administered between 2009 and 2010.²⁴ The University of Pittsburgh IRB approved the survey and all respondents gave informed consent.

Even though the Pennsylvania Department of Health conducts an annual statewide BRFSS, there are not enough interviews within Allegheny County to provide sufficient data to

analyze subpopulation health in the county.¹³¹ Therefore, the Allegheny County Health Department and the Evaluation Institute of the University of Pittsburgh's Graduate School of Public Health collaborated to conduct the ACHS. Funding came from the Allegheny County Health Department, the School of Public Health, and community partners.²⁴ A major goal of the ACHS was to collect quality local data that could guide the development of health interventions and policy within the county.¹³¹ Below is a brief summary of the target population, sampling and data collection methods, and data weighting.

6.1.1 ACHS target population

The Evaluation Institute targeted adult residents of Allegheny County, Pennsylvania for the ACHS. In 2010, 1,223,348 individuals lived in Allegheny County and 981,685 (about 80%) were adults over the age of 18. About 38% (462,137) of these adults were male and 519,548 (42%) were female. Non-Hispanic whites made up 81.5% of the total population, about 13% African American/Black, and less than 2% of the population was Latino.²⁴

6.1.2 ACHS Sampling methods

African Americans and low income residents of Allegheny County were oversampled using a disproportionate stratified sampling strategy.²⁴ The population within census tracts was oversampled if the census tracts had greater than a 50% African American population or 50% of households with incomes below \$40,000, Allegheny County's median annual household income.¹³¹ Individual Allegheny County residents 18 years of age and older were eligible to participate in ACHS.¹³¹

6.1.3 ACHS data collection

The Evaluation Institute used the Random Digit Dialing method to produce a county-representative sample.²⁴ Trained interviewers used a computer assisted telephone interviewing (CATI) system to conduct the survey interviews. ACHS topics included core and optional BRFSS modules. Community partners also added questions pertaining to their service areas. The neighborhood level and social support questions used in this study were added by a community partner.¹³¹

The interviewers called each telephone number a maximum of 15 times. The time and day of the calls were varied to increase the likelihood of reaching participants.¹³¹

6.1.4 Data weighting

In order to adjust for the disproportionate number of African American and low-income respondents, design and post stratification weights were used. Iterative proportional fitting was used to include weights for non-response and non-coverage. This was done to ensure that the weights used permitted the sample to be representative of Allegheny County adults.¹³¹

Before weighting could occur, missing demographic data had to be imputed using a hot deck imputation method.²⁴ This method replaces missing data with responses from other survey respondents who have similar characteristics¹³² (in this case, demographic characteristics). Imputation was completed for those variables necessary for the calculation of weights (e.g. race, age, and education). Annual household income was imputed due to a large percentage of incomplete data (15%).¹³¹

6.1.5 Final ACHS sample

ACHS's overall response rate was approximately 29%²⁴ and the cooperation rate was approximately 66%.²⁴ In 2010, Pennsylvania's BRFSS overall response rate was 30.9% and the cooperation rate was near 69%.¹³³ A *response rate* is the number of completed interviews with respondents divided by the number of eligible respondents and the *overall response rate* "is a more conservative response rate that assumes that more unknown records are eligible and thus includes a higher proportion of all numbers in the denominator. The rate assumes that all likely households are households and that 98 percent of known or probable households contain an adult who uses the telephone number."¹³³ (p. 4) The *cooperation rate* is the proportion of all respondents interviewed of all eligible respondents who were contacted.¹³⁴ Approximately 67% of the participants were female, 62% self-reported their annual household income as under \$50,000, and 19% self-reported their race/ethnicity as African American.²⁴ See Table 1 for selected demographics of this population.

Table 1. Selected ACHS demographic and Obesity data (n=5,442)

Variable	n	Percent
Race *		
White	4211	80.09
African American	1047	19.91
Gender		
Male	1790	32.89
Female	3652	67.11
Age		
18-24	191	3.51
25-34	517	9.5
35-44	701	12.88
45-54	1038	19.07
55-64	1203	22.11
65+	1792	32.93
Education		
Less than High School	344	6.32
High School	1732	31.83
Some college	1461	26.85
College +	1905	35.01
Income		
Less than \$10,000	261	5.66
\$10,000 - \$14,999	336	7.29
\$15,000 - \$19,999	415	9
\$20,000 - \$24,999	461	10
\$25,000 - \$34,999	643	13.95
\$35,000 - \$49,999	715	15.51
\$50,000 - \$74,999	702	15.23
\$75,000+	1077	23.36
Obesity **		
Obese	1579	30.34
Not obese	3625	69.66

* Excluded from analysis: individuals who reported race of other and Hispanic/Latino

** Excluded from analysis: Records with missing height and weight data

6.1.6 Analysis of missing data

Individuals under the age of 25 (n = 191) were automatically excluded since their results were likely to be significantly different from those of other ages and could potentially skew the results of the analyses. For the remainder of the analyses, I only included records with complete data for the variables under consideration. Over 200 records lacked height and/or weight data and were excluded. Those who were excluded as a result of missing obesity data were significantly more likely to be female. Differences based on race, age, education, and annual household income were non-significant.

6.2 VARIABLES

In this section, the variables used in this study are described: primary independent, dependent, moderating, and covariates. Coding of these variables is also discussed.

6.2.1 Primary Independent variables

Primary Independent Variables

Perceived neighborhood walking environment, social cohesion, and access to healthful foods were the independent variables. All of these were based on the scale used in the Multi Ethnic Study of Atherosclerosis (MESA) Community Survey.⁷⁶ The scale included questions the authors organized into the following broad topics: aesthetic quality, walking environment, availability of healthy foods, safety, violence, social cohesion, and activities with neighbors.⁷⁶

All neighborhood scales utilized in the ACHS used the same five-point Likert scale, with responses ranging from Strongly Agree to Strongly Disagree.²⁴ Next, the primary independent variables are described.

Perceived neighborhood walking environment was measured using an eight-item scale. It included questions about opportunities to engage in physical activity in the neighborhood, pleasantness and ease of walking in the neighborhood, seeing others exercising in the neighborhood, and perceptions of safety of walking in the neighborhood. All but one item included in the ACHS scale, neighborhood noise level, were included in analyses. Neighborhood noise level was not used because, in the Multi Ethnic Study of Atherosclerosis (MESA) Community Survey, this question was included in a measure of neighborhood aesthetic quality, not of the walking environment.⁷⁶ The command PROC CORR was used to test the internal consistency of the walkscale, as measured by Cronbach's Coefficient alpha, which was 0.749. A 0.7 reliability coefficient often is used to indicate a reliable scale coefficient.¹³⁵ This scale was coded such that the higher the score, the better the walking environment, requiring some items to be reverse coded. Possible scores ranged from zero to eight.

Perceived neighborhood social cohesion was measured using a four-item scale.⁷⁶ The scale included questions about the perception of the willingness of neighbors to help each other, how well neighbors get along, trustworthiness of neighbors, and whether neighbors share the same values. The internal consistency of the social cohesion scale, as measured by Cronbach's Coefficient alpha, was 0.79, which was again considered to be reliable based on the 0.7 cutoff.¹³⁵ This scale was such that a higher score denotes better neighborhood social cohesion. Possible scores ranged from zero to four.

Perceived neighborhood access to healthful foods was measured by two questions treated separately in analyses.⁷⁶ The questions included perceptions of neighborhood access to fresh fruits and vegetables and access to fast foods in the neighborhood.

Possible scores for each question ranged from one to five with a higher score denoting greater perceived access to the food type being measured (fruits and vegetables or fast food). Responses were then dichotomized. For perceived neighborhood access to fruits and vegetables, Strongly Disagree and Disagree were coded as 0 and Neither Agree nor Disagree, Agree, and Strongly Agree were coded as 1. For perceived access to fast foods, responses were reverse coded such that a higher score indicated lower perceived access to fast food. Wald Chi Squares were calculated to determine if the relationship between perceived neighborhood access to fresh fruits and vegetables and obesity as well as the relationship between perceived neighborhood access to fast food and obesity are significant. These items were not combined into a scale since there are only two questions pertaining to the perceived neighborhood access to healthful foods. Two items are insufficient to construct a meaningful scale because the reliability would be low.¹³⁶ See the Appendix for the list of questions included in all of the aforementioned scales.

