

Spatial and Psychosocial Influences on Food Access in Rural Appalachia

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Abstract

Purpose: To assess detailed individual-level information about complex factors affecting access to healthy foods in a vulnerable rural Appalachian population. **Methods:** A cross-sectional, mixed-methods study was conducted in a rural Appalachian county in southwestern Virginia. Methods included location and identification of food retailers, food store surveys, and in-depth interviews with lower-income women who managed their household food. **Results:** Fifty stores were identified, of which 28 were surveyed. Nine women participated in interviews. Supermarkets had the best overall availability, price, and quality of healthy foods, but grocery stores were also favorable for healthy foods as well as good service. Participants described criteria for selecting stores and foods in stores, as well as personal, social, and community factors that affected their food choices. **Conclusion:** This research suggests that a combination of factors influences access to healthy foods in a rural Appalachian community, including potential availability of healthy foods in retail stores, and a multitude of factors in the lives of consumers. Community-level interventions to increase the ease of eating healthfully may include changes in food retail, consumer education, and promotion of traditional food culture including home food production.

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Dissertation Approval Sheet

Formal approval is hereby given to this submitted dissertation by Esther Thatcher on
Spatial and Psychosocial Influences on Food Access in Rural Appalachia.

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Chapter One: Introduction

Obesity and overweight are the second leading cause of preventable deaths in the U.S., after tobacco (Danaei et al., 2009). Sixty-eight percent of U.S. adults are now overweight, including 35.7% who are obese. In children and adolescents, obesity rates have grown to 16.9% (Ogden, Carroll, Kit, & Flegal, 2012). Obesity is associated with diseases of almost every body system, including cardiovascular disease, sleep apnea, type two diabetes, cancer, arthritis, and premature death (Meires & Christie, 2011). Obese individuals are also at higher risk of psychosocial consequences and impaired functioning in job, school, or other social roles (Institute of Medicine [IOM], 2012). Direct annual medical costs from obesity-related illnesses are estimated at \$190 billion, and indirect costs from reduced economic productivity create a significant drag on the U.S. economy (IOM, 2012).

In the years following the Surgeon General's 2001 declaration that obesity was an "epidemic" in the U.S., the field of food environment research has searched for causal associations between environmental exposures to food and health outcomes such as obesity (USDHHS, 2001; Glanz, 2009). The food environment is a broad framework representing the multiple influences on the foods that individuals eat (Sallis & Glanz, 2009). The IOM (2012) describes the socio-ecological theory that guides this framework as it relates to the multiple and dynamic levels of interaction between an individual and the food environment.

Appalachia is a region with high rates of obesity and other nutrition-related diseases (Behringer & Friedell, 2006). The subregion of Central Appalachia, including

parts of Virginia, Kentucky, Tennessee, and West Virginia, has many of the worst health and economic disparities (Appalachian Regional Commission [ARC], 2012). Many of its counties also rank near the bottom for overall health in their respective states (University of Wisconsin Population Health Institute (University of Wisconsin Population Health Institute [UWPHI], 2012). Life expectancy in Central Appalachia, already lower than the U.S. average, has now fallen for women, a likely result of increased obesity and chronic diseases (Kulkarni, Levin-Rector, Ezzati, & Murray, 2011).

The purpose of this dissertation study was to assess detailed individual-level information about complex factors affecting access to healthy foods in a disadvantaged rural Appalachian population. Data from this study can assist nurses and others who provide nutrition services to rural Appalachian residents, through improved understanding of how these residents access food.

The first manuscript presented is “Geographic Information Systems in Nursing Education, Research, and Practice: A Systematic Review and Call to Action.” The goal of the review is to promote the increased use of this technology to enhance analytic and communication capabilities in the nursing profession. A total of 39 published articles are included in the review, and they cover a wide breadth of content including epidemiological surveillance, health disparities, community health practice, distribution of health services, nursing workforce, nursing education, and research methodology. A discussion of practical recommendations for increasing adoption of GIS technology concludes the review.

The second manuscript describes methods and findings in a primary data collection study to describe the availability of healthy food in a rural Appalachian Virginia county, and to understand the experiences of lower-income women making selections from among the available food sources. The manuscript, “Potential and Realized Access to Healthy Foods in Rural Appalachia: A Mixed Methods Study,” reports findings on the locations and characteristics of retail food stores. Availability, price, and quality of foods available in the stores are described. The experiences of women selecting where to shop, and which foods to buy are discussed separately and in combination with the food store characteristics.

The third manuscript continues to describe the food choice experiences of lower-income women in rural Appalachia. “Cultural and Economic Influences on Food Choice in Rural Appalachian Women” describes results of in-depth interviews with nine women. Central themes in the interviews include food knowledge and beliefs, culturally traditional foods, locally and home-produced foods, household food patterns, and family dynamics. Recommendations include promoting existing resources for healthful eating, and overcoming obstacles.

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Chapter Two: Research Proposal

Specific Aims

As prevalence of obesity continues to rise at alarming rates in the United States (U.S.), efforts to prevent obesity are an urgent national health priority. The 24 million people living in the Appalachian region of the U.S. have higher rates of obesity and associated diseases like diabetes, cancer, heart disease, and premature mortality than most other regional populations of the U.S. (Behringer & Friedell, 2006; Centers for Disease Control and Prevention, 2009). The subregion of Central Appalachia, including parts of Virginia, West Virginia, Kentucky, Tennessee, and Ohio, has especially high concentrations of obesity, other health disparities, and economic disadvantage (Barker et al., 2010). Reducing obesity would make a significant impact on its health and economic costs (Brown, Fujioka, Wilson, & Woodworth, 2009).

Obesity prevention is more effective than treatment (Wang, Liang, Caballero, & Kumanyika, 2008). Food consumption that provides more calories than those expended through physical activity is a primary cause of overweight and obesity (Korner, Woods, & Woodworth, 2009). The *community food environment* comprises food stores, restaurants, and other sites that provide access to foods from which consumers must make choices (Lytle, 2009). Measuring food environments is an important approach for assessing the ability of individuals to choose to eat a healthy diet. Individual and household demographics and other characteristics also present important resources and barriers to accessing healthy foods. In order to promote health and address health disparities, nurses

and others must understand the complex multi-level factors that determine health behaviors such as food choices. In the rapidly developing field of food environment research, few studies have focused on Appalachia.

