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OBESITY AND THE BUILT ENVIRONMENT IN TWENTY-SIX RURAL GEORGIA
COUNTIES: AN ANALYSIS OF PHYSICAL ACTIVITY, FRUIT AND VEGETABLE
CONSUMPTION, AND ENVIRONMENTAL FACTORS

by

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A Thesis Submitted to the Graduate Faculty
of Georgia State University in Partial Fulfillment
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2007

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Obesity and the built environment in twenty-six rural Georgia counties: An analysis of physical activity, fruit and vegetable consumption, and environmental factors
(Under the Direction of Dr. Valerie Hepburn)

Abstract

This study assesses environmental factors in the exercise and food environment, demographic factors, physical activity behavior, and fruit and vegetable consumption in 26 rural Georgia counties. The purpose of the study is to identify environmental indicators of physical activity and fruit and vegetable consumption; to see what agencies in Georgia, if any, are collecting these types of data systematically throughout the state; and, to analyze potential relationships between environmental factors and health behaviors. Physical activity and fruit and vegetable consumption were derived from the Georgia Behavioral Risk Factor Surveillance System (2001, 2002, 2003, and 2005). Demographic data were from the U.S. Census (2000). Environmental data were collected using Reference USA. Analysis was conducted using *Pearson's* correlation (one-tailed). No statistically significant associations were found between the food environment and fruit and vegetable consumption nor the exercise environment and physical activity; suggesting associations found in urban areas may not exist in rural areas. Fruit and vegetable consumption was positively associated with travel time to work ($P < .05$). Physical activity was positively related to travel time to work ($P < .01$) and education ($P < .05$) and negatively related to federal spending per person ($P < .05$). Findings should improve understanding of the relationship between the environment and physical activity and fruit and vegetable consumption in rural GA. Recommendations for improved data collection and interdepartmental cooperation are made.

INDEX WORDS: nutrition, physical activity, built environment, rural health, obesity

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CHAPTER I - Introduction

In response to the epidemic of obesity in the United States, various efforts are underway to implement strategies including policies and environmental changes for obesity prevention and control. The Centers for Disease Control and Prevention (CDC) currently funds and works with 28 states, including Georgia, to “build lasting and comprehensive efforts to address obesity and other chronic diseases through a variety of nutrition and physical activity strategies” (CDC 2007 p1). Public health surveillance data from the Behavioral Risk Factor Surveillance System (BRFSS) conducted annually in each state provides rich data on many individual behaviors including fruit and vegetable consumption and leisure time physical activity. Data on height and weight are also reported in the BRFSS, from which body mass index (BMI) is calculated (CDC 1984-2006). While reliable public health surveillance data exists, there is no surveillance system tracking policy or the built environment systematically and in every state. Therefore, although the epidemic of obesity is clear and the contributing behaviors, physical activity and fruit and vegetable consumption, are known it is unknown how changes in behavior relate to changes in the built environment. The relationship between the exercise environment and physical activity is unclear. Likewise the relationship between the food environment and fruit and vegetable consumption is unclear.

The evidence base is building to clarify the relationship between the built environment and obesity. The majority of research is done in urban areas and at the neighborhood level (Table 2). The relationship between many environmental factors (population density, miles of sidewalks, miles of bicycle facilities, number or acreage of community gardens, urban sprawl etc.) has been researched in urban areas and in Georgia

this preliminary evidence has led to the inclusion of strategies such as increasing the number of sidewalks and bike paths in its state plan to prevent obesity and chronic diseases (GADHR and GADPH 2005). It is unknown; however, if a positive relationship between physical activity and the presence of sidewalks exists in rural areas or is as strong in rural areas as it is in urban areas. The state plan focuses on multiple types of behavioral settings including community, faith-based, healthcare, school, and worksite. The plan does not differentiate between urban, rural, and suburban areas nor does it present strategies for communities of differing sizes or levels of development. This thesis explores the relationship between environmental factors and fruit and vegetable consumption and physical activity in 26 rural Georgia counties to identify what if any environmental data are available at the county level and what if any relationship exists between that data and physical activity and fruit and vegetable consumption. For the purposes of this research the National Institute of Health's (NIH) definition of the built environment will be used. "It encompasses all buildings, spaces and products that are created, or modified, by people. It includes homes, schools, workplaces, parks/recreation areas, greenways, business areas and transportation systems. It extends overhead in the form of electric transmission lines, underground in the form of waste disposal sites and subway trains, and across the country in the form of highways. It includes land-use planning and policies that impact our communities in urban, rural and suburban areas" (NIH 2004 p1).

The Burden of Overweight and Obesity

Overweight and obesity¹ rates have continuously increased, reaching epidemic proportions in the United States (Mokdad et al. 2001; Mokdad et al. 1999, 2000). The prevalence of overweight or obese adults increased from 56 percent during the period between 1988-1994 to 65 percent between 1999-2002 (NCHS 2007). Overweight and obesity prevalence among adults in Georgia has been increasing since 1984, when data were first collected. At that time, 37 percent of adults were overweight or obese. In 2002, that figure rose to 59 percent: 35 percent of adults in Georgia were overweight and 24 percent were obese (GADHR and GADPH 2005). Overweight and obese adults are at increased risk for cardiovascular disease, diabetes, and some forms of cancer (USDHHS 1996). Premature mortality relating to obesity and overweight is a leading cause of death in the USA (Allison et al. 1999; Mokdad et al. 2005). Approximately 10 percent of total or 6,700 deaths in Georgia are attributable to diseases resulting from overweight and obesity. 1,500 deaths are attributable to overweight and 5,200 to obesity (GADPH 2005). The health care costs associated with obesity have been estimated at \$117 billion a year not including indirect costs, which exceeds the health care costs spent on smoking and alcoholism combined (CDC 2003). Estimated direct and indirect costs of obesity in Georgia are \$2.1 billion per year (GADPH 2006).

Behavioral risk factors mitigating and preventing overweight and obesity include fruit and vegetable consumption and physical activity. Premature mortality due to physical inactivity and unhealthy diet ranks second only to tobacco-related deaths among preventable causes of death in the USA (Mokdad et al. 2005; Allison et al. 1999).

¹ An individual with a body mass index (BMI) of 25 to 29.9 is considered overweight. An individual with a BMI of 30 or more is considered obese

Environmental factors contribute to fruit and vegetable consumption and physical activity. The literature provides evidence that physical activity is positively associated with the accessibility of recreation facilities and that fruit and vegetable consumption is related to the food environment (Boehmer et al. 2006; Humpel, Owen, and Leslie 2002; Maddock 2004; Parks, Housemann, and Brownson 2003). Certain environments have been labeled obesogenic – A type of environment promoting obesity on a population level by encouraging physical inactivity and unhealthy food choices (Boehmer et al. 2006). To affect the burden of obesity and overweight in Georgia, the constructs of healthy environments and obesogenic environments must be better understood.

Systematically collected data on behavior, morbidity, and mortality allow epidemiologists and other public health professionals to see trends form and develop over time within states and across the country. Corresponding to increases in obesity and overweight there is a general belief that environmental changes have occurred during this time and that they have affected public health. However, surveillance data on environmental factors is not collected systematically in states or in the nation (Committee on Physical Activity 2005). It is difficult, therefore, to evaluate the relationship between obesity or its risk behaviors and environmental factors.

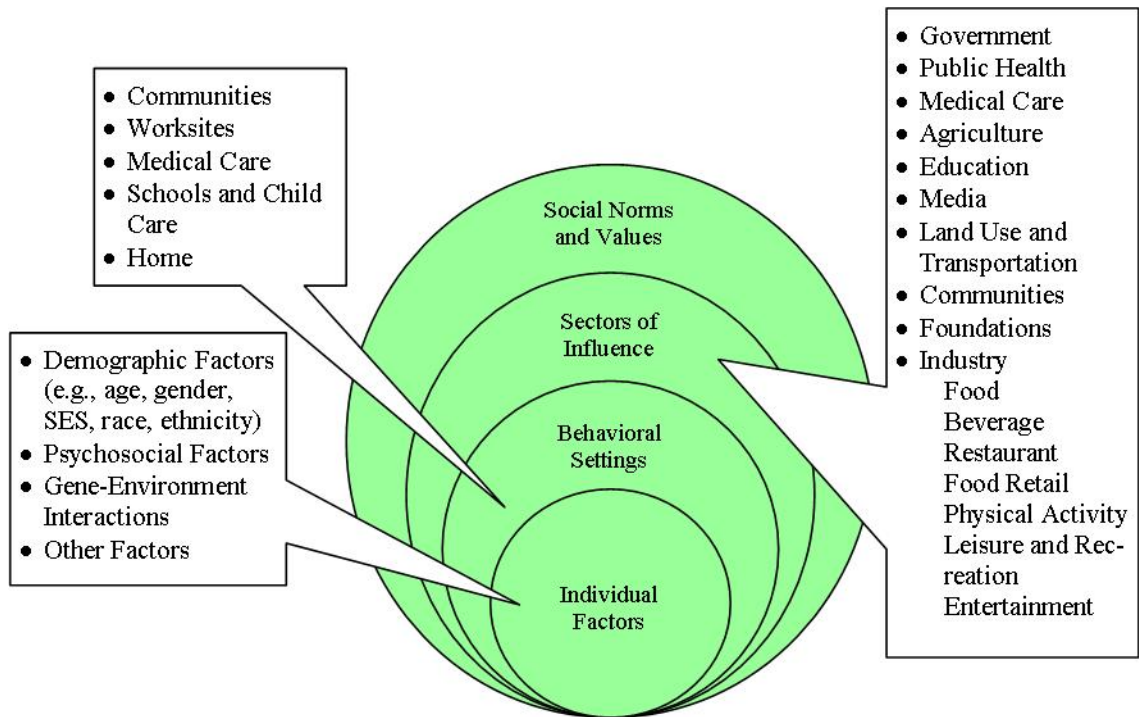
Theoretical Framework

Contemporary public health problems like obesity are not easy to solve. It is a challenge to identify correlation, let alone causation of overweight and obesity. A deep understanding of the multiple systems, resources, and policies that shape the individual is necessary to begin to address the issue. The attention being focused on environmental determinants of disease signals a “broadening in theory from the individual-level

intervention models that dominated twentieth-century practice to a social ecological model that emphasizes the role of the environment in the causation of illness” (Sloane et al. 2006 p147).

Ecological theory provides a framework for understanding the interaction between the individual and the environment. It views “health as a process nested in contexts rather than as a static attribute of individuals” (McLaren and Hawe 2005 p9). There are four levels in the socio-ecological model (Figure 1). The individual level includes personal characteristics such as gender, age, education, abilities, and health. The behavioral settings level includes environmental locations where individual behaviors such as physical activity and fruit and vegetable consumption take place. The next level includes sectors of influence - sectors that influence behavior - including agricultural policies, the food environment and the exercise environment. The highest level includes prevailing social norms and values.