6.2.2 Dependent variable

The dependent variable was obesity, as measured by Body Mass Index (BMI) greater than or equal to 30, as measured by kg/m^2 .¹³⁷ Participants self-reported height and weight, which was used to calculate the BMI. BMI was dichotomized into obese and non-obese because Lenz, Richter, and Mühlhauser found that overweight (as measured by $\text{BMI} \geq 25 < 30$) was not related to an increase of odds of all-cause mortality. However, there was a 20% increase in all-cause mortality among obese individuals as compared to those at a normal weight. There can be a

200% increase in all-cause mortality among the morbidly obese.¹³⁸ Overweight seems to be related to increased probability for some diseases and decreased probability for others.¹³⁸ I considered using overweight and obesity as the dependent variable. However, approximately 62% of the population was either overweight or obese. Additionally, because of the large number of overweight and obese individuals in this sample, inclusion of overweight individuals would leave a small comparison group that could make analysis difficult at best. Additionally, other studies also dichotomized BMI into obese versus non-obese.³ As a result, obesity alone was used as the dependent variable.

6.2.3 Moderating variable

Perceived individual-level social support was the hypothesized moderating variable. This was included in analyses because it could be related to both neighborhood environments and obesity. I also wanted to test Vitaliano et al.'s added value hypothesis.⁵³ Vitaliano et al. hypothesized that social supports would be more beneficial to the health of those with low SES. Neighborhood environments are a more removed proxy of SES, but this hypothesis can still be tested with this data. Additionally, a study using the ACHS dataset found that social support does moderate the relationship between breast and cervical cancer screening and SES in adult women in Allegheny County. (P. Documét, MD, DrPH, oral communication, August 2013).

A four-item standardized scale measured social support. This scale originated from a widely-used longer scale, the Medical Outcomes Study Social Support Scale (MOS-SSS).^{139,140} The scale used in the ACHS includes the question: "How often is each of the following kinds of support available to you when you need it?" Questions ask about the respondents' availability of people to: help with daily chores if needed, provide advice for dealing with a personal problem,

do something enjoyable with, and to love and make the respondent feel wanted. The five-point, Likert scale responses range from “none of the time” to “most of the time.” The composite score comprises the sum of responses. Possible scores range from 0 to 16. The scores were dichotomized using the bottom quartile (High defined as: >11 ; low as: ≤ 11). This was done because the lowest levels of social support may be most strongly associated with avoidable death post heart attack as compared to those with the highest levels of social support. Additionally, there may be little difference in unnecessary mortality between those with moderate and high social support levels.⁴⁷ Also, the distribution of social support in the ACHS was skewed to the left.

6.2.4 Other covariates

Studies on the neighborhood environment and obesity, obesity-related health behaviors, or chronic conditions for which obesity is a risk factor have controlled for many covariates, including: age,^{6,18,22,57,73,141} gender,^{6,18,22,73,141} race/ethnicity,^{73,141} marital status,^{57,73,141} poverty status,⁶ number of children,⁵⁷ education,^{6,22,57,73,141} parental education,²² employment status,⁵⁷ occupation,²² personal income,⁵⁷ household income,^{22,57,73,141} physical activity behaviors,¹⁸ healthy eating behaviors,¹⁸ and census region.⁶

Therefore, several self-reported potential covariates widely used in the literature were included in multivariate analyses: race (Whites and African Americans), age, gender (male and female), education (High school, some college, and college), and annual household income (< \$10,000, \$10,000 - \$14,999, \$15,000 - \$19,999, \$20,000 - \$24,999, \$25,000 - \$34,999, \$35,000 - \$49,999, \$50,000 - \$74,999, and \$75,000 +). Education was dichotomized into two categories, high school education or less and some college or more. This was done because education has

shown to be correlated with obesity such that those with higher levels of education are less likely to be obese.¹¹ Individuals under the age of 25 were excluded from all analyses to avoid potential problematic covariance. (C. Mair, Ph.D., personal communication May 2014). The median annual household income was \$35,000 and was dichotomized as $< \$35,000$ or $\geq \$35,000$. Both annual household income and education were controlled for, since Leal and Chaix argue that controlling for only one socioeconomic variable is insufficient.¹⁴ Please see Table 2 to see how all variables were coded.

Table 2. Variables and coding

Variable	Categories	Coding
<i>Independent</i>		
Neighborhood walkability	9	0 = Least walkability 8 = Greatest walkability
Neighborhood social cohesion	5	0 = Least social cohesion 4 = Greatest social cohesion
Neighborhood access to fruits and vegetables	2	0 = Least access to fruits and vegetables 1 = Greatest access to fruits and vegetables
Neighborhood access to fast food	2	0 = Greatest access to fast food 1 = Least access to fast food (Reverse coded)
<i>Dependent</i>		
Obesity (BMI)	2	0 = not obese 1 = obese
<i>Moderator</i>		
Social support	2	0 = low 1 = high
<i>Covariates</i>		
Age	5	2 = 24-34 3 = 35-44 4 = 45-54 5 = 55-64 6 = 65+
Gender	2	1 = male 2 = female
Education (dichotomized)	2	1 = ≤ High School 2 = > High School
Race	2	1 = Non-Hispanic White 2 = Non-Hispanic African American
Annual household income (dichotomized)	2	1 = < \$35,000 2 = ≥ \$35,000

6.3 STATISTICAL ANALYSIS

Data analysis was conducted using SAS 9.2. For all analyses, only records from individuals over the age of 25 and with complete data for the variables under consideration were included. For all analyses, a p-value of <0.05 was considered to be significant.¹³⁵ For the three hypotheses, PROC SURVEY FREQ was used for crosstabulations and PROC SURVEY LOGISTIC was used for logistic regressions in order to account for the weights and sampling design.

First, the distribution of obesity by demographic factors was analyzed by utilizing the command PROC SURVEY FREQ. Obesity was compared across gender, race, age, education, and annual household income characteristics.

Next, bivariate regressions were conducted for hypotheses one and two. Multivariate logistic regressions were conducted only if bivariate regressions were statistically significant. Multivariate logistic regressions included the potential covariates: age, annual household income, gender, education, and race. All of these covariates have been frequently controlled for in the literature analyzing the relationship between neighborhood environment and obesity (or health behaviors directly related to obesity).^{6,22,73} Therefore, it was important to include all of them in analyses. Adjusted Odds Ratios and 95% Confidence Intervals around the Odds Ratio were calculated. Below, each hypothesis is considered in turn. Odds Ratios and Adjusted Odds Ratios and 95% Confidence Intervals were calculated and statistical significance was determined using an alpha of 0.05.¹³⁵

6.3.1 Hypothesis One

Hypothesis 1: Allegheny County residents who perceive that they live in neighborhoods with high walkability are less likely to be obese compared to those who perceive that they live in neighborhoods with low walkability.

The formulas for bivariate and multivariate models analyzing the relationship between perceived neighborhood walkability and obesity are below.

Bivariate

$$y = \alpha + \beta_{(\text{walkability})} * X_{(\text{walkability})} + e$$

For all equations:

Where y = obesity (yes/no)

α is the constant in the equation

β is the regression coefficient

x is the value of the independent variable

e is error

Multivariate

$$y = \alpha + \beta_{(\text{walkability})} * X_{(\text{walkability})} + \beta_{(\text{age})} * X_{(\text{age})} + \beta_{(\text{gender})} * X_{(\text{gender})} + \beta_{(\text{education})} * X_{(\text{education})} + \beta_{(\text{income})} * X_{(\text{income})} + e$$

Note: In all multivariate analyses, all potential covariates were controlled for simultaneously.

Likewise, Mujahid et al. controlled for all potential covariates at once.⁷⁶

6.3.2 Hypothesis Two

Hypothesis 2: Residents who perceive that they live in neighborhoods with high social cohesion are less likely to be obese as compared to those who perceive that they live in neighborhoods with less social cohesion.