The research question was: What are some important influences on food access and food choices in low-income rural Appalachian residents? This cross-sectional mixed methods study of an economically disadvantaged rural Central Appalachian county used an ecological framework and combined multiple data collection methods (*i.e.* GIS mapping, in-store surveys, go-along interviews) to examine potential and realized food access related to individual, social, community, and policy influences. The specific aims of this study were to:

- 1) Describe the community retail food environment (*potential food access*), including store proximity, food availability, pricing, and marketing.
- 2) Describe food access behaviors (*realized food access*).
- 3) Explore psychosocial, economic, cultural, and environmental influences on realized food access.

Study Purpose

The purpose of this dissertation study was to assess detailed individual-level information about complex factors affecting access to healthy foods in a disadvantaged rural Appalachian population. Data from this study can assist nurses and others who provide nutrition services to rural Appalachian residents, through improved understanding of how these residents access food. It can also provide a foundation for subsequent interdisciplinary research and intervention design among nurses, other public

health professionals, community planners, and business leaders. Future aims of this research program will seek effective population-level and clinical-level interventions to improve the nutrition and overall health of Appalachians and other populations at high risk for obesity.

Research Strategy

Significance

Obesity. Obesity and overweight are the second leading cause of preventable deaths in the U.S., after tobacco (Danaei et al., 2009). Overweight is defined as a body mass index (BMI) of 25 to 25.9, and obesity is a BMI of 30 or higher (Institute of Medicine [IOM], 2012). Obesity rates have doubled in adults and tripled in adolescents since the 1970's (National Center for Health Statistics, 2010). Sixty-eight percent of U.S. adults are now overweight, including 35.7% who are obese. In children and adolescents, obesity rates have grown to 16.9% (Ogden, Carroll, Kit, & Flegal, 2012). Obesity is associated with diseases of almost every body system, including cardiovascular disease, sleep apnea, type two diabetes, cancer, arthritis, and premature death (Meires & Christie, 2011). It also puts individuals at higher risk of psychosocial consequences and impaired functioning in job, school, or other social roles (IOM, 2012). Direct annual medical costs from obesity-related illnesses are estimated at \$190 billion, and indirect costs from reduced economic productivity create a significant drag on the U.S. economy (IOM, 2012).

Obesity is distributed unequally among population groups. Racial minorities such as blacks, Hispanics, and Native Americans have higher rates of obesity than whites and

Asians (Wang & Beydoun, 2007). Individuals with lower income and lower education are more likely to be obese, though this trend is inconsistent in blacks and Hispanics (Braveman, Cubbin, Egerter, Williams, & Pamuk, 2010). The Southeast region of the U.S. has the highest state prevalence of obesity by state (Robert Wood Johnson Foundation [RWJF], 2010). In rural areas, overall prevalence of obesity in 2000-2001 was 23%, compared with 20.5% in urban areas (Jackson, Doescher, Jerant, & Hart, 2005). Variability included region, degree of rurality, race, and socioeconomic status.

Two major causes of obesity are excess calorie intake through food, and insufficient expenditure of calories through physical activity (IOM, 2012). The reasons for the rise in obesity are complex and are highly related to changes in social structures and the built environment that favor increased calorie dense food intake and sedentary lifestyles. (RWJF, 2010). Healthy People 2020 makes recommendations for healthful diets including limiting calories and choosing foods high in nutrients other than saturated or *trans* fats, sugar, and sodium (U.S. Department of Health and Human Services [USDHHS], 2012). Trends in food consumption have moved U.S. adults towards higher calorie consumption but a lower proportion of nutrient-dense foods (RWJF, 2010). Compared with 1970, an average of 600 additional calories are consumed daily by individuals. Sugar consumption is now three times the recommended level, and fat intake is also higher than recommended. Fiber intake is lower than recommended. Consumption of healthier, nutrient-dense foods such as fruits, vegetables, whole grains, and low fat dairy products is lower than current guidelines (RWJF, 2010).

Food environment. In the years following the Surgeon General's 2001 declaration that obesity was an "epidemic" in the U.S., the field of food environment research has searched for causal associations between environmental exposures to food and health outcomes such as obesity (USDHHS, 2001; Glanz, 2009). The food environment is a broad framework representing the multiple influences on the foods that individuals eat (Sallis & Glanz, 2009). The IOM (2012) describes the socio-ecological theory that guides this framework as it relates to the multiple and dynamic levels of interaction between an individual and the food environment. At the individual level, influences include knowledge, skills, genetics, demographics, and values. Influences at the social network level include norms and support of family, friends, and peers. At the physical environment level, community features such as neighborhoods, foods stores and restaurants, schools, and worksites are highly relevant as creating access or barriers to certain food choices. At the higher macro level are large influential factors such as regulations and policies, industries, media, government assistance programs, health systems, and broader cultural norms. Studying the food environment can inform community-level interventions aimed at making healthy foods more accessible, and making healthy lifestyle choices the easy choices.

In the seminal article by Glanz and colleagues (2005), a conceptual framework divided the food environment into separate areas of study. *Community food environment* includes consumers' direct access to food outlets in the community, such as stores and restaurants. *Organizational food environment* includes food access and exposure in settings such as schools, homes, and workplaces where food is generally available only to

defined groups instead of the general public. *Consumer food environment* includes the foods that consumers find within food outlets, and accompanying information such as price, nutrition labels, and advertising. *Information environment* includes media and advertising about food, and the government and industrial policies that affect these messages. In reality there is much overlap with these divisions. For example, spatial access to stores (community food environment) and foods stocked inside stores (Consumer food environment) are both major influences on a consumer's food choices (Dean & Sharkey, 2011). Community food environment remains a relevant concept for focusing on food access in whole communities rather than specific institutions, but its boundaries as a concept require flexibility for incorporating complex phenomena inherent in community ecologies.

Two major factors of food access are physical proximity of individuals to food outlets, and financial resources to purchase foods (Sharkey & Horel, 2008). The types of food outlets near to individuals provides important clues about food selection and prices; supermarkets often have the best in-store selection and price of healthy foods (Moore, Diez-Roux, Nettleton, & Jacobs, 2008). Neighborhoods that lack large supermarkets often have worse health indicators than neighborhoods with good access to supermarkets (Morland, Wing, & Diez-Roux, 2002). Food insecurity, or lack of adequate quantity or quality of food, is found in 21% of U.S. households with children, with higher rates in low-income households (Hager et al., 2010). It is associated with adverse health and development outcomes in children, and also with obesity in all affected individuals (Drewnowski & Spector, 2004; Hager et al., 2010). Low-cost diets tend to favor starchy,

energy-dense foods with long shelf lives, rather than fresh produce and low-fat meats (Darmon & Drewnowski, 2008).