Figure 1: The Socio-Ecological Model



Adapted from IOM, 2007

Social, political, and physical environments in the socio-ecological model influence individual behavior through access to resources and influence of community norms. A defining feature of the socio-ecological model “is the specification that intrapersonal variables, interpersonal and cultural factors, and physical environments can all influence behavior” (Sallis, Bauman, and Pratt 1998 p 380). Environmental factors are associated with individual and population physical activity and dietary behavior. These associations continue to present a complex problem because they “do not fit within simple models of causality and intervention;” they have to be understood within the ecological framework in which they occur (McLaren and Hawe 2005; Kreuter et al. 2004 p9). Addressing obesity by changing individual behaviors means that knowledge of and attitudes towards healthful eating and physical activity need to be changed. Individual behaviors will be changed through changes made in behavioral settings, sectors of

influence, and social values and norms; they are interconnected and influence one another.

Current Strategies in Georgia

The Georgia Department of Human Resources Division of Public Health recently published “Georgia’s Nutrition and Physical Activity Plan to Prevent and Control Obesity and Chronic Diseases in Georgia” (GADHR and GADPH 2005). The ten year plan focuses on the following goals: increase breastfeeding, improve healthy eating, increase physical activity, and decrease television viewing/screen time. The socio-ecologic model provides a framework for the plan.

The robust plan includes a number of objectives, goals, and priority strategies affecting each level within the socio-ecological model. Strategies targeting the community setting include:

- ❖ Define healthy community design and assess elements of healthy community design (e.g. mixed land use, trails, sidewalks, connectivity, safety, ADA compliant transportation systems) to establish baseline.
- ❖ Develop community assessment tool to assess and enhance the local healthy community design.
- ❖ Promote the development and implementation of city/county ordinances to increase sidewalks, bike paths, and green space.
- ❖ Develop baseline to assess the number of community locations that provide access to healthy choices.
- ❖ Promote and expand existing efforts to offer healthy food choices, appropriate portion sizes, and nutrition information on menus in restaurants.
- ❖ Provide access to fruits and vegetables through community gardens, gleaning projects, farmer’s markets, WIC farmer’s market, and senior farmers’ market program.
- ❖ Develop baseline to assess the current number of programs offered at parks and community recreation centers.
- ❖ Promote an increase in the number of programs offered in community recreation centers or community centers, especially in rural areas.
- ❖ Expand community recreation center schedules and provide transportation to accommodate resident needs.
- ❖ Promote existing sidewalks, walking trails, community pools, and public playgrounds in communities as close-to-home places for physical activity

The research encompassed in this thesis grew out of the state plan to identify sources of data to develop baselines and evaluate the relationship between environmental factors and risk behaviors in rural areas of Georgia. For example, the public health literature has documented a positive relationship between sidewalks and walking in urban areas (Huston et al. 2003; Berrigan and Troiano 2002; Ross 2000; Frank et al. 2006). However, relationships between environmental factors and risk behaviors evident in urban and suburban areas are not always evident in rural areas (Parks, Housemann, and Brownson 2003; Wilcox et al. 2000). This analysis attempts to determine what data are available to evaluate the food and exercise environments in Georgia and to consider if strategies should differ based upon the rural status of each community.

Percent population rural by health district varies tremendously in Georgia (Table 1). The percent population rural ranges from 0.4 percent in Health District 3-5 DeKalb to 68.6 percent in Health District 5-1 Dublin. Obesity ranges from 19.5 percent in Health District 3-4 (rural population 7%) to 29.7% in Health District 9-2 Waycross. Physical inactivity ranges from 18% in Health District 3-1 Cobb Douglas (rural population 3.1%) to 34.1% in Health District 9-2 Waycross (rural population 61%). The population consuming fewer than 5 fruits and vegetables per day ranges from 73% in Health District 3-5 DeKalb to 82.4% in Health District 3-1 Cobb-Douglas.

Table 1: Obesity Physical Inactivity, and Fruit and Vegetable Consumption in Georgia by Health District, 2000-2005

Health District	Percent of Population			
	Rural	Obesity	Physical Inactivity	<5 Fruits and Vegetables per day
1-1 Rome	45.8%	26.1%	29.4%	79.2%
1-2 Dalton	44.8%	21.8%	26.5%	77.9%
2-0 Gainesville	57.7%	22.4%	25.3%	74.6%
3-1 Cobb-Douglas	3.1%	20.4%	18.0%	75.9%
3-2 Fulton	2.1%	20.3%	22.0%	74.8%
3-3 Clayton	1.2%	26.0%	25.5%	82.4%
3-4 Lawrenceville	7.4%	19.5%	22.5%	75.8%
3-5 DeKalb	0.4%	21.2%	22.5%	73.0%
4-0 LaGrange	43.7%	24.9%	26.7%	78.4%
5-1 Dublin	68.6%	29.5%	31.9%	80.6%
5-2 Macon	37.6%	27.1%	27.9%	79.1%
6-0 Augusta	33.6%	27.0%	30.6%	78.8%
7-0 Columbus	32.3%	25.0%	27.1%	79.9%
8-1 Valdosta	47.3%	28.1%	31.9%	79.5%
8-2 Albany	48.2%	28.9%	31.5%	80.6%
9-1 Savannah	24.0%	24.0%	25.3%	77.0%
9-2 Waycross	61.0%	29.7%	34.1%	80.1%
10-0 Athens	53.0%	25.1%	27.8%	77.8%
Georgia	28.0%	24.1%	26.5%	77.2%

GA BRFSS 2000-2005 and US Census 2000 (Bryan, Thompson, and Patel 2006)

Statement of the Problem

This research seeks to document what data are available to evaluate the food and exercise environments at the county level in Georgia. It also seeks to determine if a relationship exists between fruit and vegetable consumption and the food environment and physical activity levels and the exercise environment in 26 rural Georgia counties among adults aged 18 and older.

The *food environment* includes all policies affecting food production and consumption from the highest to the smallest levels of government or organization and all

physical locations where food is available or could be available. For example, it could include national policies subsidizing the production of corn, advertisements promoting the consumption of milk, local policies allowing community gardens to be developed on public land, or institutional policies providing healthy choices in vending machines at worksites. It could also include more specific measures documenting the type and range of food available and food pricing in stores, supermarkets, et cetera. For the purposes of this study the food environment includes convenience stores, grocery stores, supermarkets, fruit and vegetable markets, restaurants, fast-food restaurants and a composite variable of grocery stores, supermarkets and fruit and vegetable markets. It is hypothesized that there will be a positive association between grocery stores and supermarkets and fruit and vegetable consumption, a negative association between convenience stores and fruit and vegetable consumption, and a negative association between fast food restaurants and fruit and vegetable consumption.

The *exercise environment* is quite similar to the food environment although it relates to policies affecting exercise or physical activity and physical locations where exercise/physical activity take or can take place. It includes policies that affect land use and transportation, like those allowing or disallowing mixed use development, high density land uses, or the expenditure of public or private dollars on bicycle facilities or sidewalks. It includes policies and programming that encourage the use of stairs instead of elevators or escalators, or institutional policies that encourage walking meetings at worksites. It also includes health clubs, gymnasiums, recreation centers, parks, tennis courts, et cetera. For the purposes of this study the exercise environment includes fitness centers, public golf courses, nature parks and a composite variable of all three labeled all

physical activity. It is hypothesized that there will be a positive association between the measure all exercise facilities and physical activity.

Some aspects of the food environment might be more likely to promote the consumption of fruits and vegetables than others. For example, convenience stores provide “convenient” food - or food that requires little if any preparation. These stores are typically much smaller than grocery stores or supermarkets and also have less space dedicated to food refrigeration. Thus, grocery stores and supermarkets may be more likely to have a larger quantity and larger variety of fruits and vegetables. Rural areas with smaller and less densely concentrated populations might be less supportive of larger supermarkets and may therefore be served by smaller stores including grocery and convenience stores. With reduced access to fruits and vegetables and with increased access to prepared foods it is hypothesized that the rural population would consume fewer fruits and vegetables than a population with greater access to supermarkets.

Likewise, rural areas might be less supportive of sidewalks and bicycle facilities which are primarily funded at the local level because more mileage of sidewalk would be required to connect locations in a low density environment. The material cost would be higher and the cost would be distributed among fewer taxpayers than in a suburban or urban environment. With a smaller population to serve, the demand for fitness centers and other locations for physical activity may be more limited than in an urban area. Rural areas, which by definition, are less developed may have more land dedicated to open space or parkland. Parks, therefore, may be more strongly associated with leisure time physical activity in rural areas than in urban areas.

There are many measures of physical activity and fruit and vegetable consumption in the built environment. The availability of systematically collected data on those measures at the county level in Georgia is unknown as is the relationship between those measures and individual behavior in rural Georgia. This research seeks to better understand these issues.

Hypotheses

Hypothesis 1. There will be a positive association between grocery stores and supermarkets and fruit and vegetable consumption.

Hypothesis 2. There will be a negative association between convenience stores and fruit and vegetable consumption.

Hypothesis 3. There will be a negative association between fast food restaurants and fruit and vegetable consumption.

Hypothesis 4. There will be a negative association between persons at or below poverty level and fruit and vegetable consumption.

Hypothesis 5. There will be a positive association between all exercise facilities and physical activity.

Hypothesis 6. There will be a negative association between percent rural and fruit and vegetable consumption.

Hypothesis 7. There will be a negative association between percent rural and physical activity.

Hypothesis 8. There will be a negative association between persons at or below poverty level and physical activity.

CHAPTER II – Review of the Literature

The Food Environment and Fruit and Vegetable Consumption

A healthful diet can reduce major risk factors for chronic diseases such as obesity, high blood pressure, and high blood cholesterol (USDA and USDHHS 2000). According to the 1999-2000 Healthy Eating Index, only 10 percent of the American population met most recommendations of the Dietary Guidelines for Americans and only 17 percent consumed the recommended number of servings of fruit per day (Basiotis et al. 2004). The population may be fulfilling its physiological need to eat; however, the majority have diets needing improvement. Segments of the population including adolescent males, non-Hispanic Blacks, low-income populations, and those with lower education had lower quality diets (Basiotis et al. 2004). Decision making surrounding diet and nutrition is constrained by resources such as time and money (Ulrich 2005; Rashad 2005; Zenk et al. 2005). In addition, pleasure such as the biological desire for fats and sweets influences decision making (Ulrich 2005; Rashad and Grossman 2004).