The formulas for bivariate and multivariate models analyzing the relationship between perceived neighborhood social cohesion and obesity are below.

Bivariate

$$y = \alpha + \beta_{(\text{social cohesion})} * X_{(\text{social cohesion})} + e$$

Multivariate

$$y = \alpha + \beta_{(\text{social cohesion})} * X_{(\text{social cohesion})} + \beta_{(\text{age})} * X_{(\text{age})} + \beta_{(\text{gender})} * X_{(\text{gender})} + \beta_{(\text{education})} * X_{(\text{education})} + \beta_{(\text{income})} * X_{(\text{income})} + e$$

6.3.3 Hypothesis Three

Hypothesis 3: Residents who perceive that they live in neighborhoods with high access to healthful foods are less likely to be obese compared to those who perceive that they live in neighborhoods with low access to healthful foods.

Analysis of the relationship between perceived access to healthful foods and obesity was determined by analyzing perceived access to fresh fruits and vegetables and fast foods separately. Odds Ratios and Chi Squares were conducted to determine the relationship between

neighborhood access to fresh fruits and vegetables and obesity and neighborhood access to fast food and obesity.

Below are the equations for the bivariate and multivariate analyses of the relationship between perceived neighborhood access to fast foods (or fresh fruits and vegetables) and obesity.

Bivariate

Fresh fruits and vegetables

$$y = \alpha + \beta_{(\text{fresh fruits and vegetables})} * X_{(\text{fresh fruits and vegetables})} + e$$

Fast food

$$y = \alpha + \beta_{(\text{fast food})} * X_{(\text{fast food})} + e$$

Multivariate

Fresh fruits and vegetables

$$y = \alpha + \beta_{(\text{fresh fruits and vegetables})} * X_{(\text{fresh fruits and vegetables})} + \beta_{(\text{age})} * X_{(\text{age})} + \beta_{(\text{gender})} * X_{(\text{gender})} + \beta_{(\text{education})} * X_{(\text{education})} + \beta_{(\text{income})} * X_{(\text{income})} + e$$

Fast food

$$y = \alpha + \beta_{(\text{fast food})} * X_{(\text{fast food})} + \beta_{(\text{age})} * X_{(\text{age})} + \beta_{(\text{gender})} * X_{(\text{gender})} + \beta_{(\text{education})} * X_{(\text{education})} + \beta_{(\text{income})} * X_{(\text{income})} + e$$

6.3.4 Objective Two social support moderation

Objective Two: How does social support moderate the relationship between the perceived neighborhood environment and obesity?

Hypothesis 4: Perceived social support moderates the relationship between perceived neighborhood environments (walkability, social cohesion, and food access) and obesity such that

those residents with high levels of perceived social support are less likely to be obese, even if they perceive their neighborhood environment to be poor.

The command PROC SURVEY LOGISTIC was used and an interaction term was added between perceived social support and perceived neighborhood variables by using a DOMAIN statement to determine if moderation existed. The moderation hypothesis was only tested if the main effect between the primary independent variables and obesity were significant in multivariate models.

Analyses were conducted for potential moderation by utilizing the dichotomized social support scale (<11 as low social support and ≥ 11 as high social support). The equations for potential moderation are below.

Walkability

$$y = \alpha + \beta_{(\text{walkability})} * X_{(\text{walkability})} + \beta_{(\text{social support})} * X_{(\text{social support})} + \beta_{(\text{walkability} * \text{social support})} * (X_{(\text{walkability})} * X_{(\text{social support})}) + \beta_{(\text{age})} * X_{(\text{age})} + \beta_{(\text{gender})} * X_{(\text{gender})} + \beta_{(\text{education})} * X_{(\text{education})} + \beta_{(\text{income})} * X_{(\text{income})} + e$$

Where y = obesity (yes/no)

α is the constant in the equation

β is the regression coefficient

x is the value of the independent variable

e is error

Social cohesion

$$y = \alpha + \beta_{(\text{social cohesion})} * X_{(\text{social cohesion})} + \beta_{(\text{social support})} * X_{(\text{social support})} + \beta_{(\text{social cohesion} * \text{social support})} * (X_{(\text{social cohesion})} * X_{(\text{social support})}) + \beta_{(\text{age})} * X_{(\text{age})} + \beta_{(\text{gender})} * X_{(\text{gender})} + \beta_{(\text{education})} * X_{(\text{education})} + \beta_{(\text{income})} * X_{(\text{income})} + e$$

7.0 RESULTS

Overall, 30.34% of the ACHS sample reported height and weight indicative of obesity (BMI \geq 30).¹³⁷ Table 3 below shows the distribution of obesity by demographic factors in the ACHS population. Significant inequities can be seen in the distribution of obesity in Allegheny County. Obese individuals were significantly more likely to be African American, have a high school education or less, and have an annual household income less than \$35,000. First, the distribution of obesity by demographic factors is discussed. Then, the results are discussed by objective.

Table 3. Obese individuals by demographic variables: percentages and Rao-Scott Chi Square

Variable	Frequency	Weighted frequency	Standard deviation	Percent Obese	Rao-Scott Chi-square	p-value
Gender (n = 5015)						
Male	499	117806	55271	30.7141	0.0272	0.869
Female	1047	129031	39891	30.4641		
Race (n = 4846)						
White	1094	201961	61532	29.592	48.3741	<.0001
African American	410	38454	1967	42.8042		
Age (n = 5015)						
25-34	129	29454	2940	24.1143	0.1608	0.6885
35-44	213	48518	3661	33.4156		
45-54	331	59547	3569	32.2853		
55-64	420	56488	2916	36.8938		
65+	453	52829	2555	26.1252		
Education (n = 5015)						
≤ High School	651	112277	4745	34.5514	18.8573	<.0001
≥ Some college	895	134559	48771	27.9083		
Annual Household Income (n = 4338)						
< \$35,000	694	101012	4151	33.8711	9.0698	0.0026
≥ \$35,000	682	120102	4909	29.0163		

* Since those under the age of 25 were excluded, Chi Squares and p-values were not calculated for the distribution of obesity by age group.

** Significant p-values (<.05) are in bold.

7.1 OBJECTIVE 1 – TO DETERMINE HOW PERCEIVED NEIGHBORHOOD ENVIRONMENT AFFECTS OBESITY IN ALLEGHENY COUNTY

7.1.1 Hypothesis 1 – walkability

Hypothesis 1: Allegheny County residents who perceive that they live in neighborhoods with high walkability are less likely to be obese compared to those who perceive that they live in neighborhoods with low walkability.

Analysis of the distribution of perceived neighborhood walkability by demographic characteristics indicated that: females, African Americans, those with a high school education or less and those whose incomes were less than \$35,000 were significantly less likely to perceive that they lived in highly walkable neighborhoods. (Data not shown).

Those who reported higher levels of neighborhood walkability had a 9% decreased odds of obesity (OR 0.908 (95% CI 0.878, 0.940)). The Chi Square of 29.86 was significant ($p < .0001$). Thus, according to bivariate analysis, those who reported higher levels of neighborhood walkability had a 9% decreased odds of obesity for each increase in walkability. *Multivariate analysis of the relationship between perceived neighborhood walkability and obesity are presented in Table 4.* In multivariate analyses, the relationship between walking environment and obesity was attenuated slightly but remained significant (AOR=0.932 (95% CI: 0.899, 0.966); $p < 0.01$). Thus, while controlling for potential covariates, the odds of obesity decreased by approximately 7% per unit of perceived walkability as perceived neighborhood walkability increased.

7.1.2 Hypothesis 2 – social cohesion

Hypothesis 2: Residents who perceive that they live in neighborhoods with high social cohesion are less likely to be obese as compared to those who perceive that they live in neighborhoods with less social cohesion.

Analysis of the distribution of perceived neighborhood social cohesion by demographic characteristics indicated that: African Americans, those with a high school education or less, and those with annual household incomes less than \$35,000 were significantly less likely to report living in neighborhoods with high perceived social cohesion. (Data not shown).