While physical proximity and finances may have broad influence on food access, the food choices that individuals ultimately make are based on complex psychosocial and economic factors that merit investigation at the individual level. An integrated review of studies of Appalachian women, for example, suggested that food choices are affected by cultural norms, gender roles, education, and rurality (O'Brien & Talbot, 2011).

Qualitative methods in food environment research are uncommon, but are needed to understand the complex and nuanced phenomena that ultimately contribute to food choices and nutrition (Oakes, Masse, & Messer, 2009). Identifying barriers to food access in a community, as well as the resources that are employed to facilitate access, are important in designing interventions that are appropriate for specific communities.

Overall, food environment measurement has several current challenges. Achieving a balance between accuracy of data and the cost of collecting data means making trade-offs in study designs. Reaching consensus on variable classification systems and data collection methods has not yet been achieved, leading to impaired ability to compare and synthesize studies to provide stronger evidence regarding causal factors (Story et al., 2009).

Data sources and analysis. Secondary analysis of existing data is the most common method in current food environment studies (Oakes et al., 2009). Common sources of secondary data on health outcomes include regional or national health surveys, and data on food outlets is available from industry or business listings (IOM, 2012).

Direct observation, or *ground truthing*, of the study area is more expensive and time consuming than secondary analysis, but can result in higher quality data (Sharkey, 2009). Direct observation can be useful for studies of small geographic areas, or for testing the validity and reliability of secondary data (Bader, Ailshire, Morenoff, & House, 2010). Data collected from this method can include observation notes, surveys, and interviews. Geographic Information Systems (GIS) is a computer-based method of manipulating, analyzing, and displaying spatial data (Nyerges & Jankowski, 2010). Because the community food environment is conceptualized around spatial access and exposure to food, GIS is a tool that is highly useful and heavily used in this research (McKinnon, Reedy, Handy, & Rodgers, 2009). The mountainous terrain of Central Appalachia, which presents unique barriers to travel for food access, can be illustrated using GIS maps. Qualitative methods have been used to gather rich data that can help researchers to better understand the complexity of community food environments (Oakes et al., 2009). Through individual or group interviews, researcher observation, a variety of participatory methods, or other methods, a researcher can interact with residents and other stakeholders to better understand the perspectives and experiences of these individuals (Ulin, Robinson, & Tolley, 2005).

Food environment and health disparities. There is strong evidence that food environments are associated with health disparities. Food prices and food outlet locations are both factors in this. Calorie-dense, low-nutrient processed foods are cheaply and easily available in most food outlets. Fresh fruits and vegetables, whole grains, and low-fat dairy and fresh meats tend to be cost more per calorie than energy-dense processed

foods (Darmon & Drewnowski, 2008). Socioeconomic status is inversely associated with obesity in Whites, but not in Blacks or Hispanics (Wang & Beydoun, 2007).

Supermarkets tend to locate in areas of higher income, leaving many residents with low spatial access to healthy foods (Zenk et al., 2005). In urban areas, living in a neighborhood with small food stores but being far from a supermarket both increase the probability of residents being obese (Michimi & Wimberly, 2010; Gibson, 2011).

Current state of community food environment research. The current state of community food environment research is largely focused on providing evidence of association or causality, but it is starting to shift to intervention studies. There is widespread agreement that access and exposure to food has significant influence on what one eats, and that fast food and convenience stores are associated with unhealthy food choices (Hickson et al., 2011; Morland, Diez Roux, & Wing, 2006). The influence of grocery stores and supermarkets has been assumed to have a protective effect on health and weight, but recent studies have questioned this association, especially in longitudinal studies (IOM, 2012). Innovative methods of measuring individuals' access and exposure to food outlets show promise for improving data quality for community food environment studies. Few studies have prospectively measured "natural experiments" in food environment interventions, though several community-level programs are currently underway and plans are in place to measure outcomes (e.g., Schwarte et al., 2010). Recent studies have recommended further investigation in areas that have conflicting or inconclusive evidence, including objective vs. perceived access to healthy foods (Gustafson, Hankins, & Jilcott, 2011), the effect of travel distance to food outlets in rural

settings (Walker et al., 2010), and influences on food selection behaviors within food outlets (IOM, 2012).

Conceptual framework of study. The dominant conceptualization for this study was based on Sharkey and Horel's (2009) framework, and was supplemented by related concepts and methods from current research. In their research on U.S. rural food environments, Sharkey and Horel (2009) framed food choices as results of dynamic relationships between diverse factors in the lives of potential consumers, and the characteristics of the food outlets available to them (Figure 1). *Potential access* is the availability of food outlets, and exists as a precursor of *realized access*, the critical point at which the consumer utilizes a food outlet to access food. At both the individual and food outlet level, there are many characteristics that present barriers or facilitators to realized access that could become a target of an intervention to improve food choices and, ultimately, healthful eating patterns.

Additional concepts and methods from current research enhanced the study. Current literature provides evidence of or speculation about important factors of individuals' food access: 1) Intrapersonal factors such as food management skills, standards, past experiences, and subjective food choice capacity (Bisogni, Jastran, Shen, & Devine, 2005), food preferences (Glanz et al., 1998), financial resources, and time (Darmon & Drewnowski, 2008); 2) Interpersonal and household factors such as mobility and vehicle ownership (Sharkey & Horel, 2008), household membership including presence of a partner or spouse and children (Bisogni et al., 2005), caretaking roles (Son et al., 2007), food sharing or reciprocal economies (Sharkey, 2009), raising or hunting

food (Gittelsohn & Sharma, 2009), and adequacy of housing including plumbing and kitchen (Schafft et al., 2009); 3) Community factors such as cultural or social norms about food or weight (Maley et al., 2010), and trust of community and perception of community safety where they live and where they access food (Dean & Sharkey, 2011); and 4) Policy factors such as access, effectiveness, and acceptability of government or other food support programs (Dean & Sharkey, 2011).

Ethical framework. Justice is an ethical principle that refers to treating similar cases equally (Schmidt, 2009). Procedural justice is the equal inclusion of all affected parties in a decision-making process, and distributive justice refers to the outcomes of equitable distribution of resources and burdens (Childress et al., 2002). Social justice aims at equitable distribution among social groups such as race and ethnicity, gender, and nationality (Blacksher & Lovasi, 2011). Environmental justice refers to equitable distribution of natural resources and exposure to environmental toxicities among social groups (Wilson, 2009). Public health science has historically focused on justice as a means to examine and reduce disparities in health for economically or socially disadvantaged populations (Blacksher & Lovasi).