Energy dense foods high in fat and sugar cost less than more nutritious recommended diets (Drewnowski, Darmon, and Briend 2004). High energy dense foods may be more readily available in rural areas that support more convenience stores than supermarkets. Typically, convenient foods cost less per calorie. Buying healthy foods can increase a food budget by 1,000 to 5,000 percent per calorie (Drewnowski, Darmon, and Briend 2004; Ulrich 2005). Individuals may also derive a biological pleasure from these foods. A study of eating habits found that taste was the most important factor in food choice, followed by cost, nutrition and convenience (Glanz et al. 1998). In 2005, 32.6 percent of the U.S. adult population surveyed in the BRFSS consumed two or more

servings of fruit per day and only 27.2 percent consumed vegetables three or more times per day (CDC 2007b). College graduates, persons who earned more than \$50,000 per year, and persons who were not overweight or obese had the highest prevalence of eating fruit two or more times per day and eating vegetables three or more times per day (CDC 2007b). Perishable foods including fresh fruits and vegetables may be more expensive in smaller food stores such as grocery stores and then more expensive in even smaller stores such as convenience stores because the cost of storage is higher and if unsold are a loss to the retailer.

Aspects of the food environment have been measured by researchers in a number of ways. The type of food location such as vegetable market, bakery, liquor store, or supermarket has been collected and matched to census areas to examine differences in food environment by race/ethnicity and socioeconomic composition (Moore and Diez Roux 2006). The USDA has examined differences in access to supermarkets and the prices of foods between rural and metro areas (Kauffman 1999). Researchers have collected data on food stores from Info USA (Moore and Diez Roux 2006) and from state Departments of Agriculture (Zenk et al. 2005). Glanz and others developed the Nutrition Environment Measures Survey (NEMS) which measures food stores and restaurants, and also the healthfulness and price of food and meals sold (Glanz et al. 2006). Frequently, the relationship between the presence of food stores, type of food store, and socioeconomic status is investigated using spatial analysis. These studies are important because they have shown that the food environment and access to the food environment differs by race/ethnicity, socioeconomic status, and between rural and metropolitan areas.

Segments of the population living in low-income or rural areas do not have the opportunity to make the same food purchase decisions as more urban and middle class segments of the population. Rural areas have fewer supermarkets per person than metro areas (Kauffman 1999). Low income urban neighborhoods support half as many supermarkets as wealthier areas (Moore and Diez Roux 2006). In addition, African Americans have reduced access to supermarkets compared to Caucasians even after controlling for income (Zenk et al. 2005). At least one study has shown increased distance to the nearest supermarket is associated with increased odds of obesity (Boehmer et al. 2006). The adult population purchases more than half of their food from retail food stores (Carlson, Kinsey, and Nadav 2002). Retail food store category is comprised of grocery stores, convenience stores, supermarkets and other locations where unprepared food may be purchased. Supermarkets offer more types of foods and a larger variety of each type including brand and generics. Supermarkets are able to take advantage of economies of scale to offer foods at lower prices because of the volumes in which they purchase and sell (Kauffman 1999). When supermarkets are not available the population must purchase food from other retail food outlets such as grocery and convenience stores.

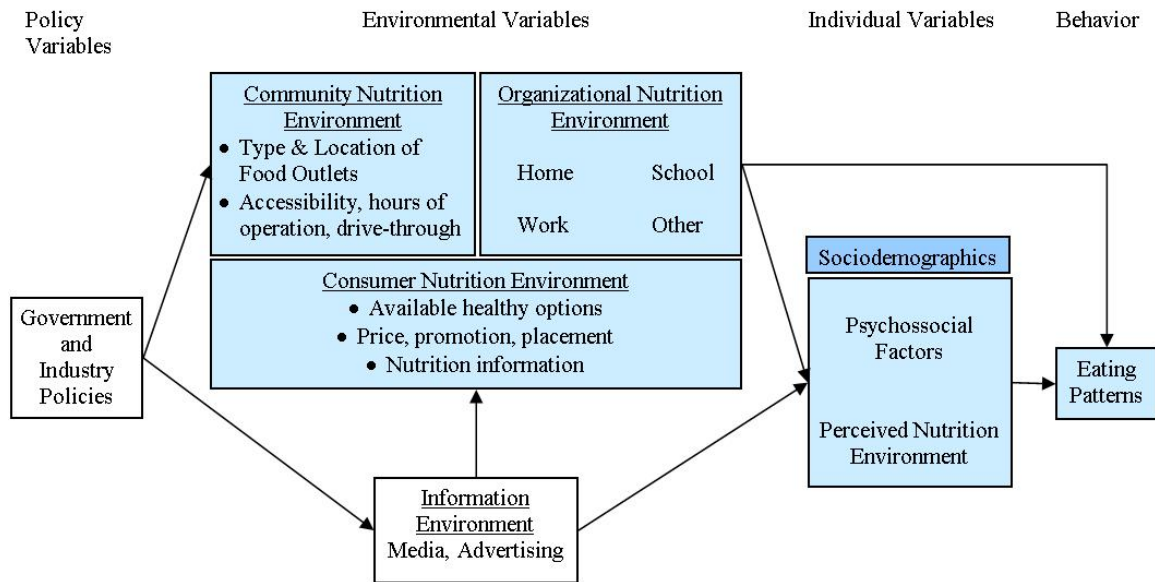
“Partly because of their small size and fragile economics, convenience stores tend to devote much more of their shelf space to less healthy snacks and prepared foods” (Proscio 2006 p21). Although fruits and vegetables are healthier for the population they have a very short shelf life and expensive storage and shipping costs. Freezer space is limited and costly in small grocery and convenience stores. It is in the economic interest of small grocers and store-owners to sell less healthy snacks and processed foods.

Populations with decreased access to supermarkets also have decreased access to healthier foods and greater risk for diet-related disease (Zenk et al. 2005).

Access to healthy foods is also influenced by the food service sector. According to the food service and restaurant sector, food-away-from-home expenditures grew from 26 to 47 percent of each food dollar between 1960 and 1995. In recent years, expenditures on food away from home have approached 50 percent (Putnam and Allshouse 1996). Typically, restaurant meals contain fewer nutrients and are higher in fat than meals prepared at home (Sallis and Glanz 2006). Indications point to restaurant growth as a primary cause of increased obesity after 1980 (Rashad and Grossman 2004). Restaurant growth has saved people time and money (Rashad 2005), but may have negative health outcomes. In a state-wide analysis, Maddock found a positive association between both the number of residents per fast food restaurant and the square miles per fast food restaurants with state-level obesity prevalence (Maddock 2004). State level obesity prevalence was higher in states with more fast food restaurants per person and also per square mile.

There are many indicators illustrating the relationship between the food environment and fruit and vegetable consumption (Figure 2). At the community level the type of food outlet such as restaurant, fast food restaurant, supermarket, and convenience store are “Environmental Variables” (Glanz et al. 2005). The consumer nutrition environment accounts more specifically for the nutritional content and price of foods within the nutrition environment.

Figure 2: Model of Community Nutrition Environments



Adapted from Glanz, 2005

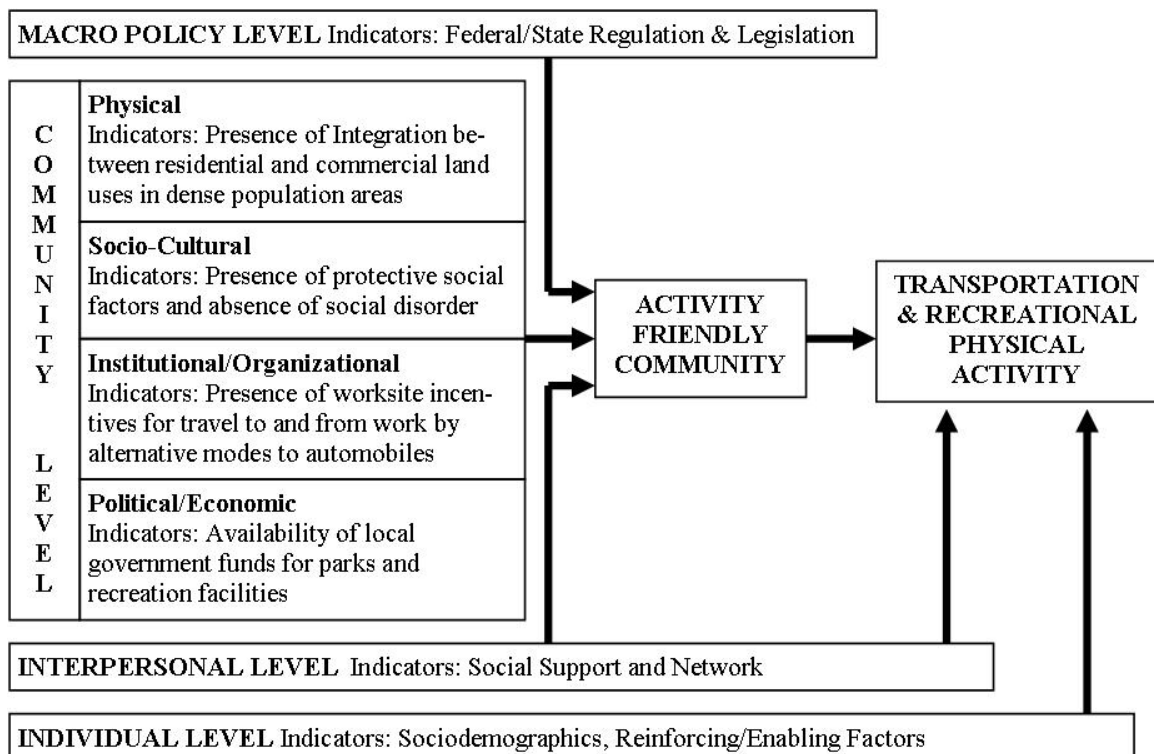
The organizational nutrition environment refers to the behavioral setting where food consumption occurs. Sectors of influence are represented in this model as “Policy Variables”. Individual factors are listed as “Individual Variables”. The model of Community Nutrition Environments incorporates many features of the socio-ecological model. However, it goes into greater detail representing variables that affect nutrition.

The Exercise Environment and Physical Activity

Physical inactivity is associated with increased risk of chronic diseases and mortality. “Regular physical activity substantially reduces the risk of dying of coronary heart disease, the nation's leading cause of death, and decreases the risk for stroke, colon cancer, diabetes, and high blood pressure. It also helps to control weight; contributes to healthy bones, muscles, and joints; reduces falls among older adults; helps to relieve the pain of arthritis; reduces symptoms of anxiety and depression; and is associated with fewer hospitalizations, physician visits, and medications” (CDC 2006 p1). If every

Georgian met recommendations for physical activity, there would be an estimated 3,581 fewer deaths and 21,593 fewer hospitalizations (Falb et al. 2006). Fewer than 50 percent of American adults and fewer than 57 percent of Georgians are regularly active enough to achieve health benefits (Falb et al. 2006; CDC 2006). The Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine recommend adults engage in moderate intensity activities for at least 30 minutes on five or more days each week (CDC 2006). Communities can create supportive environments for physical activity (Figure 3). Likewise, policies and social norms can promote or discourage physical activity. Individuals can meet recommended physical activity levels in activity friendly communities.