In bivariate analyses of the relationship between perceived neighborhood social cohesion and obesity, the Odds Ratio was 0.913 (95% CI 0.857, 0.973). This is significant and the p-value was 0.005. Thus, as the level of perceived neighborhood social cohesion increased, odds of obesity decreased by nine percent. In multivariate analyses, the relationship between perceived neighborhood social cohesion and obesity was in the same direction, but was no longer significant. (AOR 0.960 (95% CI 0.895, 1.029); p 0.2474).

Multivariate analysis of the relationship between perceived neighborhood social cohesion and obesity are presented in Table 4.

Table 4. Logistic modeling of the odds of obesity by perceived neighborhood walkability and social cohesion

Scale	Covariate	AOR	95% CI	Chi square	p-value
Model 1 :Walkability (n = 3,922)					
Walkability		0.932	0.899, 0.966	14.4345	0.0001
	Age	0.996	0.991, 1.001	2.0081	0.1565
	Annual Household Income	1.004	0.959, 1.050	0.0235	0.8782
	Education	0.836	0.758, 0.921	13.0249	0.0003
	Gender	0.948	0.809, 1.112	0.4284	0.5128
	Race	1.606	1.311, 1.969	20.8804	<.0001
Model 2: Social Cohesion (n = 3,645)					
Social Cohesion		0.960	0.895, 1.029	1.3378	0.2474
	Age	0.998	0.992, 1.003	0.7974	0.3719
	Annual Household Income	0.985	0.939, 1.034	0.3730	0.5414
	Education	0.851	0.769, 0.942	9.6938	0.0018
	Gender	0.922	0.783, 1.085	0.9552	0.3284
	Race	1.577	1.266, 1.966	16.4915	<.0001

* Significant p-values are in bold text.

7.1.3 Hypothesis 3 – healthful foods

Hypothesis 3: Residents who perceive that they live in neighborhoods with high access to healthful foods are less likely to be obese compared to those who perceive that they live in neighborhoods with low access to healthful foods.

Analysis of the distribution of perceived access to fast food by demographic characteristics indicated that only those reporting \$35,000 or more in annual household income

were significantly more likely to report living in neighborhoods with greater access to fast food. No other differences based on demographics are evident.

In bivariate analyses modeling the relationship between obesity and perceived access to fast food, the Odds Ratio was 0.973, (95% CI .835, 1.134). This is non-significant based on Confidence Intervals. Similarly, the p-value was 0.7305. The Wald Chi Square was 0.1186 with a non-significant p-value of 0.7305. Since bivariate analysis was clearly non-significant, multivariate analysis was not conducted.

Analysis of the distribution of perceived access to fresh fruits and vegetables by demographic characteristics indicated that African Americans, those with a high school education or less, and those with an annual household income of less than \$35,000 were significantly less likely to report having neighborhood access to fresh fruits and vegetables.

In bivariate analyses modeling the relationship between obesity and perceived access to fresh fruits and vegetables, the Odds Ratio was 0.874 (95% CL: 0.750, 1.019). Since the Confidence Intervals included one, this was non-significant. The Wald Chi Square was 2.966 with a non-significant p-value of 0.085. Multivariate analyses of the relationship between perceived access to fast food or fresh fruits and vegetables and obesity were not conducted since neither factor was significantly or nearly significantly related to obesity in bivariate analyses.

7.2 OBJECTIVE 2 – DOES SOCIAL SUPPORT MODERATE THE RELATIONSHIP BETWEEN PERCEIVED NEIGHBORHOOD ENVIRONMENT AND OBESITY?

Hypothesis 4: Perceived social support moderates the relationship between perceived neighborhood environments (walkability, social cohesion, and food access) and obesity such that those residents with high levels of perceived social support are less likely to be obese, even if they perceive their neighborhood environment to be poor.

Analysis of the distribution of perceived social support dichotomized into high and low (≤ 11 versus > 11) by demographic characteristics indicated that: African Americans, those with a high school education or less, those with an annual median income below \$35,000 were significantly less likely to report high levels of social support. (Data not shown).

Next, the bivariate relationship between social support and obesity was analyzed. There was no statistically significant relationship between perceived social support and obesity. The Odds Ratio was 0.977 (95% CI 0.827, 1.154) with a p-value of 0.7832. This is not surprising, since social support alone is not hypothesized to be an independent predictor of obesity.

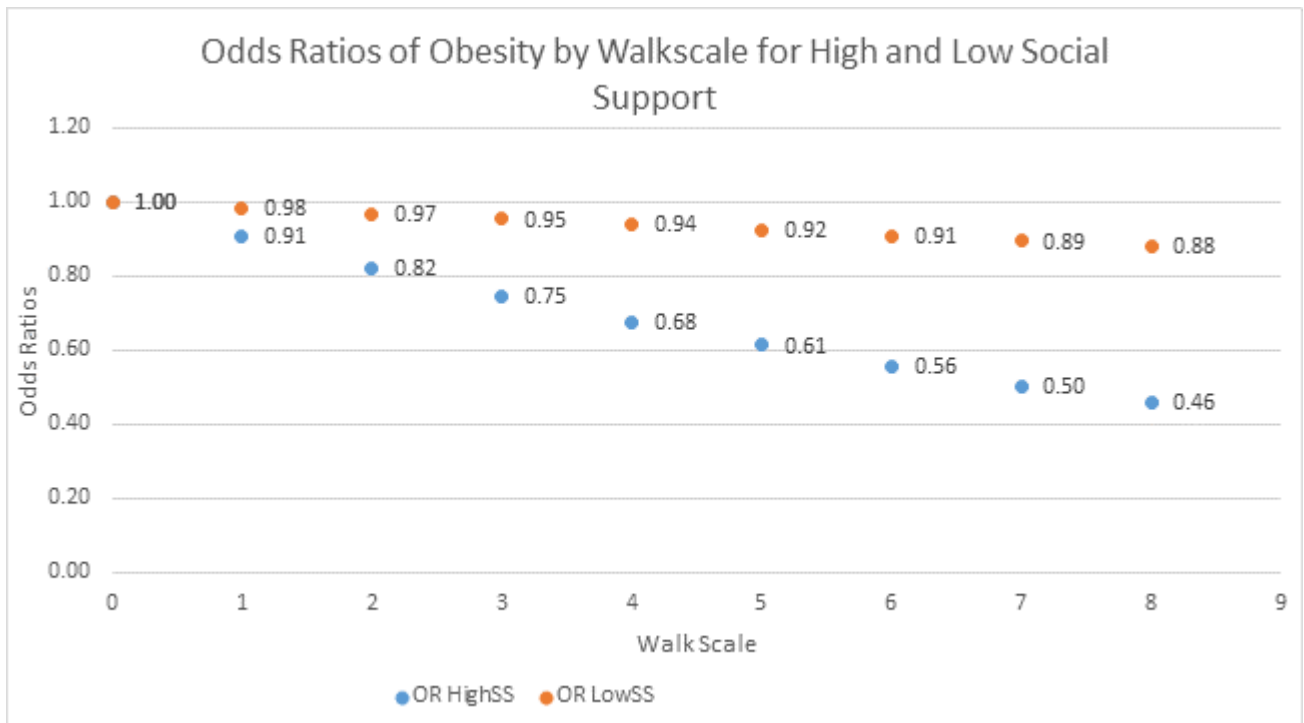
7.2.1 Walkability

In multivariate analyses of interactions, the main term (walkability) and the interaction term (social support scale x walkability) were statistically significant. Table 5 shows the results of this analysis.