The social justice principle is a way to test for equity in social determinants of health. When unjust distribution of healthful foods skews the available options in favor of highly caloric and less nutritious foods for certain populations, then the social injustice is that these populations have reduced agency to select foods that lead to better health (Blacksher & Lovasi, 2011). At issue is the extent to which individual agency, or the autonomy to make choices for oneself, is hampered by inequitable distribution of healthy

foods in one's environment. The ethic of social justice is an assumption in many ecological models in that these models depict determinants of health found in one's environment, and that equitable distribution of these determinants should occur through public health, community planning, policy, and other action (Wilson, 2009).

Food environment and rural health. Rural food environment research claims several unique attributes that limit the translatability of non-rural community food environment studies. The association of obesity and distance to supermarkets is not significant in nonmetropolitan areas (Michimi & Wimberly, 2010). Rural areas have as many or more disadvantaged populations, such as racial minorities and low socioeconomic status (Lichter & Parisi, 2008). In rural areas, where public transportation is scarce, supermarkets that are in easy driving distance may still be inaccessible to residents who have no car (Bustillos, Sharkey, Anding, & McIntosh, 2009). Rural residents with low income or low mobility may be more likely to buy food at nearby convenience stores or at nontraditional food retailers such as dollar stores, which usually sell less healthy foods selections (Bustillos et al., 2009). Cultural differences in rural areas are also important to consider. Though cultures of rural residents vary widely across the U.S., rural culture may be an important influence on health behaviors (Hartley, 2004). Measurement of rural community food environments may also differ from urban areas, as secondary sources of food outlet listings are more likely to be erroneous (Sharkey, 2009). The field of rural food environment research related to obesity and health outcomes has only been studied within the past few years, with the majority of publications since 2006 (e.g., Boehmer, Lovegreen, Haire-Joshu, & Brownson, 2006). Rural resident travel

patterns and relations with food outlet personnel may also vary in ways that affect the community food environment (J. R. Sharkey, personal communication, March 18, 2011).

Low-income rural Appalachian residents. The population of the mostly rural Appalachian region has disproportionately high rates of many diseases related to nutrition (Behringer & Friedell, 2006). The region surrounding the Appalachian Mountains includes 24 million people and extends from Mississippi to New York (Appalachian Regional Commission [ARC], 2012). It has disproportionately high rates of obesity, smoking, diabetes, heart disease, hypertension, and cancer, and lower health-related quality of life (Barker et al., 2010; Zullig & Hendryx, 2011).

The subregion of Central Appalachia, including parts of Virginia, Kentucky, Tennessee, Ohio, and West Virginia, has many of the worst disparities (ARC, 2012). Many of its counties also rank near the bottom for overall health in their respective states (University of Wisconsin Population Health Institute [UWPHI], 2012). Life expectancy in Central Appalachia, already lower than the U.S. average, has now fallen for women, a likely result of increased obesity and chronic diseases (Kulkarni, Levin-Rector, Ezzati, & Murray, 2011). Prevalence of diseases and disability are high in central Appalachia. For example, in the Lenowisco Health District in far southwestern Virginia, which includes the proposed study area of Lee County, rates of obesity, chronic obstructive pulmonary disease, asthma, diabetes, cancer, and disability were all higher than the state average (Virginia Department of Health [VDH], 2010). Central Appalachia also has disproportionately high rates of mental disorders, including psychiatric inpatient admissions, opiate drug abuse, and tobacco abuse (ARC, 2008b; VDH, 2010).

Central Appalachia also has a history of persistent poverty including low income, low educational attainment, high unemployment, and out-migration of educated youth (Wood, 2005). Important historical influences on the people of Central Appalachia include geographic isolation due to the mountains and rivers, economic isolation, and economic exploitation of the people and land. Coal mining and logging are two major industries of the area, creating boom-and-bust economic cycles as well as severe environmental damage to the land and water (Flaccavento, 2010). Unique cultural traits of Central Appalachian communities are based on ties to the rugged mountainous land and include tendencies towards self-reliance, distrust of outsiders, strong social ties to family and church, and egalitarianism (Keefe, 2005; Russ, 2010).

Food environment in Appalachia. Despite significant health disparities in Appalachia, few studies on community or consumer food environments have been conducted in the region. A 2010 study of diabetes risk in Appalachia referred to a study of food outlets in Alabama, and a food security study in Ohio (Barker et al., 2010). Recent studies on obesity and other chronic diseases in Central Appalachia have not referenced food access studies from the subregions (Holben & Pheley, 2006; Smith, 2011; Wu et al., 2007). Likewise, few rural studies mentioned in recent integrative reviews of food access took place in Appalachia (Gustafson et al., 2012; Walker, Keane & Burke, 2010). Several studies of health in Central Appalachia have focused on individual-level health risks and health beliefs (Coyne et al., 2006; O'Brien & Talbot, 2011; Pancoska et al., 2009; Della, 2011; Deskins et al., 2006).

Food security in Appalachia. Food insecurity is defined as situations in which “the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain” (National Research Council [NRC], 2006). Low-income individuals and households are at risk of food insecurity, which can include accessing food through less socially acceptable means, eating inferior foods, or going hungry (Bickel, Nord, Price, Hamilton, & Cook, 2000). Food insecurity can lead to many long-term social and health problems, including obesity. A study of rural Appalachian low-income counties in Ohio found that food-insecure individuals had higher rates of obesity and diabetes than food-secure individuals (Holben & Pheley, 2006). Supplemental Nutrition Assistance Program (SNAP) benefits are accessed by more than 20% of the population in many Central Appalachian counties (Wilde, 2012). As another indicator of food insecurity, free and reduced school lunch program participation in Lee County, VA ranges from 47 to 86 percent (Lee County School System, 2012).

Qualitative food environment research. Qualitative research has been relatively rare in food environment studies. However, the rich data available from qualitative methods may better capture the complex dynamics between individuals, social systems, and food environments (Oakes et al., 2009). Qualitative methods allow researchers to better understand the natural context of the subjects or phenomena they study through interviews, focus groups, participant observation, or other approaches (Ulin, Robinson, & Tolley, 2005). Zenk and colleagues (2011) identified urban African American women’s barriers and adaptive strategies for accessing food through in-depth interviews.