Figure 3: Ecological Framework of an Activity-Friendly Community



Kelly et al, 2006

Researchers have collected data on the environment including aesthetics, convenience, age of home, length of walking facility, walkability², sprawl, topography, streetlights, safety, weather, traffic and access to open space, recreation facilities, beaches et cetera. Data have been collected using surveys, secondary data, accelerometers and environmental scans (Table 2).

Table 2: Physical Activity Research Measures by Setting

Measurement Tool	Setting	Measure	Author
Survey and Accelerometer	Urban	Walkability	Saelens et al. 2003
Survey	Metropolitan Area	Spatial Access to Recreation Facilities, streets, open space, and beaches	Giles-Corti and Donovan 2002b
Survey	Urban	Quality of Sidewalks, Activity Facilities, Accessibility of Shopping and Public Transportation	De Bourdeaudhuij, Sallis, and Saelens 2003
Survey	Urban	Spatial Access to recreation facilities. Perception of access, traffic, and aesthetics	Giles-Corti and Donovan 2002
Survey	United States	Neighborhood characteristics, presence of sidewalks, traffic, aesthetics, personal barriers	Brownson et al 2001
Survey	Urban	Perception of access to recreation facilities. Safety, social issues, barriers, characteristics of facilities	Kirtland et al 2003
Commercially purchased business records	United States	Access to Recreation Facilities	Gordon-Larsen et al. 2006
Survey	Urban and Rural Counties	Sidewalks, trails, unattended dogs, safety	Huston et al. 2003
Survey	Rural and Urban	Places for exercise, health status, social support for exercise	Parks, Housemann, and Brownson 2003
US Census and BRFSS	Counties and Metropolitan Areas	Sprawl Index	Ewing et al. 2003
Trust for Public Land, BRFSS, and NPTS	Metropolitan Areas	Parkland	Zlot and Schmid 2005
Survey	Rural	Perception of access to recreation facilities. Safety, Traffic, Nonresidential Destinations	Boehmer et al. 2006

² Walkability is defined based on concentration of nonresidential land uses, mix of uses, block length, and street connectivity.

Survey	Metropolitan Area	Number of destinations, safety, aesthetics	Suminski et al. 2005
Survey and environmental scan	Urban	Highway, sidewalks, recreation facilities, access to motor vehicle, access to shopping	Giles-Corti et al. 2003
Meta-analysis	Urban	Density, subdivision age, mixed use, street connectivity	Badland and Schofield 2005
Survey and accelerometer	Urban	Density, home equipment, land use, aesthetics, connectivity, walking/biking facilities, safety, traffic, recreation facilities	Atkinson et al. 2005
NHANES and US Census	United States	Year home built	Berrigan and Troiano 2002
California Health Interview Survey, CA DOT, US Census	California	Vehicle Miles of Travel	Lopez-Zetina. Lee, and Friis 2006
Survey	Urban Area	Trip mode	Cervero and Duncan 2003
Survey	Urban Area	Land-Use mix, time spent in cars	Frank, Andersen, and Schmid 2004

Many environmental measures have been correlated with physical activity.

Sidewalks and the presence of facilities for physical activity are two commonly researched indicators. Previous research has found that individuals living in counties that are more walkable tend to walk more and have lower body mass indices than people living in less walkable areas (Doyle et al. 2006). In one study, the variable crime, measured by crime rates, was negatively associated with the behavior “walking” and BMI (Doyle et al. 2006). Measured a different way, safety has been positively associated with walking (Kirtland et al. 2003). The presence, convenience and safety of facilities has also been positively associated with physical activity (De Bourdeaudhuij, Sallis, and Saelens 2003; Saelens et al. 2003; Giles-Corti and Donovan 2002b; Owen et al. 2004; Brownson et al. 2001). Higher quality of sidewalks, accessibility of shopping, destinations, and public transportation were positively associated with walking (De Bourdeaudhuij, Sallis, and Saelens 2003; Owen et al. 2004). Population and residential density have also been positively correlated with walking (Atkinson et al. 2005; Saelens,

Sallis, and Frank 2002; Saelens et al. 2003). Saelens and Sallis (2003) identified an association between environmental factors, physical activity, and BMI. They found residents of high-walkability neighborhoods reported higher residential density, mixed land use, connectivity, and safety. They also found respondents in high-walkability areas had 70 more minutes of physical activity and lower obesity prevalence than those living in low-walkability neighborhoods (Saelens et al. 2003).

Attributes associated with walking for exercise were different from those associated with walking for transportation (Owen et al. 2004). However, active transportation (i.e. walking and bicycling) was positively and strongly associated with walkability and negatively associated with BMI among adults even after controlling for socioeconomic status (Frank et al. 2006). Even though active transportation has been negatively associated with BMI, residents without access to a motor vehicle has been positively associated with obesity (Booth, Pinkston, and Poston 2005). Yet access to a motor vehicle all the time has been negatively associated with obesity (Giles-Corti et al. 2003). Socioeconomic status may confound the relationship between active transportation and obesity. To improve understanding of these relationships more specific research is needed. Variables like time spent in automobiles and access to motor vehicles may need to be better understood, or they may simple be proxy variables for other indicators. For example, community attributes, including density, land use mix, park acreage, and walkability that create a supportive environment for physical activity also create a supportive environment for active transportation (Zlot and Schmid 2005).

Individual characteristics and demographics are also associated with physical activity. However, results have varied between studies. In some studies, lower

socioeconomic status (SES) areas had reduced access to facilities (Gordon-Larsen et al. 2006) and in other studies superior access (Giles-Corti and Donovan 2002). Regardless of spatial access, lower SES communities are less likely to use facilities compared to those living in higher SES areas (Gordon-Larsen et al. 2006; Giles-Corti and Donovan 2002b; Parks, Housemann, and Brownson 2003). Social marketing may be able to enhance physical activity in all communities regardless of SES (Maibach 2003). Respondents to surveys have reported barriers to physical activity including perception of safety, lack of time, feeling too tired, and no motivation (Brownson et al. 2001; Wilcox et al. 2000). Ross (2000) found that people living in neighborhoods where many residents hold college degrees are more likely to walk, and that the effect of neighborhood education level was more significant than the individual's education. Environmental supports for physical activity are necessary, but may not be sufficient to increase physical activity in all communities (Giles-Corti and Donovan 2002b). Existing research is only beginning to identify indicators of physical activity and obesity within the built environment. To build the evidence base indicators, communities and influences on behavior must be better understood.

The Rural Environment and Public Health

Urban, suburban and rural areas are not directly comparable. The built environment, specifically land use, mix of land use (if any), and transportation networks are different in each of those areas. Berrigan and Troiano (2002) for example, found year of housing built to be correlated with physical activity in the urban and suburban areas in United States (Berrigan and Troiano 2002). Year of housing built is a proxy indicator for the type of development and street network. A subdivision constructed in 1920 would

typically be on a grid street network, houses were constructed without garages on smaller lots compared to houses built after World War II which were built with carports or garages on larger lots with cul-de-sacs. The researchers did not find this relationship in rural areas (Berrigan and Troiano 2002). This may be because in rural areas age of housing is not related to neighborhood development patterns or street level characteristics. Development in areas with greater population concentration such as urban and suburban areas is regulated and developed differently than rural areas. Level of development is one of the reasons the community types are not directly comparable. Open space is abundant in rural areas. However, in urban areas the value of land and demand for development makes open space scarce. Government regulations in urban or suburban areas preserve open space and city governments mandate land is set aside for open space in development projects.

The majority of research on the relationship between the environment and public health is set in urban areas. The results of those studies may not be simply generalized to rural areas. Environmental correlates of physical activity differ between rural and urban areas (Wilcox et al. 2000; Parks, Housemann, and Brownson 2003). In general, rural areas are understudied (Saelens, Sallis, and Frank 2002). Studies have shown, in addition, the prevalence of leisure-time inactivity and obesity is higher in rural areas compared with large metropolitan and suburban areas (Wilcox et al. 2000; Parks, Housemann, and Brownson 2003). It is unknown if the difference in prevalence is related to environmental factors or because rural communities are at higher risk of poor health outcomes due to issues of poverty and access to healthcare (Parks, Housemann, and Brownson 2003; Wilcox et al. 2000). The influence may be socioeconomic. In a 2003 study by Parks,

Housemann, and Brownson of urban, suburban and rural communities and physical activity, the researchers found rural residents were least likely to meet physical activity recommendations and that there were “important” differences between activity-related features. In another study, differences between urban and rural women and their environments were found. Rural women were more sedentary than urban women and had greater body mass indices (Wilcox et al. 2000). They were also less likely to report sidewalks and access to facilities than their urban counterparts (Wilcox et al. 2000). A study of overweight in rural, urban, and suburban Georgia found a higher prevalence of overweight in rural Georgia than in urban or suburban Georgia. This was true in rural growth locations and rural decline locations (Lewis et al. 2006). Results of studies such as these illustrate the need to better understand the environment and health in each community type.

Planning and Public Health

There is no single risk factor causing obesity and overweight. Likewise, there is no single environmental factor linked to increases in physical activity or fruit and vegetable consumption. “Complex environmental health problems are in reality a constellation of linked problems embedded in the fabric of the communities in which they occur” (Kreuter et al. 2004 p1). There are however, environmental factors that have consistent associations with physical activity behavior (Humpel, Owen, and Leslie 2002). “Many fit the criteria of wicked problems because they are enmeshed in the community’s political, cultural, social, and economic structure” (Kreuter et al. 2004 p10).

Within the planning field there are a number of specializations including, but not limited to, land use, transportation, recreation, urban design, and historic preservation.

Much of the land use planning work is completely separate from the transportation planning and vice versa presenting a challenge to understanding specific problems and in making changes to promote public health. Likewise, the research on obesity rarely focuses on physical activity and nutrition. Often, only one of the risk factors is studied. Recommending policy is difficult without comprehensive information. “In urban planning the demand for walking and bicycling derives from the demand for other activities, a utilitarian model for active living. In contrast, by emphasizing leisure-time physical activity, public health has most often applied a recreational model for active living” (Hoehner et al. 2003 p15). To evaluate the environmental influence on physical activity it is necessary to capture utilitarian and recreational physical activity.

There is more to the physical activity and nutrition resource environment than physical resources. Price and quality are “at least as useful” measures (Sloane et al. 2006 p146). For example, a neighborhood fitness center that is accessible, affordable, and programmed well offers more physical activity benefits than one that is not. An inventory of the number of fitness centers, the miles of sidewalk, or the number of grocery stores does not provide information on the quality, condition, or price. There is evidence that some communities may be healthier than others (Frank et al. 2006; Boehmer et al. 2006; Booth, Pinkston, and Poston 2005). It is not clear, however, whether the community environment can cause an individual to be physically active or to consume fruits and vegetables or if people who want to be physically active choose to live in supportive environments.