Table 5. Logistic modeling of the moderation of relationship between perceived neighborhood walkability and odds of obesity by dichotomized social support scale in two models (n=3,590)

Covariate	Coefficient	AOR	95% CI	Wald Square	Chi p-value
Model 1 : Logistic modeling without social support moderation					
Age	-0.0038	0.996	0.991, 1.002	1.9581	0.1617
Annual Household Income	-0.0122	0.988	0.943, 1.035	0.2616	0.6090
Education	-0.1671	0.846	0.766, 0.934	10.9285	0.0009
Gender	-0.0641	0.938	0.797, 1.103	0.5994	0.4388
Race	0.4498	1.568	1.274, 1.930	17.9808	<.0001
Walkscale	-0.0719	0.931	0.896, 0.966	14.2454	0.0002
Social support	0.1747	1.191	0.989, 1.434	3.4111	0.0648
Model 2: Logistic modeling with social support moderation					
Age	-.0038	0.996	0.991, 1.001	1.9801	0.1594
Annual Household Income	-.0119	0.988	0.943, 1.035	0.2524	0.6154
Education	-.0167	0.846	0.767, 0.935	10.8757	0.0010
Gender	-.0677	0.935	0.794, 1.099	0.6669	0.4141
Race	0.4544	1.575	1.279, 1.940	18.2982	<.0001
Walkscale	-0.0159	0.984	0.923, 1.049	0.2387	0.6251
Social support	0.5992	1.821	1.173, 2.826	7.1342	0.0076
Walkscale x Social support	-0.0820	0.921	0.853, 0.995	4.3340	0.0374

Thus, dichotomized social support does moderate the relationship between perceived neighborhood walkability and obesity such that those with higher levels of social support are less likely to be obese at all levels of perceived neighborhood walkability. The moderated relationship between perceived neighborhood walkability and obesity by social support is significant for all. However, the protective effect that walkability has on obesity increases for those with high social support as walkability increases. This can be seen in Figure 2, below. This figure models the Odds Ratios of obesity by walkscales for those with high and low social support. The Odds Ratios modeled closer to the top of the chart represent those with low social support. Those closer to the bottom represent those with high social support. Note that the reference group is Walkscale = 0.



* Reference group is Walkscale = 0

Figure 2. Odds Ratios of Obesity by Walkscale for High and Low Social Support

7.2.2 Social cohesion and access to healthful food

The result of multivariate analyses of the interaction effects of perceived neighborhood social cohesion and obesity was non-significant. Additionally, there was no statistically significant relationship between access to fresh fruits and vegetables or fast food and obesity in bivariate models. Therefore, moderation by social support was not tested for perceived neighborhood social cohesion, access to fresh fruits and vegetables, or fast foods.

8.0 DISCUSSION

Consistent with national trends, obesity is an urgent public issue. 30.34% of the ACHS sample reported height and weight indicative of obesity ($BMI \geq 30$).¹³⁷ The Pennsylvania BRFSS reported that 29% of Pennsylvania adults were obese in 2010.¹⁴² Between 2011 and 2012, approximately 34.9% of American adults were obese.⁷ African Americans were significantly more likely to be obese (47.8%) as compared to whites (32.6%).⁷ Those with less income and education were also more likely to be obese as compared to wealthier and better educated individuals.⁸ Likewise, racial and socioeconomic inequities in the distribution of obesity are evident in Allegheny County. African Americans, those with a high school education or less, and those with an annual household income less than \$35,000 reported greater prevalence of obesity.

This study has two objectives. The first is to determine if there is a relationship between perceived neighborhood environment and obesity among Allegheny County adults. The second is to determine if the relationship between perceived neighborhood environments (walkability, social cohesion, and access to healthful foods) and obesity is moderated by social support. Results indicated that perceived neighborhood walkability was significantly associated with odds of obesity. However, perceived neighborhood social cohesion was not significantly related to the odds of obesity after controlling for potential covariates. The relationship between perceived access to fresh fruits and vegetables and access to fast food and obesity was found to be non-

significant. Dichotomized perceived social support moderated the relationship between perceived neighborhood walkability and obesity but not perceived neighborhood social cohesion and obesity.

First Objective

The first objective was: To determine if there is a relationship between perceived neighborhood environment and obesity among Allegheny County adults. Results of analyses indicated that perceived neighborhood walkability is significantly associated with obesity. The relationship between perceived neighborhood social cohesion was significant in bivariate analyses, but disappeared when covariates were controlled for. There was no statistically significant relationship between perceived neighborhood access to healthful foods or fast food and obesity. Results will be discussed by hypothesis.

Hypothesis 1 (*Allegheny County residents who perceive that they live in neighborhoods with high walkability are less likely to be obese compared to those who perceive that they live in neighborhoods with low walkability*) was supported by analyses such that those who reported high neighborhood walkability were significantly less likely to be obese. The 2010 and 2011 Pennsylvania BRFSS did not include any questions related to perceived neighborhood environment.¹⁴² Therefore, comparisons between the results of Allegheny County's perceived neighborhood environment measures cannot be compared to those of the state of Pennsylvania. Evidence about the association between perceived neighborhood walkability and obesity is mixed. However, the evidence generally supports an association between perceived neighborhood walkability and obesity such that low perceived neighborhood walkability is associated with greater odds of obesity.¹⁸

Other studies have found a statistically significant association between neighborhood walkability or access to exercise / recreational facilities and lowered odds of obesity.^{14,17} Mujahid et al. utilized results from the Multi Ethnic Study of Atherosclerosis (MESA) Community Survey, which provided the model of the neighborhood scales used in the ACHS. They combined measures of neighborhood walkability and access to healthful foods into a neighborhood physical environment score. They found a statistically significant relationship between neighborhood physical environment and obesity. However, comparisons between these studies should be done with care since Mujahid et al. included access to healthful foods in a measure together with walkability and the ACHS provides no evidence of a relationship between perceived access to healthful foods and obesity. At least, not as access to healthful foods was measured in the ACHS. Auchincloss et al. also utilized MESA Community Survey data and found no statistically significant association between perceived neighborhood environment and obesity after controlling for potential covariates.¹⁸ This discrepancy in results could be due to at least two factors. First, this study was conducted with a different population. The MESA Community Survey studies utilize survey results from certain census tracts from New York City/Bronx, New York; Forsyth County, North Carolina; and Baltimore City/County, Maryland.^{18,76} Second, while all three studies include several of the same covariates (age, gender, race/ethnicity, and education^{18,76}), this study did not use all of the same covariates. Auchincloss, et al. control for: household assets (such as homeownership), per capita household income (this study controlled for annual household income), cigarette smoking status, and high weekly consumption of alcohol.¹⁸ Mujahid et al. control for length of residence in the neighborhood.⁷⁶ These other variables were not present in the ACHS.

Cleland et al. found statistically significant associations between increased perceived neighborhood walkability and both leisure time physical activity and travel related physical activity in women living in poor neighborhoods in rural and urban Australia.¹⁴³ It is possible that physical activity mediates the relationship between perceived neighborhood walkability and obesity.

Several studies combined perceived neighborhood walkability and access to healthful foods into a measure of perceived physical neighborhood environment.^{4,76} However, when perceived neighborhood walkability and perceived neighborhood access to healthful foods are combined into one scale, one cannot separate the effects of the walking and food environments. They are conceptually different, so I felt it was important to conduct separate analyses.

Hypothesis 2 (*Residents who perceive that they live in neighborhoods with high social cohesion are less likely to be obese as compared to those who perceive that they live in neighborhoods with less social cohesion*) was supported in bivariate, but not multivariate, analyses.

Bivariate analyses of the relationship resulted in a significant relationship between perceived neighborhood social cohesion and the odds of obesity. However, this relationship was no longer significant when potential covariates were controlled for. One potential explanation is that social cohesion may be correlated with SES.¹⁴⁴ This study controlled for two measures of SES, annual household income and education level, which could explain why effects of social cohesion on obesity are not seen.

Mujahid et al. combined questions measuring perceived neighborhood social cohesion, aesthetics, safety, and violent crime in order to measure the relationship between perceived neighborhood social environment and obesity in the MESA Community Survey. They found no

statistically significant relationship between neighborhood social environment and obesity, although comparability may be skewed to their inclusion of other domains of the social environment in their analyses.⁷⁶ Other studies have found no statistically significant association between perceived neighborhood social cohesion and obesity.²¹ However, others have found a significant relationship between neighborhood social cohesion and obesity.¹⁴ It is possible that, in Allegheny County, adults walk in their neighborhoods if they have sidewalks even if they do not trust, or get along with, their neighbors.