A study in rural New York assessed social norms and environmental factors of food choice, identifying barriers to healthy eating that go beyond personal choices (Maley, Warren, & Devine, 2010). A North Carolina study assessed rural women's perceptions of how healthy or unhealthy foods fit in their lives, finding that family preferences, workplace culture, and exposure to food outlets during commutes were important influences. (Jilcott, Laraia, Evenson, & Ammerman, 2009). Focus groups in the rural Midwest found influences of community engagement and advocacy on food access (Smith & Morton, 2009). Though qualitative studies have provided valuable data about the lived experience of interacting with food environments, more studies are needed to investigate other important aspects of food environments.

Mixed methods food environment research. Mixed methods usually refer to combining qualitative and quantitative approaches in a study. Mixed methods can be appropriate when a single data type is inadequate to understand a research question (Creswell & Plano Clark, 2011). Two recent literature reviews on food environment research have recommended mixed methods research to assess objective and subjective measures (Gustafson et al., 2012; Walker et al., 2010). Gustafson and colleagues (2011) compared scored perceptions of low-income women about availability of healthy foods with an objective assessment of healthy foods in food outlets in their neighborhoods. Additional mixed methods studies were not found.

Gaps in the literature. Important gaps in the literature are inherent to the relatively young food environment research field. Methodologies and even the definitions of variables are still in development. Evidence that once seemed irrefutable, such as the

effect of close-by supermarkets on obesity, has become less clear. While there is a plethora of cross-sectional studies, very few have been done in Appalachia. Central Appalachia, as a region of significant health and socioeconomic disparities, has little evidence about community food environments or consumers' perceptions. More qualitative and mixed methods studies have been recommended recently, but the vast majority of studies are quantitative.

Innovation

This study was innovative in that it addressed a population with little research evidence for influences on food access; it used an innovative mixed methods approach to explore a complex concept, and used methods that are innovative in nursing research. A small proportion of food environment researchers focus on rural settings (Gustafson et al., 2012), and there is need for studies specific to the unique circumstances of Central Appalachia. The convergence of qualitative data on individuals, and quantitative data on food outlets, advances the science of food environment research by acknowledging often complex relationships between individuals and food environments (Walker et al., 2010). Go-along interviews are not widely used in food environment or nursing research (Carpiano, 2008), but are a promising way to connect objective studies of food outlets with qualitative studies of consumer perceptions. The technology and methods of GIS are underutilized in nursing research, education, and practice, and the convergence of GIS data with qualitative data is a little-used but promising way to enhance both (Endacott, Boulos, Manning, & Maramba, 2009; Mathews, Detwiler, & Burton, 2005).

Approach

Design and methods. This cross-sectional descriptive study used a mixed methods approach to describe potential and realized access to food outlets in an economically at-risk Appalachian rural county in southwestern Virginia. This study had two data collection phases: data on food outlet characteristics were collected first; participant data were collected second. This design allowed the PI to become deeply familiar with the community food environment, and improved the quality of the questions asked of the participants about their interactions with the community food environment. Table 2 shows how each data collection method addressed a specific aim.

Subjects and settings. Lee County, Virginia is very rural and economically at-risk Appalachian county. Disparities of health and socioeconomic status are some of the worst in the state (UWPHI, 2012). Building on two pilot studies conducted there in Spring 2012, the PI will recruit participants through the local health district and the county Head Start program. The Director of the LENOWISCO Health District, and the assistant director of the Head Start program wrote letters in support of the proposed study. Lee County is representative of Central Appalachia in some key socioeconomic indicators (Table 1).

The target population was rural Appalachian residents with low incomes. Sampling units were individuals and food outlets. A convenience sample with a goal of 20 Lee County residents comprised the sample of individuals. Inclusion criteria included self-reporting as: a female between age 18 and 65 years, English speaking, resident of Lee County for at least one year, having at least one child living in the home, the main

food shopper for her household, and eligible by income for Supplemental Nutrition Assistance Program (SNAP) or Women Infants and Children (WIC) benefits . Only women were targeted in this study because women tend to be more actively involved in household food procurement and preparation than men (Jilcott et al., 2009). Non-English speakers were excluded, as fewer than 1% of the population is foreign-born (U.S. Census, 2011b). The lower age limit of 18 reflected that most people who independently buy their own food are 18 or older. Seniors over 65 years of age have unique needs and barriers in accessing healthy nutrition, which are beyond the scope of this study (Dudek, 2010). If a potential participant was not currently enrolled in SNAP, but self-reported as eligible by income, she was able to be included in the study. Selection of food outlets is described in Food Outlet Location and Type.

Recruitment: A convenience sample was sought through opportunistic, purposive, and snowball recruitment strategies. Recruitment activities included: A) placing IRB-approved flyers in the Health Department and at Head Start sites (Appendix I); B) Partnering with nurses, teachers, program assistants, and other service providers to ask their clients with possible eligibility if they were interested in participating in the study; C) The PI was present to provide information at events sponsored by the Health Department or Head Start where women with children are likely to attend, such as children's health fairs and WIC clinics (Appendix J); and D) Asking enrolled participants if they can refer other individuals who may be eligible. Procedures: A study eligibility screening form was developed (Appendix K). The PI trained appropriate personnel at the two partnering agencies to administer the screening form to clients who expressed

interest in the study. The PI scheduled the first meeting with the participant through phone or face-to-face contact. The consent process occurred at the beginning of the first scheduled interview. During the consent process, the PI provided a copy of the form (Appendix L), read the form to the participant, and asked her if she had any questions or concerns. If the participant agreed to enroll in the study, a signature was obtained and the participant was given a copy of the consent form. Participants were offered choices of where the first and third interviews were held: a community service facility, other community sites, or the participant's home. If the participant stated she was not enrolled in SNAP, the PI offered referrals to Social Services or other programs. Avoiding bias: Geographic location of a participant's residence is likely to influence where she accesses food. To avoid clusters of participants from one part of the county, the town of residence was included on the screening form. Attempts were made to recruit at least two participants from each of four areas of the county: western, southeast, northeast, and central. Incentives: A payment of \$10 cash per interview was offered to participants. Payment was given at the start of each interview, and the participant was informed that she could keep the payment even if she decides to stop or withdraw from the study before the interview was over.

Measures and data collection protocol.

Food outlet characteristics. Food stores were identified and mapped. Food stores are defined as retail outlets open to the public that sell one of three index items: milk, bread, or fresh produce (Hosler et al., 2008). Stores were classified based on Sharkey's categorization (2009; Bustillos et al., 2009): 1) supermarket or supercenter (100+ parking

spaces), 2) small grocery (<100 parking spaces), 3) convenience (with or without gas pump), 4) specialty stores such as meats or produce; 5) non-traditional food stores such as dollar stores or pharmacies; and, 6) others such as seasonal farm stands and weekly farmers' markets. Sampling: Three criteria were used: 1) All food outlets in Lee County; 2) All grocery stores and supermarkets within 5 miles of the county line, by road network distance; and 3) All food outlets outside of Lee County identified by participants during Interview One. Data Collection: Secondary data sources for food outlet location in rural areas have limited reliability and should be supplemented with *ground-truthing*, i.e., systematically driving to all stores and along all roads where there is a possibility of additional stores (Sharkey, 2009).