The health outcomes of obesity are known. Adult obesity is associated with higher rates of hypertension, dyslipidemia, and insulin resistance, which are risk factors

for coronary artery disease, the leading cause of death in North America (Belay, Belamarich, and Racine 2004). Environmental correlates of obesity include land use mix (Rutt and Coleman 2005) and transportation (Zenk et al. 2005; Booth, Pinkston, and Poston 2005). The weight of evidence does not yet show causation between identified environmental factors and obesity nor does it do so by community type.

Although the complex relationships between individual behaviors and the environment are not well understood, the seriousness of obesity's health threat in terms of negative health outcomes, reduced quality of life, and economic costs necessitates interventions now. Time spent waiting for science to build the evidence would be time spent watching the epidemic of obesity grow. Interventions must be based on the best and most current research available. With plans made to reduce the prevalence of obesity and overweight and with interventions implemented evaluation must occur to find the most effective interventions. In addition, research must continue to seek causes of obesity and to understand the relationship between environmental factors and health behaviors including, but not limited to physical activity and fruit and vegetable consumption.

CHAPTER III – Data and Methods

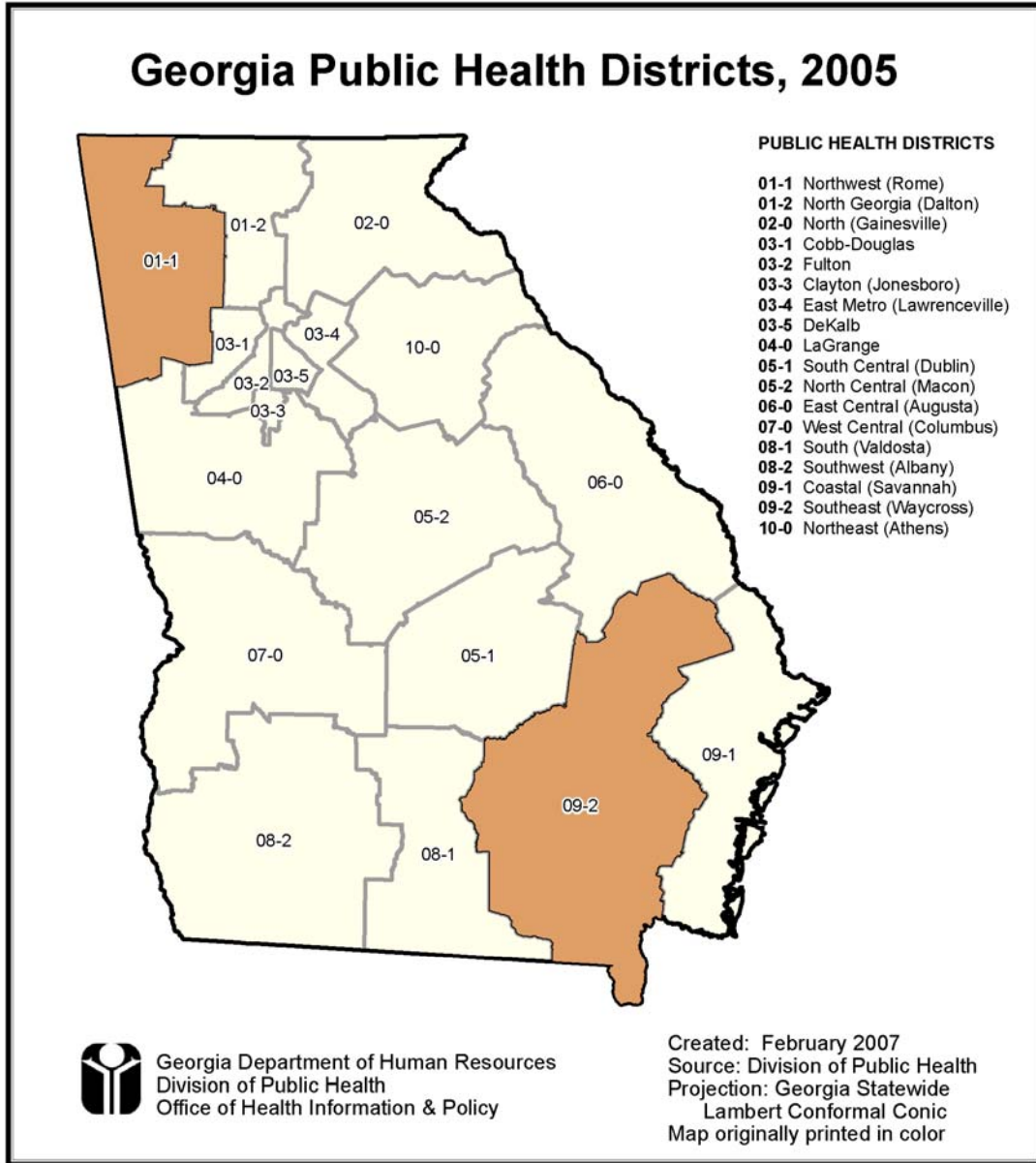
Setting

The setting for this study was 26 counties comprising two health districts in Georgia. Health District 1-1 Northwest (Rome) contains the following 10 counties: Bartow, Catoosa, Chattooga, Dade, Floyd, Gordon, Haralson, Paulding, Pierce, Polk, and Walker. Health District 9-2 Southeast (Waycross) contains the following 16 counties: Appling, Atkinson, Bacon, Brantley, Bulloch, Candler, Charlton, Clinch, Coffee, Evans, Jeff Davis, Pierce, Tattnall, Toombs, Ware, and Wayne. These mostly rural health districts were selected for inclusion among all Georgia health districts based on percent population rural, fruit and vegetable consumption and physical activity variability, and the presence and tenure of the assigned Health Promotion Coordinator. Basic data including obesity and overweight, physical activity, fruit and vegetable consumption, population, percent population rural, and median household income were collected for each of the 18 Georgia Health Districts. The present research was interested in rural areas and only nine health districts had a rural population greater than 10 percent of total population. Those nine health districts were then narrowed to two based on variation in obesity prevalence, fruit and vegetable consumption, and physical activity. The selection was influenced by the availability of a district health promotion coordinator who could provide context and background for the health districts.

Health Districts 1-1 and 9-2 are pictured in Figure 4. Health District 1-1 Northwest (Rome) is located northwest of the Atlanta Metropolitan Area and contains two counties (Bartow and Paulding) in the Metropolitan Atlanta Planning Area. Some counties in District 9-2 border Tennessee and Alabama. Health District 9-2 Southeast

(Waycross) is located in southeast Georgia. Some counties in the district reach the Florida-Georgia border. Health District 9-2 does not include coastal counties.

Figure 4: Health Districts 1-1 and 9-2



Measures

Decennial US Census data were used to characterize the 26 counties in the study area. Data collected include total population, urban and rural population, age, means of

transportation to work, median household income, poverty status, median year structure built, educational attainment, travel time to work, and vehicles available.

Roadway characteristics including Roadway Mileage and Vehicle Miles Traveled (VMT) were obtained from the Georgia Department of Transportation (GDOT) Office of Transportation Data (GADOT 2005). An attempt was made to collect data on bicycle lanes, sidewalks, and multiuse trails. GDOT did not have this data nor did the Regional Development Centers (RDC). Data on bicycle facilities is not collected on a statewide or county level; therefore, data on bicycle and pedestrian facilities are not included in this study.

Food environment and exercise environment data were collected using Reference USA (InfoUSA 2007). Reference USA is a database containing listings for more than 14 million U.S. businesses. It is updated monthly with information from InfoUSA and is searchable by standard industrial classification (SIC code), company name, company type, geography and more. The measurements of the food environment collected from Reference USA are listed in Appendix A. They include food stores, restaurants, parks, recreation facilities, and golf courses. Environmental data were collected by county and include address, longitude, latitude, and sales data. Data were categorized for analysis using operational definitions listed in Appendix A.

The initial data collection process revealed 229 variables in the exercise environment. Five were removed as duplicates after matching for longitude, latitude, address and name. An additional three were removed because they were not exercise environment variables of interest to the study despite matching for SIC code. A barber shop, an advocacy group, and a governmental office incorrectly matched for SIC code.

There were 2,279 environmental factors revealed in the food environment using Reference USA none were removed during the data cleaning process. While food environment data were being cleaned the absence of multi-purpose super stores containing supermarkets identified during site visits was noticed. An additional data collection effort was made using business websites to locate these locations within the study area. These were coded as supermarkets.

Physical activity and fruit and vegetable consumption data are from the GA BRFSS and were provided by the Georgia Division of Public Health. Percent adults who meet physical activity recommendation data by county were derived from the combined 2001, 2003, and 2005 GA BRFSS. Percent adults who consume 5 or more fruits and vegetables per day data by county were derived from the combined 2002, 2003, and 2005 GA BRFSS.

Attempts were made to collect additional data related to the built environment and physical activity and fruit and vegetable consumption from municipalities, counties, the Georgia Department of Community Affairs, the Georgia Recreation and Parks Association, the Georgia Department of Natural Resources, and the National Parks Service. The Georgia Department of Natural Resources has data on the number of and locations of State Parks in Georgia. The National Parks Service has data on the number of and locations of National Parks, monuments, and battlefields in Georgia. The Georgia Recreation and Parks Association has information only on the names and websites of member organizations throughout Georgia. The Georgia Department of Community Affairs has comprehensive plans for almost all of the counties and municipalities in the study area available electronically. However, plans were not comparable. Requests for

information made directly to counties and municipalities on the variable *Parks* resulted in various responses ranging from the exact number of parks to answers like “that information is not available” to “tons.” The capacity to collect, make available, and report data appears to differ between counties within the study area.

The researcher interviewed the health promotion coordinators in Health District 1-1 and 9-2 using a standardized instrument. The survey instrument is included in Appendix B. The instrument was administered in person and was meant to improve understanding of the district and its counties through the collection of qualitative data. Information on district programs targeted at increasing physical activity and fruit and vegetable consumption were also collected.

Data Analysis

Physical activity and fruit and vegetable consumption data from the GA BRFSS were analyzed using SAS to determine the percent of adults meeting recommendations in each county. SUDAAN was utilized to determine confidence intervals. The GA BRFSS data are collected for analysis at the state and health district level. Annual sample sizes are not sufficient for county level analysis. For this reason multiple years of the GA BRFSS were combined. After combining 3 years of data multiple counties in the study area still did not have sufficient sample sizes. County specific estimates were obtained, when necessary, by including responses from participants in adjacent counties. If a county had fewer than 200 respondents after combining years, respondents from adjacent counties were included as if they were residents of the county of interest. If, after adding one concentric ring of counties, there were still fewer than 200 respondents, a second ring or third ring was added. Only Georgia residents were used.