Hypothesis 3: Residents who perceive that they live in neighborhoods with high access to healthful foods are less likely to be obese compared to those who perceive that they live in neighborhoods with low access to healthful foods.

No statistically significant relationship for perceived neighborhood access to fresh fruits and vegetables or fast foods and obesity was found. Results of the literature analyzing the association between perceived neighborhood access to fast food and obesity is mixed.^{34,36} Many studies and literature reviews indicate that there is a statistically significant relationship between neighborhood access to healthful foods and obesity,^{23,25,33,34} although another found no relationship.²¹

The results of this study are similar to some research on neighborhood food environment and obesity. Pouliou and Elliott found no significant relationship between fast food density and BMI in their study of Canadian adults living in Toronto and Vancouver.⁴ Black et al. found in their study of neighborhood environments and obesity in New York City that neighborhood access to a supermarket was significantly associated with lower odds of obesity.¹⁴¹ Gustafson, et al. found a relationship existed between objective measures of access to healthful foods in a grocery store, but not perceptions, and BMI and fruit and vegetable consumption.²⁵ It could be

that the objective reality is more important for Allegheny County residents' fresh fruit and vegetable consumption. Powell-Wiley et al. did not find statistically significant associations between perceived access to food stores and obesity while controlling for covariates.²¹

There are a few possible explanations for the lack of significant associations between access to healthful foods and odds of obesity in Allegheny County. Fuller, Cummins, and Matthews found that there was no significant relationship between reported neighborhood access to grocery stores and fruit and vegetable consumption in two Philadelphia, Pennsylvania neighborhoods.¹⁴⁵ Hirsch and Hillier studied the food shopping habits of individuals living on two blocks in two different neighborhoods in Philadelphia, Pennsylvania.¹⁴⁶ One block was characterized as having a favorable food environment and the other had an unfavorable food environment. Hirsch and Hillier found that only about one fourth of those in the favorable and about one fourth of those in the unfavorable food environments conducting their largest food shopping trips at the closest supermarket to their home. Most respondents (87%) traveled more than 0.5 miles to purchase food. The common designation for a local food environment is 0.5 miles.¹⁴⁶ Likewise, residents of Allegheny County may travel outside of their neighborhood to purchase food or their proximity to a grocery store may not be related to their consumption of fruits and vegetables. This analysis was not conducted with ACHS data but could be done in the future.

The second potential is that the two measures of the food environment, perceived access to fresh fruits and vegetables and to fast food outlets, may be incomplete measures of access to healthful foods. Participants may consider other factors when thinking about access to fresh fruits and vegetables, including: affordability, food selection, and store access to local residents.³⁶ The MESA Community Survey included two additional questions concerning

neighborhood access to healthful foods that the ACHS did not. They are: “The fresh fruits and vegetables in my neighborhood are of high quality” and “A large selection of low-fat products is available in my neighborhood.”⁷⁶ (p. 861) Mujahid et al. dropped the question “there are many opportunities to purchase fast foods in my neighborhood” in order to improve the internal consistency of the availability of healthy foods scale.⁷⁶ This question nevertheless was included in the ACHS. Other studies of neighborhood access to healthful foods have included other measures, including affordability⁵⁷ and presence of specific food amenities such as supermarkets, small grocers, and beverage and snack foods stores.¹⁴¹

Additionally, there may be an issue with measuring perceived access to fast food solely at the neighborhood level. Individuals may be more likely to consume fast foods when they eat lunch. Since people tend to work outside of their neighborhoods, neighborhood access to fast foods may not be as important as their access at their work environments.³⁷

Caspi et al. found only weak evidence for the connection between access to – and consumption of – fast food and obesity. They hypothesized that this could be due to the fact that fast food restaurants are pervasive across the country in comparison to other sources of food.³⁶ Additionally, individuals may choose fast food when they believe that they do not have the time to cook or if they do not know how to cook. Inglis et al. found that self-reported access to “healthy options to eat out locally” was associated with less fast food consumption and more fruit and vegetable consumption.¹⁴⁷ (p. 194) This could mean that less access to restaurants that serve healthful foods in the neighborhood could be more important than access to fast food restaurants in terms of the odds of obesity.³⁶

Interestingly, analyses indicated that individuals who reported having an annual household income of \$35,000 or more also reported greater access to fast food as compared to

individuals who reported an annual household income of less than \$35,000. I am unaware of research investigating whether more fast food restaurants are located in low income or more affluent neighborhoods in Allegheny County. However, nationally, fast food restaurants are pervasive³⁶ yet disproportionately located in poor and minority communities.^{34,35} It is possible that higher income individuals residing in Allegheny County are health conscious and are aware of the fast food restaurants in their neighborhoods and do not want them to be there. They could be more likely to report neighborhood access to fast food as a result of their heightened awareness of their presence. On the other hand, fast food restaurants could be so common in poorer neighborhoods that residents do not think much about their presence. Or, while they are technically located in their neighborhoods, perhaps the residents think that they have to walk too far of a distance from their home to purchase fast food. Despite national trends, it is possible that owners of fast food restaurants in Allegheny County may not wish to open their businesses in poor areas. Austin et al. found in their study of the distribution of fast food restaurants around Chicago-area schools that fast food establishments were more likely to be located in middle and higher income neighborhoods as compared to poorer neighborhoods.¹⁴⁸ Future research could explore these patterns of perceived neighborhood access to fast food in an attempt to find an explanation.

Second Objective

The second objective was: How does social support moderate the relationship between the perceived neighborhood environment and obesity? The results were mixed. Perceived social support moderated the relationship between perceived neighborhood walkability and obesity. In moderation analyses, perceived social support moderated the relationship between perceived

neighborhood social cohesion and obesity. However, when covariates were entered into the model, the moderation effect was non-significant.

Hypothesis 4: Perceived social support moderates the relationship between perceived neighborhood environments (walkability, social cohesion, and food access) and obesity such that those residents with high levels of perceived social support are less likely to be obese, even if they perceive their neighborhood environment to be poor.

Perceived access to social support moderates the relationship between perceived neighborhood walkability and odds of obesity. Perceived neighborhood social cohesion, access to fresh fruits and vegetables and fast foods were not significantly associated with obesity. Therefore, moderation analyses were not conducted for these variables.

Perceived individual-level social support moderates the relationship between perceived neighborhood walkability and obesity for those with low and high perceived walkability. However, perceived social support is more protective for those individuals who also report better neighborhood walkability. Individuals who reported poor walkability were more likely to be African American, low income, and have low educational attainment. It is likely that, even if they think that they have high levels of social support, they have more barriers to overcome in maintaining a healthy weight than just poorly walkable neighborhoods. This result does not support Vitaliano et al.'s added value hypothesis, which suggests that social support will be more protective of health in those with low income versus higher incomes.⁵³ There are a few possibilities of why this hypothesis was not supported. First, I considered perceived neighborhood walkability to a proxy for SES since those who reported low neighborhood walkability were more likely to be African American, have low income, and low education. However, neighborhood walkability may be a poor proxy for SES. Second, walking may be

related to social support in some way. Walking may be a social activity. Perhaps with more social support, people have more opportunities to walk in their neighborhood and they will see others who are also walking, thereby contributing to the social nature of walking in one's neighborhood. To my knowledge, this is the first study that has tested social support moderation of associations between perceived neighborhood walkability, social cohesion, and access to healthful foods and obesity.

Distribution of primary independent variables and moderator in population and potential historical connection

Inequities were seen in the analyses of the distribution of perceived neighborhood walkability, social cohesion, and perceived social support by demographics. African Americans, those reporting an annual household income of less than \$35,000 and a High School education or less were significantly more likely to report living in neighborhoods with poor walkability and social cohesion, as well as low social support. Perhaps this is not surprising, given the historical influences on the development – and collapse – of many neighborhoods.