Pilot work by the PI used secondary data to compile an accurate list of food stores in Lee County. Geospatial coordinates were obtained at the main entrance of the outlet by using a handheld GPS device. The UVA Scholars Lab supplied this device and trained the PI on field use and transferring data to ArcGIS 10 software (Environmental Systems Research Institute, 2011). Categorization of outlets was through direct observation. The Food Outlet Identification Form (FOIF, see Appendix A) was developed by the PI to keep detailed records on the multi-step process of identifying, locating, and mapping food outlets potentially accessible to the study population. A separate form was filled out for each outlet. The name, address, GPS coordinates, inclusion criteria, and category was recorded. Records were kept of accuracy of secondary sources of food outlets, noting incorrect or omitted data compared with ground-truthing. These data were compiled in an Excel spreadsheet. Finalized food outlet data with georeference points, also on an Excel

spreadsheet, were imported to a GIS document for mapping and analysis. Additional GIS map layers were collected through secondary sources and include roads, political boundaries, topography, and other features.

In-store food assessment. The goal of this assessment was to obtain objective data on the availability and accessibility of healthy foods in the stores where low-income Appalachian women shop or potentially could shop. A modification of a validated instrument was used.

The Nutrition Environment Measures Survey in Stores (NEMS-S) is a widely used instrument that assesses the presence (availability), quality, and price of a list of standardized food items in a retail food outlet (Glanz, Sallis, Saelens, and Frank, 2007). It has been used in other rural areas (i.e. Gustafson et al., 2011) and offers training on its administration. Items: NEMS-S includes 10 categories of foods that are common in American diets, including milk, fruit, vegetables, meats, frozen foods, baked goods, bread, beverages, snack chips, and cereal. Healthy food items were selected based on federal agency guidelines and health research. Scoring: Standardized scoring for each food item includes its presence/availability and price per pound or unit. For fresh produce, quality is scored as acceptable or unacceptable, based on defined standards. Subsequent scoring instructions assign points to an individual store for characteristics such as the proportion of items in a food category that are healthy choices, or for price structures that make healthy choices the same or lower price than less healthy alternatives. Interpretation: Raw data and scores are entered into a statistical program and analyzed to produce a composite “food environment quality” score for the food store,

based on availability, quality, and price. **Validity and Reliability:** The NEMS-S has highly standardized instructions and procedures to maximize feasibility, reliability, and validity. An online or in-class training module is available to administrators (Glanz et al., 2007). Validation testing found high inter-rater and test-retest reliability, ranging from 80 to 100% (Glanz et al., 2007). Variations in store inventory cycles and seasonal availability can affect validity; the NEMS-S is designed to be a cross-sectional, one-time study of foods available in a store. A study of this temporal instability of store inventory showed that one observation was sufficient for an accurate measure of food availability within the season (Zenk, Grigsby-Toussaint, Curry, Berbaum, & Schneider, 2010). One threat to external validity is how accurately the NEMS-S scores reflect the healthy food options in all food outlets. The racial and ethnic homogeneity in the study area facilitate the development of a valid instrument. The NEMS-S can be modified to local conditions and food preferences of the study population, but should be pre-tested to ensure reliability (Glanz et al., 2007).

Modified NEMS-S Store Survey. After pre-testing the original NEMS-S instrument in the study area, modifications were planned in consultation with local key informants and a diabetes educator. The Rudd Center Revised NEMS-S (NEMS-S Rudd) contained most of these modifications, and was used previously in an Appalachian study (Andreyeva, Blumenthal, Schwartz, Long, & Brownell, 2008; Gustafson, Christian, Lewis, Moore, & Jilcott, 2013).

The NEMS-S Rudd survey was selected as the study instrument, but revised to reflect local brands and culturally specific foods (Appendix B). For example, fresh

collard greens and sweet potatoes were added, and cauliflower and celery were omitted. Canned Vienna sausages were substituted for tuna in oil. Frozen French fries and strawberries were added to the frozen vegetables as regular and healthy options, respectively. A new section on cooking oils, including olive oil and lard, was added. Price and availability of milk focused on gallon containers, the most commonly bought by families. The original NEMS-S Rudd also assessed whether stores accepted SNAP and Women Infants and Children Nutrition Program (WIC) benefits, and brief notes on exterior and interior store conditions. A full version of the revised survey is available from the PI.

The scoring system for the modified NEMS-S Rudd food store survey was based on the system for the original NEMS-S (Glanz et al., 2007). Food categories were scored for availability, price, and quality, and then scores were totaled for each food store in the sample (Appendix C). Availability scoring awarded points for healthier options. Point values were higher in the categories of fresh fruits and vegetables, milk, and fresh meat. Availability scores had a possible range of -3 to 35. Price scores reflected the relative accessibility within a store of a healthier option in comparison with a less healthy but similar alternative. For example, price per ounce of frozen vegetables was compared with price per ounce of frozen French fries. Price scores had a possible range of -6 to 17. Quality scores only applied to fresh fruits, vegetables, and meats. Quality scores could range -2 to 4 points. By adding these three scores, total store scores could range -11 to 56 points.

Procedures: Upon entering the store, the PI sought verbal consent from a manager. If the manager requested more information, a printed letter was given to introduce the study, request permission to survey the store, assure that doing the survey will not interfere with the normal business operations, and provide contact information if more information was needed. If the manager refused to allow the store to be surveyed, the store would still be included with the GIS data analysis but a note will be made that the in-store assessment data was not available. The in-store food assessment was anticipated to take 1 hour in supermarkets, and 20 minutes in convenience stores. Results of both instruments were entered into SPSS as soon as possible after data collection. Sampling: All supermarkets and grocery stores in the study area were surveyed. Dollar stores, pharmacies, convenience stores, and other small food stores were surveyed in a pattern of every third store identified during ground-truthing procedures.

Participant interviews.

Overall plan for participant data collection. All participants were invited to participate in the three interviews. If they declined or were unable to participate in Interview Two, the PI proceeded to Interview Three. Interviews were spaced approximately one week apart when possible.