After county level percentages were derived for the dependent variables (physical activity and fruit and vegetable consumption) all data were entered into SPSS. *Pearson's* correlation (one-tailed) was used to test the association between the following variables and physical activity: roadway miles, VMT per 1,000 adults, average travel time to work, active transportation to work, median household income, percent population rural, percent population in poverty, fitness centers per 1,000 adults, golf courses per 1,000 adults, nature parks per 1,000 adults, and a combined field including fitness centers, golf courses, and nature parks. *Pearson's* correlation (one-tailed) was also used to test the association between the following variables and fruit and vegetable consumption: average travel time to work, median household income, percent population rural, percent population in poverty, convenience stores per 1,000 adults, fast food restaurants per 1,000 adults, restaurants per 1,000 adults, grocery stores per 1,000 adults, supermarkets per 1,000 adults, fruit and vegetable markets per 1,000 adults and a combined factor including supermarkets, grocery stores, and fruit and vegetable markets.

Due to the exploratory nature of this thesis project, the small sample size and limitations in the data multiple regression analysis was not conducted.

The following assumptions were made: (a) the Reference USA data used to measure the food and exercise environments were accurate and complete; (b) adult self-report data on BRFSS were honest, accurate, and complete; and (c) participants in adjacent counties used in the ring analysis are representative as a group of the study county.

CHAPTER IV – Findings

Data Availability

After literature review 28 environmental indicators were selected based on the strength of their association with health behaviors. Attempts to collect data narrowed the list to 15 indicators. The final environmental indicators and data sources can be found in Table 3.

Table 3: Environmental Indicators

Indicator	Data Source
Median Year Structure Built	US Census 2000
Population Density	US Census 2000
Roadway Mileage	GA DOT
Travel Time to Work	US Census 2000
Vehicle Availability	US Census 2000
VMT	GA DOT
Exercise Environment	
Fitness Centers ³	Reference USA
Public Golf Courses	Reference USA
Nature Parks	Reference USA
Food Environment	
Convenience Stores	Reference USA
Grocery Stores	Reference USA
Supermarkets	Reference USA, Business Websites
Fruit and Vegetable Markets	Reference USA
Restaurants	Reference USA
Fast Food Restaurants	Reference USA

Business data are systematically collected by Info USA and categorized in its propriety database Reference USA. Public sector data are not systematically and consistently

³ Includes dance studios, gymnasiums, and recreation centers

collected at the county or state level in Georgia. County and municipal governments do not have inventories on their facilities neither do their parks and recreation departments. Planning and engineering departments in Georgia at the local, regional, and state level do not have information on sidewalks, bicycle facilities or parks. Comprehensive plans in Georgia submitted to the Georgia Department of Community Affairs do not include data on recreation facilities or other locations for physical activity. Likewise, municipal and county governments do not consistently list their facilities with Info USA.

Descriptive Data

The population in the 26-county study area, according to the US Census, has a lower median household income, a lower average travel time to work, and fewer high school graduates or higher than Georgia or the United States. The study area has a higher rural population than the state or nation as well. Individuals in Health District 9-2 are almost twice as likely to be below the federal poverty line as those in Health District 1-1, Georgia, or the nation.

Table 4: Descriptive Data from the United States, Georgia, and the Study Area

	US	GA	HD 1-1	HD 9-2	Study Area
Percent Rural	21%	28%	47%	61%	51.6%
Median Household Income	41,994	42,433	37,257	28,321	31,758
Average Travel Time to Work	25.5	27.7	23.68	19.15	20.89
Individuals Below Poverty Line	12.4%	13%	11%	20.3%	16.73%
Population non White	25%	35%	10%	27%	21%
Population High School Graduate or higher	81%	79%	69%	66%	67%
Population per square mile	79.78	141.37	153.6	40.2	73.7

US Census 2000

Fruit and Vegetable Consumption and the Food Environment

The food environment in the study area is illustrated in Figures 5 and 6. The percentage of the population consuming five or more fruits and vegetables per day by county ranges from 13.6 to 24.7 percent in the study area and the median was 19.3 percent. There were no significant associations between fruit and vegetable consumption and the food environment. However, fast food restaurants were negatively associated with fruit and vegetable consumption whereas restaurants were positively correlated with fruit and vegetable consumption (Table 5). The direction of the relationship was consistent with Hypothesis 3; however the association was weak and not significant.

Table 5: Bivariate Correlation Fruit and Vegetable Consumption and Restaurants

	Fast Food Restaurants	Restaurants	All Restaurants
Fruit and Vegetable Consumption	-.197	.295	.179

Twenty-six Georgia Counties

Table 6: Bivariate Correlation Fruit and Vegetable Consumption and Food Stores

	Convenience Stores	Grocery Stores	Fruit and Vegetable Markets	Supermarkets	Grocery, Supermarkets, and Fruit and Vegetable Markets
Fruit and Vegetable Consumption	-.077	-.089	-.023	-.225	-.149

Twenty-six Georgia Counties

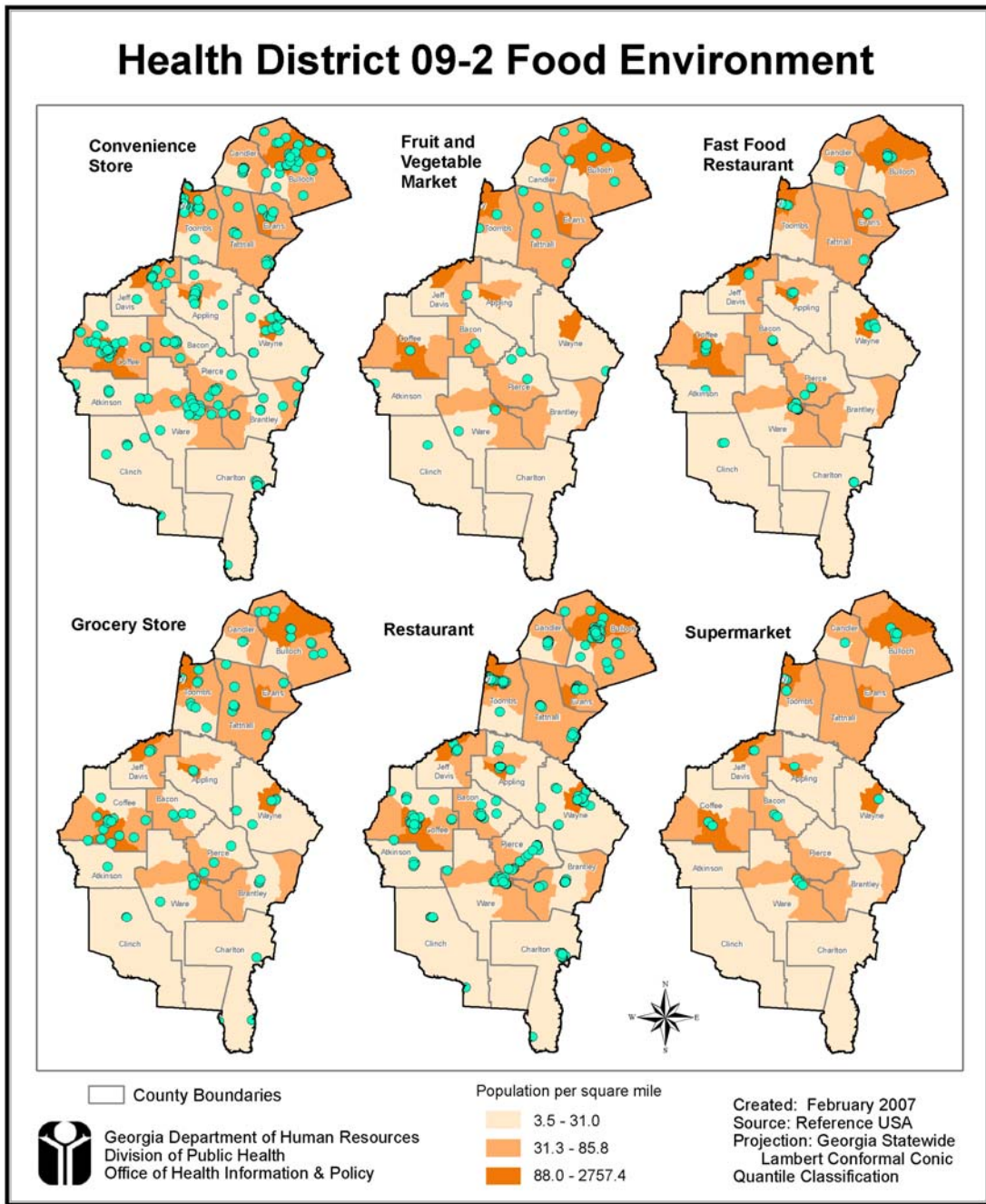
No significant associations were found between retail food stores and fruit and vegetable consumption. All associations were weak and negative (Table 6). There was no evidence to support Hypotheses 1 or 2.

Figure 5: Health District 1-1 Food Environment⁴



⁴ Green dots on each map represent single locations. For example on the convenience store map each green dot represents a single convenience store location.

Figure 6: Health District 9-2 Food Environment⁵



⁵ Green dots on each map represent single locations. For example on the convenience store map each green dot represents a single convenience store location.

The number of restaurants in the twenty-six county study area ranged from 1.12 to 2.55 per 1,000 adults by county with a median of 1.63 restaurants. Fast food restaurants ranged from 0 to 0.71 per 1,000 adults by county with a median of 0.40. Convenience stores per 1,000 adults by county ranged from 0.42 to 2.14 with a median of 1.22. Counties were much more likely to have multiple convenience stores than they were likely to have a single supermarket or fruit and vegetable market. Grocery stores per 1,000 adults by county ranged from 0.13 to 0.71 with a median of 0.40. Supermarkets per 1,000 adults by county ranged from 0 to 0.27 with a median of 0.11 and fruit and vegetable markets ranged from 0 to 0.40 with a median of 0.05 per 1,000 adults by county (Table 7).

Table 7: Food Environment per 1,000 Adults by County and Health District

	HD 1-1	HD 9-2	Study Area
Fruit and Vegetable Consumption	13.6 – 24.7	18.0 – 23.9	13.6 – 24.7
Standard deviation	3.7	2.0	2.7
Convenience Stores	.42 - 1.47	.99 – 2.14	.42 – 2.14
Standard deviation	.3	.3	.3
Grocery Stores	.14 - .71	.13 - .58	.13 - .71
Standard deviation	.2	.1	.2
Supermarkets	.09 - .18	0 - .27	0 - .27
Standard deviation	.03	.1	.1
Fruit and Vegetable Markets	0 – 0.09	0 - .40	0 - .40
Standard deviation	.03	.1	.1
Fast Food Restaurants	.28 - .58	0 - .71	0 - .71
Standard deviation	.1	.2	.2
Restaurants	1.12 – 2.47	1.16 – 2.55	1.12 – 2.55
Standard deviation	.4	.4	.4
N	10	16	26

Health District 9-2 had fewer grocery stores and supermarkets per 1,000 adults by county than Health District 1-1, but on average had a higher percentage of its total adult population consuming five or more fruits and vegetables per day.