Immigration, fueled by the steel industry, helped Polish and Italian immigrants to build strong neighborhoods in Pittsburgh in areas such as Bloomfield, Lawrenceville, and the South Side.¹²¹ It is likely that individuals in these neighborhoods would have reported high levels of neighborhood social cohesion. They tended to work with family members and friends and, therefore, were able to form strong kinship networks within industry. African Americans, however, had a very different experience. They faced many challenges when migrating to the Pittsburgh region, including racism in employment and housing. They were forced to accept the most menial jobs and to live in neighborhoods with substandard housing. They did not have

strong kinship networks in their workplaces and did not have many people to count on when times inevitably became tough.¹²¹

However, the Hill District in Pittsburgh was a shining example of a strong African American community. It did have substandard housing, but it also had a vibrant social life that helped to make sure that everyone had enough food and clothing and that kept young men from getting into too much trouble.¹²³

Beginning in the mid-20th century, the federal government pursued the urban renewal program was designed to help to clear “blight” from neighborhoods.^{123 (p. 20)} Urban renewal happened in various parts of the Pittsburgh region, including: McKeesport, Wilkinsburg, Pittsburgh, and Carnegie.¹²² However, perhaps the most striking example of Pittsburgh’s urban renewal program is the Hill District, which was largely bulldozed in order to make way for the Civic Arena.¹²³ Residents’ emotional and social support systems were destroyed. Root shock, “the traumatic stress reaction to the destruction of all or part of one’s emotional ecosystem”, set in.¹²³ This led to an increase in social and health ills. Root shock can negatively impact individuals’ social relationships and lead to increased odds of many health conditions including anxiety, depression, and heart attack.¹²³ Refer to section 4.2.1 for a more in-depth discussion of root shock and its effects.

Deindustrialization, beginning in the early 1980s, also led to disintegration of neighborhoods. Many communities depended on steel and other industries for their livelihood and identities.¹²⁶ Male unemployment skyrocketed as a result of deindustrialization, but African American and working class neighborhoods surrounding Pittsburgh were the most affected by the loss of jobs.¹²⁷ EPA regulations offered no incentives for companies to redevelop former industrial sites, which meant that the land went unused, limited capital circulated, businesses

closed, crime increased,¹²⁷ and those who could left the towns to find work elsewhere.¹²⁰ While Pittsburgh is touted as America's most livable city and for being resilient in reinventing itself after deindustrialization, not all communities reap the benefits of this reinvigoration.¹²⁰ Many former mill towns are still depressed. For example, Homestead, Duquesne, and Rankin have some of the worst poverty and crime rates in Allegheny County.¹²⁸ All three of them are former mill towns.

It is possible that the inequities in the distribution of perceived neighborhood walkability, social cohesion, and social support *could* be evidence of historical processes that disadvantageously impacted racial minorities and those in the lower social classes in the greater Pittsburgh region. After all, Thompson argued that “the notion of class entails the notion of historical relationship... Class is defined by men as they live their own history, and, in the end, this is its only definition.”¹¹⁸ (p 11) However, ACHS cannot prove or disprove that historical processes have impacted the inequitable distribution of these variables in Allegheny County.

Neighborhoods with former industrial sites, especially if they have not been remediated and put to use for the community, have many health issues. Berman and Forrester argue that these exposures and lack of access can have profound public health consequences, including elevated crime rates and few opportunities to engage in physical activity in the neighborhood.¹⁴⁹ Fullilove and Wallace argue that urban renewal and deindustrialization decimated the social fabric of the Hill District. Before urban renewal and deindustrialization, the Hill District was full of African Americans who took great pride in their neighborhood and who strove to make it a better place through the vast number of community organizations. Networks throughout the neighborhood shared responsibility for raising children. Although they do not specifically use the term “social cohesion”, this seems like good evidence that social cohesion existed in the Hill

District. However, after urban renewal and deindustrialization, former Hill residents were scattered to other public housing units within the Hill District and throughout Pittsburgh. Those who remained did not have the skills to enter health care and education sectors that began to offer gainful employment to Pittsburgh residents. Drugs and violence took hold in the Hill District. Fullilove and Wallace term this a “social rupture”,^{150 (p. 386)} which could be considered the antithesis of social cohesion.

What can be done to improve neighborhood environments in order to improve the obesity epidemic?

Obesity is one of the most important causes of avoidable chronic disease and subsequent health care costs in this country.¹ Obesity is a risk factor for the development of many chronic conditions, including: diabetes,²⁻⁵ heart disease,³⁻⁵ high blood pressure,³⁻⁵ metabolic syndrome,⁵ osteoarthritis,^{3,5} sleep apnea,⁵ and certain forms of cancer.^{3,5} Obesity raises the risks for all of these conditions and makes treatment more complicated.² Deaths due to obesity are second behind cigarette smoking and are estimated to range between 112,000 and 300,000.⁶ Up to 20.6% of national health spending is used to treat obesity-related diseases.¹⁰

The prevalence of obesity has more than doubled in the last three decades, but increases in adult obesity rates seem to be slowing down. Additionally, childhood obesity prevalence is beginning to decrease, although minority and low-income communities are seeing either a slower reduction in childhood obesity or no reduction at all.¹

The time to act is now. Schools, policy experts, community members, and business leaders have collaborated to ensure that childhood obesity prevalence decreases. A similar collaborative approach must be taken regarding adult obesity.¹ Obesity is a complex public

health issue that is affected not only by personal health behaviors, such as exercise and healthful eating,^{11,12} but also by physical and social environments.^{4,15,16} Ignoring these contexts can result in ineffective behavioral interventions.^{14,15} Neighborhood environments are thus important to consider in attempts to ameliorate the obesity epidemic.^{13,14}

Health researchers and policymakers must look to collaborations with other sectors that are not often associated with health, such as the community development sector. Community development policies are usually not seen as health policies, yet they can have profound health impacts.¹⁵¹ Unlike urban renewal, community development helps to provide poor neighborhoods with the resources necessary to improve their neighborhoods by building health centers, affordable housing, and child care centers. Community development helps poor communities to become stronger economically and socially.¹⁵² While such collaborations are time and resource-intensive, they are likely to reduce long-term costs.^{151,152} Additionally, neither the community development nor the health fields will be able to stem the tide of obesity and other health inequities on their own.¹⁵¹

There are examples of partnerships between the health and community development sectors to improve neighborhood environments. The Healthy Food Financing Initiative is a program run jointly by the US Treasury, the Departments of Agriculture, and Health and Human Services. This program provides funding to build grocery stores in food deserts and also pays for expensive refrigeration equipment to allow fresh foods to be sold at these grocery stores.¹⁵¹

Furthermore, partnerships with the community development sector can result in more walkable neighborhoods and even greater neighbor social cohesion and support for neighbors who are in experiencing hardship.¹⁵³ There is an academic-community development partnership in San Francisco that will analyze the health impacts of a project to redevelop a large low-

income housing project. Reconstruction is part of a program called HOPE SF, modeled after the federal program Housing Opportunities for People Everywhere (HOPE VI), which demolished dilapidated public housing to replace it with mixed-income housing. Unfortunately, many low-income residents who had been displaced were unable to return to their neighborhoods. Unlike the federal program, however, HOPE SF will emphasize maintaining a home for displaced individuals within the housing community. Construction has not yet begun, but the collaboration will allow redevelopment to occur in ways that should theoretically improve the health of the residents and will allow for prospective research about the impacts of neighborhood improvements on health. Results from this collaboration may also provide a blueprint for other academic-community partnerships to be able to improve the health of poor neighborhoods in their communities.¹⁵⁴

A better understanding of the impacts that neighborhood built, food, and social environments can have on health behaviors will help in the development of more effective public policies that can improve the health of neighborhoods. Without consideration of these factors, health education interventions to combat obesity will not be as effective.³ This type of change will not be easy. In fact, the task proposed herein is immense and will likely take many years to accomplish if undertaken.