Interview one: participant demographics and short-answer questions. Measures: The first interview session lasted about 1 hour and proceeded with four parts: 1) the consent forms; 2) a questionnaire for demographics and household food patterns (Appendix D); 3) a questionnaire on food outlets accessed by the participant (Appendix E); and 4) a household food security screening (Appendix F). The PI for this study

developed the forms for the first three parts. The questionnaire in part two addressed factors of food access that can have short or multiple choice answers. Topics included participant's demographics and occupations, household structure and food preparation resources, transportation, use of non-retail food sources such as garden and food banks, participation in government nutrition assistance programs. The questionnaire in part three asked the participant to name specific food outlets where she usually does activities such as major restocking of food, fill-in shopping, buying fast food, and buying other prepared foods. Part four was the U.S. Department of Agriculture (USDA) *U.S. Household Food Security Survey Module* which contained up to 18 closed-ended questions. Developed in 1995 by the U.S. Department of Agriculture, this survey has undergone extensive testing to establish validity and reliability in diverse populations across the nation (NRC, 2006). The HFSSM includes sections on the household, adults, and children. It is designed to minimize respondent burden by skipping questions if initial questions in each section indicate adequate food security. Data Collection: All the forms were verbally administered to the participant, to minimize participant burden due to possible low literacy. This interview was audio recorded to ensure accuracy of the PI's notations of the participant's responses. At the end of this interview session, the PI scheduled Interview Two or offered to follow up by phone if the participant was not sure of her schedule.

Interview two: go-along interview in grocery store. The go-along interview is an ethnographic method designed to prompt the participant to share observations and to bring the researcher along during an interaction with an environment of interest (Carpiano, 2008). Go-along interviews have been used for other environments, such as

neighborhoods and routine social activities. Use of this method to learn about consumers' experiences in grocery stores could be an innovative way to bridge other qualitative data with quantitative in-store food assessments. Sampling: At the end of Interview 1, the PI explained the go-along interview and asked the participant if she was interested in doing this. Measure: A semi-structured interview guide (Appendix G) included questions about the general appearance and accessibility to the store, observations of what the participant notices in the store, and food selection patterns. Data Collection: The participant and the interviewer usually met at the store at a time convenient for the participant to shop for groceries. The PI offered the participant the option to be audio recorded via lapel microphone, or that the PI could simply make written field notes during and after the interview.

Interview three: semi-structured interview. Measure: The participant was asked open-ended questions about psychosocial, cultural, economic, and environmental factors that affect food access (Appendix H). These questions were meant to encourage narrative exploration of factors in daily life that affect choices about where to access food. For participants who took part in Interview Two, a set of semi-structured questions was used to check and clarify the data collected in this go-along interview. Data Collection: This interview lasted approximately one hour and was audio recorded for transcription. The interviewer asked additional questions to follow up as appropriate, based on the subject's answers. Written notes were be taken during the interview.

Data management. Food Outlet Identification Form (FOIF) data was entered into Excel spreadsheets, then imported to ArcGIS 10 software. Modified NEMS-S in-store

food assessment data was coded according to a modification of original protocols (Glanz et al., 2007), then entered into SPSS analytic software. Participant Demographic responses were entered into an Excel spreadsheet. Field notes from Interview Two were written in MS Word. Interview Two transcriptions or field notes were checked against the audio recording, if available. A transcriptionist with training in the responsible conduct of research transcribed Interview Three verbatim as soon as possible after the interview. Interview transcriptions from Interviews Two and Three were checked for accuracy by reviewing the audio recording with the transcript.

Data analysis. Food outlet characteristic data were analyzed through GIS and statistical methods. Store outlet location, category, density, and in-store food survey results were analyzed and mapped with GIS methods (Gorr & Kurland, 2010). Network analyst processes were used to calculate road distance between participants' residences, or other starting point, and the food outlets where they shop. Ordinal and continuous data for the NEMS-S instrument were analyzed in SPSS for total NEMS-S scores and comparisons of survey items across stores.

Questionnaire data were analyzed through quantitative comparisons and qualitative identification of themes. Thematic analysis of field notes and interview transcripts were used to identify factors that underlie participants' food access and choices. Following a stepwise approach (Cohen, Kahn, & Steeves, 2000), all available transcripts were read through, so the PI became immersed in the data. Significant strips of data were identified in the text, and coded into categories according to similarity. These categories were then analyzed to discern overall themes. Analysis of individual

participants' transcripts were compared with their demographic data and mapped activity spaces, to discern additional patterns of behavior related to psychosocial or economic circumstances. Final mixed methods analysis employed Creswell and Plano Clark's (2011) guidelines for convergent design, by taking the independently analyzed quantitative and qualitative data, specifying which dimensions to compare the two sets of results, and identifying the information to compare within each dimension. For example, participant comments about food outlets were combined with NEMS-S survey results. Presentation of mixed methods analysis also integrated qualitative data into GIS maps, such as participant comments about food outlets (*i.e.* Matthews et al., 2005; & Cope & Elwood, 2009).

Potential limitations. With a small sample of 20 participants or fewer, and a small number of food outlets in the sample, results of this study may not be generalizable to the Central Appalachian region or beyond. However, there are geographic, socioeconomic, and health similarities between Lee County and Central Appalachia overall. The food outlets assessed and convenience sample of participants might not be generalizable to other areas. The use of GIS can be limited by the quality of data. The NEMS-S in-store food assessment relies on comparison of national brands which might not be available in the sample stores, and the varieties of foods assessed might not be important to the sample population. During the training module, the NEMS-S was piloted in Lee County food outlets, and modifications were made for local conditions. Potential limitations to the three interviews include sample error, researcher bias, and lack of participant disclosure due to the researcher's "outsider" status. Error due to convenience

sampling was addressed by partnering with local agencies to facilitate recruitment at different sites. Potential for researcher bias was mitigated through frequent interaction with faculty advisors who participated in the data analysis, to resolve disagreements and to assure that important details in the data were not overlooked.

Preliminary Studies

Study 1: Mapping the Weight Environment in a Rural Appalachian Community

Research Practicum: Snyder, A. (Faculty), Cantrell, E. S. (On-site Supervision)

A set of maps were requested by a local healthcare provider, to illustrate factors that may contribute to overweight and obesity in Lee County, Virginia. A framework for spatial assessment of weight environment was developed, and six Geographic Information Systems (GIS) maps were produced using primary and secondary data. Findings included high rates of obesity in the surrounding region of Central Appalachia, adequate numbers of grocery stores and supermarkets, barriers to accessing physical activity sites, and high rates of free/reduced lunch program participation in county schools. A poster of findings was presented at the 2012 Association of Community Health Nursing Educators conference. This study was funded in part by a student fellowship through the Healthy Appalachia Institute.