Table 8: Bivariate Correlation of Fruit and Vegetable Consumption and Demographic Variables

	Rural Population	Population Density	Federal Spending per person	Persons at or below poverty level	Percent high school graduate or higher	Percent non white	Travel Time to Work
5 or more Fruits and Vegetables	.086	-.214	.008	-.094	.231	-.016	.402*

* p<0,05 level Twenty-six Georgia Counties

Travel time to work was significantly positively associated with fruit and vegetable consumption (Table 8). Although not significant, level of education measured by percent high school graduate or higher was positively associated with fruit and vegetable consumption. Persons at or below poverty level was inversely correlated with physical activity. The association was not significant and was very weak, it does support hypothesis 4. Population density was negatively associated with fruit and vegetable consumption. Percent rural population was not significantly associated with fruit and vegetable consumption. In addition the positive association that did exist was very weak (.086). There was no evidence to support Hypothesis 6.

Physical Activity and the Exercise Environment

The exercise environment in the study area is illustrated in Figures 7 and 8. The percentage of the population meeting the recommended physical activity levels by county ranged from 32.3 to 50.5 percent in the study area and the median was 41.6 percent.

Public golf courses had a negative moderate association ($p < .01$) with physical activity (Table 9). There were a total of 35 public golf courses in the 26 county study area. There was no evidence to support Hypothesis 5.

Table 9: Bivariate Correlation Physical Activity and Exercise Environment per 1,000 Adults by County

	Fitness Centers	Public Golf courses	Nature Parks	All Physical Activity
Physically Active	-.130	-.355*	.012	-.207

* $p < 0.05$ level (1-tailed). Twenty-six Georgia Counties

The combined number of physical activity sites in the twenty-six county study area ranged from 0 to 0.70 per 1,000 adults by county with a median of 0.38 (Table 10).

Table 10: Exercise Environment per 1,000 Adults by County and Health District

	HD 1-1	HD 9-2	Study Area
Physically Active	38.6 – 48.5	32.3 – 50.5	32.3 – 50.5
Standard deviation	3.2	5.1	4.5
All Physical Activity Sites	.23 - .69	0 - .70	0 - .70
Standard deviation	.1	.2	.2
Fitness Centers	.10 - .35	0 - .57	0 - .57
Standard deviation	.1	.2	.1
Public Golf Courses	.02 - .26	0 - .13	0 - .26
Standard deviation	.1	.1	.1
Nature Parks	.02 - .21	0 - .40	0 - .40
Standard deviation	.1	.1	.1
N	10	16	26

Figure 7: Health District 1-1 Exercise Environment⁶

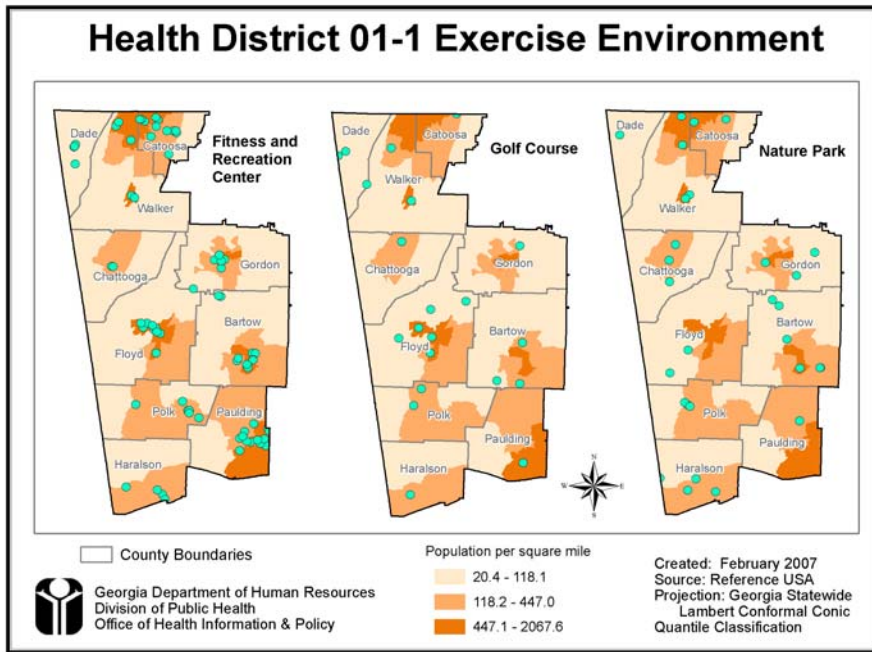
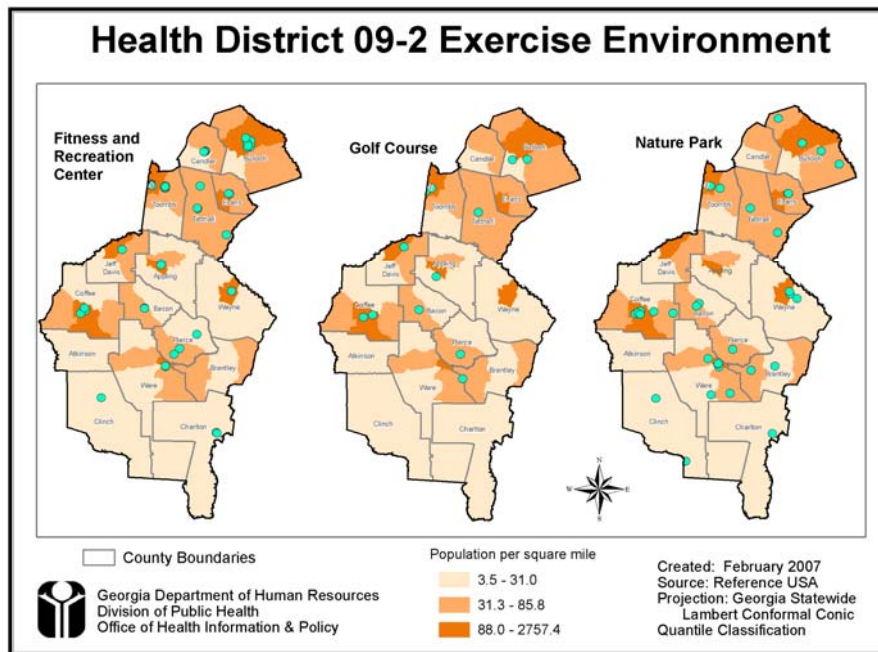


Figure 8: Health District 9-2 Exercise Environment⁷



⁶ Green dots on each map represent single locations. For example on the nature park map each green dot represents a single nature park location.

⁷Green dots on each map represent single locations. For example on the nature park map each green dot represents a single nature park location.

Health District 9-2 had more counties with fewer to zero physical activity sites, fitness centers, public golf courses, and nature parks than Health District 1-1.

Table 11: Bivariate Correlation of Physical Activity and Demographic Variables

	Rural Population	Federal Spending per person	Persons at or below poverty level	Percent high school graduate or higher	Travel Time to Work
Physically Active	-.049	-.385*	-.202	.369*	.456**

p < 0.05 level (1-tailed). ** p < 0.01 level (1-tailed). Twenty-six Georgia counties

Among variables tested, travel time to work had the strongest correlation with physical activity (Table 11). The association was moderate, significant ($p < .01$) and positive. There was no significant relationship between percent rural population and physical activity. Hypothesis 7 was not supported by the evidence. Federal spending per person, a measure of dependence, was negatively associated with physical activity ($p < .05$). Education level, measured by percent high school graduate or higher was moderately, positively associated with physical activity ($p < .05$). Persons at or below poverty level was negatively associated with physical activity. Although the relationship is not significant, this evidence supports Hypothesis 8.

CHAPTER V – Discussion and Conclusion

Summary

The goal of the state plan is to reduce overweight and obesity through changes in behavioral settings including communities. The strategies of increasing physical activity and the consumption of fruits and vegetable are effective to prevent overweight and obesity among most individuals. Environmental strategies to support and facilitate physical activity and fruit and vegetable consumption appear to be different depending upon the type of community (urban or rural). Using the socio-ecologic model as a framework for behavior change; changes in the physical environment will produce changes in individuals. Changes in the physical environment should differ between urban and rural communities. In addition, strategies that improve education levels and reduce poverty levels may also be effective in the reduction and prevention of overweight and obesity.

Findings in the Context of Earlier Research

Although the association was weak and not significant, the results of this study showed a negative association between fast food restaurants and fruit and vegetable consumption. A recent study among states indicated a positive association between fast food restaurants and obesity prevalence (Maddock 2004). Improved behavioral health data collection at the county level may refine the relationship further. This measure is a promising indicator of fruit and vegetable consumption at the local and state level.

Access to locations where people can be physically active has been found to be a measure of physical activity in urban areas (Gordon-Larsen et al. 2006; Giles-Corti and Donovan 2002b; De Bourdeaudhuij, Sallis, and Saelens 2003; Parks, Housemann, and

Brownson 2003). This study did not find a relationship between recreation facilities or the exercise environment and physical activity. There was a significant, moderate association between public golf courses and physical activity, however, because there were so few golf courses in the study area that finding was unexpected and may be spurious.

Similarly, although previous studies in urban and suburban areas have found a relationship between the number of supermarkets and fruit and vegetable consumption (Kauffman 1999; Moore and Diez Roux 2006), results from this study did not find any significant relationship. In urban and suburban areas the variable supermarkets may reflect the food offerings within the store and likewise for grocery stores and convenience stores. In rural areas, the variables may not reflect the consumer food environment within the store.

The results of this study support previous research by showing an association between education level and also poverty status and physical activity (Gordon-Larsen et al. 2006; Wilcox et al. 2000; Ross 2000). As education level increases physical activity increases. As the number of persons at or below poverty level increases physical activity goes down. As federal spending per person (a measure of dependence) decreases physical activity increases. It may be worthwhile to investigate the relationship between federal spending per person and physical activity in greater detail and further research needs to be conducted before interpretations can be made. Federal spending per person includes funding distributed over 60 programs. Half of the funding is distributed for Social Security, Medicare, and Medicaid. Additional spending is for Homeland Security,

agriculture, forestry, transportation, and education. With additional research funding on specific programs could be analyzed discretely.