9.0 STRENGTHS AND LIMITATIONS

This study has several strengths. First, the Allegheny County Health Survey is a fairly large sample that is representative of Allegheny County adults, which allows generalization to Allegheny County. Second, to my knowledge, this is the first study to use this dataset to analyze the relationship between perceived neighborhood environment and obesity and if this relationship is moderated by social support. Third, the ACHS oversampled for African Americans and those with low SES. Therefore, health inequities can be detected using this sample. Not all studies comparing neighborhood environments and health outcomes, including obesity, have oversampled for these sub-populations.¹⁴¹ Fourth, the discussion considers historical processes in the discussion of results which Krieger and others have argued is vital to understanding public health issues.^{96,115,117}

There are also several limitations. First, the ACHS is cross-sectional. Therefore, causation cannot be determined.⁷² Second, the ACHS relies solely on perceptions of the independent variables. It is argued that perceived and objective measures should be combined to best analyze the effect that the environment can have on health.^{13,25} On the other hand, perceptions of neighborhood environment are valuable to measure in and of themselves³² and may be more strongly associated with health than objective measurements.^{29,73,110} Third, the ACHS includes only two measures of perceived access to healthful foods, fresh fruit and vegetables and fast food. ACHS coordinators may want to consider adding additional measures

that research has shown to be meaningful in future versions of the ACHS. These measures include perceived food quality and food cost.²⁵ Fourth, while the Allegheny County Health Survey includes respondents' zip codes and nearest street intersection, results were not analyzed based on the neighborhood within which respondents lived. Leal and Chaix recommend including such neighborhood-level measures into analyses, because not including these measures can skew analytical results.¹⁴ Fifth, there could be errors in the calculation of BMI since height and weight were obtained from self-report.³⁷ People tend to claim that they weigh less than they do. There may be an underestimation of obesity in this survey.¹³ However, Spencer et al. argue self-reported height and weight is accurate enough to be valid for use in epidemiological studies. They suggest taking physical measurements of height and weight of a random sample of the study participants and applying these to the whole study population if more accurate measures are required.⁶⁷ Sixth, interviewers provided no definition of neighborhood to respondents (T. Bear, Ph.D., oral communication, June 2014). This could have led to reporting bias if respondents defined neighborhoods differently from other survey respondents. However, residents may not be able to perceive distances accurately even when they are provided by research staff.¹³ In this instance, there may be ordering effects from the survey questions. The neighborhood module followed directly after questions asking participants for their neighborhood/municipality, zip code, and nearest street corner.²⁴ Therefore, participants may have responded to the neighborhood questions while thinking about the neighborhood/municipality they had just reported. Seventh, the ACHS did not include questions about how long respondents had lived in their neighborhoods. Other studies have included this measure to account for variances based on perceptions of the neighborhood environment based on length of residence in the neighborhood.⁷⁶ ACHS coordinators may want to consider adding a

measurement of length of residence to future versions of the ACHS. Eighth, neighborhood scale data and social support data are in Likert scale format, which is ordinal level data.¹⁵⁵ For analyses, the ordinal data were treated as interval. This is often done in psychology and other disciplines. In addition, it has been argued that it is an acceptable practice with Likert scales that include between four and eight potential responses.¹⁵⁶ With five Likert scale responses, the ACHS responses are in this range.²⁴ Therefore, I felt comfortable treating the ordinal variables as interval variables. Finally, the use of a brief, four-item scale to measure social support does not allow analysis by the subscales included in the full MOS-SSS (emotional, informational, tangible, positive social interaction, and affectionate support).¹³⁹

10.0 CONCLUSIONS AND RECOMMENDATIONS

Results of this study indicate that, among adult residents of Allegheny County, perceived neighborhood walkability is significantly associated with obesity. Bivariate analysis indicates that perceived neighborhood social cohesion is significantly related to obesity but this association disappears in multivariate analyses. Perceived neighborhood access to fresh fruits and vegetables and access to fast food are not significantly associated with obesity. Perceived social support moderates the relationship between perceived neighborhood walkability and obesity. This thesis results in several recommendations for future research. First, I make recommendations for future research more generally. Second, I make suggestions for changes to future versions of the ACHS.

10.1 RECOMMENDATIONS FOR FUTURE RESEARCH ON NEIGHBORHOOD ENVIRONMENT AND OBESITY

Future research should combine objective and subjective measures of neighborhood environment characteristics when possible. Studies can also use the method that Mujahid et al. used to calculate Intra-neighborhood Correlation Coefficients in order to create a more objective measure of the neighborhood environment with this self-reported data.⁷⁶

I found very few longitudinal analyses studies of the relationship between neighborhood environment and obesity.¹⁸ It is important to determine if exposure to unhealthy neighborhood environments precede the onset of obesity, if they make losing weight harder once obesity has been reached, or if there is a combination of the two.

Studies could measure physical activity as a mediator of the relationship between perceived neighborhood walkability and obesity. Future research should also consider including questions about the acceptability of the fresh food available in neighborhood, for example, food quality.³⁶

Since racial and some gender differences were seen in the distribution of obesity and the neighborhood factors measured, analyses by gender and race could be completed. Additionally, neighborhood environments may be embodied through stress and elevated cortisol excretion.²¹ Long-term cortisol levels can now be measured fairly easily by measuring the concentration of cortisol in study participants' hair.¹⁰² Studies that include in-person measurements could include measurements of cortisol levels. Additionally, future research could study how historical processes influence health outcomes in neighborhoods and other geographic areas today.

10.2 RECOMMENDATIONS FOR FUTURE VERSIONS OF THE ACHS

The Pennsylvania Department of Health added cell phones to their sampling in 2011,¹⁴² a year after the final ACHS interviews were conducted. When the ACHS is conducted again, the survey developers may want to consider incorporating cell phones using the same methodology. Next, I make suggestions for improvements to the neighborhood module of the ACHS. I realize that researchers need to exercise caution when developing surveys. Surveys should be

comprehensive enough to obtain enough information to make meaningful inferences about the health of a population. However, they also must be brief enough to avoid respondent fatigue.

⁷⁰Additionally, since the ACHS is a collaborative project between the University of Pittsburgh's Graduate School of Public Health, the Allegheny County Health Department, and many community organizations, compromises must be made to ensure that all community partners are able to include questions of meaning to them. If all agree that measurements of the neighborhood environment are very important to measure, I make the following suggestions for additions and deletions of questions to the survey based on my literature review.

Questions to consider removing

- Perceived access to fast food – Mujahid et al. deleted this question from analyses to improve the scale's internal consistency.⁷⁶
- “There is a lot of noise in my neighborhood” from perceived neighborhood walkability scale – In the MESA Community Survey, this was a part of a scale measuring perceived neighborhood aesthetic quality.⁷⁶

Questions to consider adding

- Question about length of residence within the neighborhood⁷⁶
- If the question about neighborhood noise level is deemed important, consider adding other measures of perceived neighborhood aesthetics from the MESA Community Survey⁷⁶
- Access to fast food at locations other than neighborhoods (e.g. work environments)³⁷
- Neighborhood access to restaurants with healthful food options^{36,147}
- Questions about neighborhood access to healthful foods:

- Food Quality (included in the MESA Community Survey)⁷⁶ and suggested by others²⁵
- Food cost^{25,57}
- Access to low-fat products (included in the MESA Community Survey)⁷⁶
- Food selection³⁶
- Neighborhood access to supermarkets^{34,141}
- Neighborhood access to convenience stores^{34,141}

APPENDIX: LIST OF NEIGHBORHOOD SCALE QUESTIONS

Walkability

My neighborhood offers many opportunities to be physically active.

Local sports clubs and other facilities in my neighborhood offer many opportunities to get exercise.

It is pleasant to walk in my neighborhood.

In my neighborhood, it is easy to walk places.

I often see other people walking in my neighborhood.

I often see other people exercising (for example, jogging, bicycling, playing sports) in my neighborhood.

I feel safe walking in my neighborhood, day or night.

Busy roads make it unsafe to walk in my neighborhood.

There is a lot of noise in my neighborhood. ++

Access to healthful foods

A large selection of fruit and vegetables is available in my neighborhood.

There are many opportunities to purchase fast foods in my neighborhood.

Social cohesion

People around here are willing to help their neighbors.

People in my neighborhood generally get along with each other.

People in my neighborhood can be trusted.

People in my neighborhood share the same values.

Notes:

+ For all questions, 5 point Likert scale responses were:

Strongly agree

Agree

Neither agree nor disagree

Disagree

Strongly Disagree.

++ Item included in ACHS but not in analyses.

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