Studies in urban areas have shown increases in BMI and decreases in physical activity as travel time to work and time spent in cars increases (Frank, Andersen, and Schmid 2004; Lopez-Zetina, Lee, and Friis 2006). The results of this study have shown moderate, significant, and positive associations between travel time to work and physical activity and fruit and vegetable consumption. Travel time to work may be a proxy indicator for some other variable or its association may differ between rural and urban areas. Further research needs to be done before interpretations can be made. Perhaps in rural areas, travel time to work is a proxy indicator for the type of job people have. It may be that counties with higher overall travel times to work in rural areas have higher paying jobs or that individuals are traveling to areas with greater environmental supports for physical activity. More research needs to be done on travel time to work in urban and rural areas to improve understanding of how that variable relates to physical activity.

Limitations

Limitations for this study included geographical location and exercise environment measurement. This study only included environmental data listed in Reference USA within the 26 county geographic area. This study was limited by the self-reporting accuracy of respondents to the Behavioral Risk Factor Surveillance Survey (BRFSS) and the United States Decennial Census. These data sets represent the best surveillance systems in place for population estimates, but they are difficult to use for small area analysis. The 26 counties in this study represent two health districts. There are 10 counties in health district 1-1 and 16 counties in health district 9-2. BRFSS data are

representative of the population at the health district level. For this study multiple years of the BRFSS were combined to represent the population at the county level. Following the data procedures in the 2006 Georgia Physical Activity Surveillance Report, county specific estimates were obtained, when necessary, by including responses from participants in adjacent counties. If a county had fewer than 200 respondents after combining years, respondents from adjacent counties were included as if they were residents of the county of interest. If, after adding one concentric ring of counties, there were still fewer than 200 respondents, a second ring or third ring was added. Only Georgia residents were used.

The cross-sectional nature of the data limits any inference of causality. The ecological fallacy must also be considered; associations observed at the county level might not hold true for individuals. Likewise, the use of county as a geographic area is arbitrary. County governments have control over many features of the physical and policy environment within their borders. However, these borders are porous. Individuals living within counties do not necessarily restrict their activities and behaviors to the geographic and political county boundary. Individuals may participate in leisure time physical activity outside of the county of residence. It is also possible that gymnasiums, golf courses, dance studios and other facilities for physical activity are opening in areas of high demand and are a proxy for physical activity instead of a cause. Likewise farmers markets and other retail locations for fruits and vegetables may be opening in areas of high demand and are a proxy for fruit and vegetable consumption not a cause.

The exercise environment measured for this thesis is only a slice of the total physical activity environment. Public-sector data on the exercise environment have not

been systematically collected nor reported. For this reason Reference USA data, representing private sector locations for physical activity, may be an underestimate of the actual exercise environment in each county. In addition, physical activity as reported in the BRFSS is only “leisure-time” physical activity and does not include utilitarian or non-leisure-time physical activity. Although the BRFSS differentiates between types of physical activity, environmental supports for physical activity may not. For example, a bicycle lane may support a recreational physical activity and a utilitarian trip to the grocery store.

Recommendations

The Georgia Division of Public Health (GADPH) should over sample the BRFSS in selected urban, suburban, and rural counties to improve understanding of differences between community types. The GADPH should also work with the Georgia Department of Community Affairs (DCA) to improve the statewide county and municipal planning process to collect meaningful public health data. For example comprehensive plans could include data on park acreage, park facilities, bicycle trails, and sidewalks in the same way comprehensive plans currently have information on vehicle miles of travel and mileage or roadway. DCA has a community indicator web-based tool. GADPH should work with DCA to include potential environmental indicators of health.

Counties should collect and report data on government facilities such as parks and recreation facilities. They should further identify number of programs, ages served, and number served by programs. These data can assist public health practitioners to better understand the relationship between the exercise environment and physical activity and also assist communities with performance measurement. The exercise environment

should be mapped by the GIS group at the Regional Development Centers (RDCs) in Georgia. These data should be publicly available and shared with the GIS group at the GADPH. District Health Promotion Coordinators in rural areas of Georgia represent very large geographic areas. If the RDCs collected and reported these data, District Health Promotion Coordinators could use the data for research and program development.

The GADPH should coordinate District level activities and provide education necessary at already occurring meetings to train local staff to enable systematic data collection. Environmental health offices at local boards of health should enter restaurant data into a statewide electronic repository. This could aid public health professionals and researchers. When environmental health officers inspect restaurants they could collect a menu from the restaurant and nutritionists at the board of health or the health district could analyze the menu for nutrition content and pricing using the Nutrition Environment Measures Survey or some other instrument. The food environment should be mapped using GIS to examine differences between access to sources of food and health status at the local level.

DCA should provide greater support for smart growth in rural areas, provide example plans for rural areas to follow, provide technical assistance to rural areas. DCA should assist GADPH to recognize the multiple types of rural communities- those that are developing and those in decline as well as those with a high demand for public services and those with low demand. DCA should create new full time employment positions for Health Planners to work with local communities. Health Planners should work closely with District Health Promotion Coordinators to find context sensitive policy and environmental strategies to reduce overweight, obesity and other chronic diseases.

GADPH should modify the state plan to incorporate specific strategies for urban and rural communities instead of offering one set of strategies that may not be effective in all communities. Lastly GADPH should at minimum add non-leisure time physical activity to BRFSS or a question about total physical activity instead of leisure time physical activity. GADPH should consider asking individuals to self-report the availability of recreation facilities and fresh fruits and vegetable sources within their communities as well.

Georgia is fortunate to have human capital dedicated to the prevention and control of obesity. Within the field of public health, professionals are conducting research, education, and interventions. These professionals are supported by community members who are advocating policy and environmental change. Urban planners and elected officials are responding and implementing change. It is important, as promising practices develop, for the state plan to be a living document-flexible enough to respond to new evidence and specific needs. Opportunities for collaboration should be taken advantage of to continue to build momentum around obesity and its threat to the public's health.

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APPENDIX A

Data

Data collected from summary file one include Total Population: P1, Urban and Rural Population: P2, and Sex by Age: PCT12. Data collected from Summary File 3 include Means of Transportation to Work: P30, Median Household Income in 1999: P53, Poverty Status in 1999 by age: P87, Median Year Structure Built: H35, Sex by Educational Attainment: P37. Data collected from Summary File 4 include Travel time to Work: PCT56 and Tenure by Vehicles Available: HCT32.

The measurements of the food environment collected from Reference USA were confined to the following SIC codes: 539905 Farmers Co-op Retail Stores, 541103 Convenient Food Stores, 541105 Grocer's Retail, 541108 Grocer's Health Foods, 543101 Fruits and Vegetables and Produce-Retail, 543102 Farm Markets, and 581208 Restaurants. The measurements of the exercise environment were confined to the following SIC codes: 799101 Health Clubs, Studios, and Gymnasiums, 799102 Gymnasiums, 799201 Golf Courses-Public, 799701 Recreation Centers, 799951 Parks, 799958 Racquetball Courts-Public, 799969 Swimming Pools-Public, and 799971 Tennis Courts-Public.

Operational Definitions

- (1) Convenience Store. A convenience store is listed in Reference USA under the SIC code 541103.

- (2) Fruit and Vegetable Market. A fruit and vegetable market is listed in Reference USA under one or more of the following SIC codes 539905, 543101, and/or 543102.
- (3) Grocery Store. A grocery store is listed in Reference USA under one or all of the following SIC codes 541105 and/or 541108 and has Sales below \$10 million.
- (4) Supermarket. A supermarket is listed in Reference USA under one or all of the following SIC codes 541105 and/or 541108 and has Sales above \$10 million or is not listed under SIC codes 541105 and/or 541108 in Reference USA and is a Wal-Mart Supercenter.
- (5) Restaurant. A restaurant is listed in Reference USA under the SIC code 581208 and does not include fast food restaurants.
- (6) Fast Food Restaurant. A fast food restaurant is listed in Reference USA under the SIC code 581208 and is named Arby's, Burger King, Captain D's Seafood, Checkers Drive-In Restaurant, Chick-Fil-A, Church's Chicken, Hardee's, KFC, Krystal, Long John Silver's, McDonald's, Mrs Winners Chicken & Biscuits, Popeye's Chicken & Biscuits, Sonic Drive-In, Taco Bell, Wendy's, or Zaxby's.
- (7) Nature Parks. A nature park is listed in Reference USA under the SIC code 79951.
- (8) Golf Course. A golf course is listed in Reference USA under the SIC Code 799201.
- (9) Fitness and Recreation Center. A fitness and recreation center is listed in Reference USA under one or more of the following SIC codes 799101, 799102, 799701, 799958, 799969, and/or 799971.

APPENDIX B

Survey Instrument

Health Promotion Coordinator Interview

1. How long have you worked in this Health District?
2. What are the two greatest public health strengths of the District?
3. What are the two greatest public health weaknesses of the District?
4. What are the two greatest public health opportunities in this District?
5. What are the two greatest public health threats in the District?
6. Which, if any, local governments are actively involved in public health issues?

The following questions relate specifically to physical activity and nutrition in Health District 1-1/9-2. Please answer them based upon your professional experience

7. Where does the majority of physical activity in the district take place (in parks, gyms, home etc.)? Does it vary by County or geographic boundary?
8. There are several state parks in Health District 1-1/9-2. Are these utilized by residents of the District or do they primarily serve non-residents? Are there programs to encourage residents to utilize these parks more often?
9. Does transportation play a key role in access to physical activity facilities? If so, for what groups?
10. Are fresh fruits and vegetables readily available at supermarkets/grocery stores and convenience stores?
11. Do local restaurants and fast food outlets offer healthy options that include fruits and vegetables?
12. Are there farmers markets? If so, do they draw customers locally or regionally?
13. Are there community garden programs? If so where?
14. Are there community leaders in physical activity and nutrition or obese overweight in Health District 1-1/9-2 if so what types of programs do they offer or advocate for?

15. What are the major barriers to physical activity in Health District 1-1/9-2? Do these vary by County?

16. What are the major barriers to fruit and vegetable consumption in Health District 1-1/9-2? Do these vary by County?

The next set of questions imagines no political or financial barriers to address overweight and obesity.

17. How would you increase the percentage of adults regularly engaging in physical activity in Health District 1-1/9-2?

18. How would you increase the percentage of adults consuming 5 or more fruits and vegetables per day in Health District 1-1/9-2?

19. Are there other behaviors you would address to decrease the prevalence of overweight and obesity in Health District 1-1/9-2?

The next set of questions are related to community cohesion

20. Are there events that bring the community together that include (directly or indirectly) a physical activity or nutrition component?

21. Do you have a sense that the Health District 1-1/9-2 community is close-knit or made up from a number of close-knit communities?

22. Are there segments of the population that are seen as or think of themselves as outsiders despite residence in the District?