Study 2: Physical Activity Focus Groups in Lee County, Virginia

Research Practicum: Snyder, A. (Faculty), Cantrell, E. S. (On-site Supervision)

In collaboration with the LENOWISCO Health Department, which includes Lee County, the student has developed a focus group question guide and protocol. The goal of the focus groups is to assess Lee County residents' attitudes and perceptions about

physical activity. Question topics include social and cultural norms, perceived benefits, and barriers to engaging in physical activity. There are specific questions about parks, schools, and other programs or facilities for physical activity. Focus groups are planned for summer or fall of 2012.

Study 3: Partnering with Rural Youth and Parents to Design and Test a Tobacco, Alcohol, and Drug Use Prevention Program Model

Kulbok, P.A. (Co-PI), Meszaros, P. (Co-PI)

The goals of this three-year study were to establish a community participatory research team in a rural county to conduct a community assessment on youth substance use, select a youth substance use intervention program, and test the feasibility and effectiveness of the intervention program. This study was funded by the Virginia Foundation for Healthy Youth. The student participated as a graduate research assistant on several special projects for the study: a) GIS mapping of community assessment data as a component of the community based participatory research process; b) Collection and analysis of qualitative data, including conducting focus groups and research team-based data analysis; and c) Assistance in preparation of manuscripts, conference presentations, and posters based on study findings.

Protection of Human Subjects

This study includes human subjects was approved by the Institutional Review Board (IRB) for the University of Virginia, and for the Virginia Department of Health as a partnering agency.

Risks to human subjects

Human subjects involvement, characteristics, and design. Human subjects were involved as participants in three interviews, each lasting approximately 1 hour. Recruitment, inclusion criteria, and consent processes are described in Subjects and Settings. The participant designated a meeting place of her choice for the first and third interviews; the second interview was conducted at a grocery store or supermarket of the participant's choice. Data collection for the first interview involved the PI writing responses to questions asked verbally to the participant. In the second interview, while grocery shopping, the participant had a choice to be audio recorded or that only field notes be recorded. The third interview, with semi-structured questions, was audio recorded.

Sources of materials. Sources of materials included protected as well as public sources. Protected sources included participant screening form for eligibility, data from questionnaires, audio and transcribed interview data, and field notes. All protected data collected from interview participants were coded with unique identifiers; identifying information such as participant contact information were kept separate from these data. Audio recordings and transcriptions of recorded interviews were locked in a secured file

drawer in a locked office at the University of Virginia School of Nursing at all times, and were only be available to the PI and the faculty involved in the study.

Potential risks. Because the population may be considered a vulnerable population (including low-income individuals living in a poverty-endemic area), there is a potential risk to subjects that they experience a psychological burden during the interview process. During the consent process, participants were told that they could decline to answer any questions, stop participating in an interview, or withdraw from the study at any time with no explanation required. They were also told that if, during an interview, they felt fatigued or otherwise inconvenienced, they could take a break or re-schedule the interview. For the possibility of participants becoming upset or exhibiting signs of psychological stress, the PI had ready a list of local community resources and assist with referrals as needed, with particular attention to food and nutrition support programs.

Protection of confidentiality. All audio recordings and forms with personal information were transported in a personal vehicle from the field to the UVA School of Nursing in a locked box. The audio materials, transcribed text, and forms were stored in a locked file inside the UVA School of Nursing were only accessible to the PI and analysis team. All electronic files with protected personal information were stored on a secure server in the UVA School of Nursing. Codes or pseudonyms for each participant replaced identifying information on all files with data collected from participants. A document with participant identifying information associated with these codes was kept in a locked drawer in a separate location. Protecting confidentiality in displays of spatial data is of

special concern (Brownstein, Cassa, Kohane, & Mandl, 2005). Map displays for publication or presentation were formatted to generalize residence locations within a larger area.

Special protection of confidentiality applies in rural communities with sparse populations (Ramos, 1989). The name of the county, health district, or other identifying titles will not be used in publications or conference presentations. However, results of this study will be shared in local and regional forums, and it cannot be guaranteed that the identity of the county will remain unknown. The shape of the county on GIS maps will also be a clue to its identity. Therefore, descriptions of individual participants were generalized, *i.e.*, “An unemployed woman in her 30’s with two children.” If it is necessary to identify the area of the county where an individual participant lives, additional efforts to generalize any identifying information will be made. When describing a certain area of the county, a composite analysis of the group of participants may be used. Participants’ addresses were geocoded and added to GIS maps for analysis of distance from food outlets. However, no data on individual participants were included on any maps presented in a public forum.

Adequacy of protection against risks.

Recruitment and informed consent. Approvals were obtained from IRB’s of UVA and the Virginia Department of Health prior to recruitment of participants. Informed consent was obtained by each participant prior to starting Interview One.

Potential benefits of the proposed research to human subjects and others. No known direct benefits were promised to participants of this study. Research findings will

be shared with local communities and service providers, and may contribute to future health-related or economic investments of resources in the LENOWISCO Health District, thereby indirectly helping the participants or others. Minimal risks to participants were counterbalanced by the knowledge that they are contributing to the body of knowledge regarding rural food access and Appalachian foodways. Participants were informed they could withdraw at any time from the study.

Importance of the knowledge to be gained. This study serves as a needed baseline of food environment data for rural Central Appalachia. It also helps move the science of food environment research forward by utilizing innovative methods such as mixed methods and go-along interviews. Local and regional health professionals, planners, and others will benefit from this study by obtaining needed data to better understand the factors of health disparities. The knowledge gained from this study will add several sources of important information to local community assessments and planning for health and economic interventions. Future directions include to coordinating with ongoing efforts by local and outside organizations, including at the University of Virginia, to plan programs that improve the health, economy, and social capital of the LENOWISCO Health District through improved access to healthy foods and physical activity. Existing networks doing this work include Healthy Appalachia Institute and Appalachian Prosperity Project. It is reasonable to expect that the methods and certain findings of this study can be utilized in other populations and settings, particularly in rural Appalachia.

Inclusion of Women and Minorities

Inclusion of women. Women were included in this study.

Inclusion of minorities. Lee County's population is 93% White, 4% Black or African American, and 2% Hispanic (U.S. Census Bureau, 2011b). Recruitment strategies included recruitment of racial and ethnic minorities, but it was difficult to access this small population.

Inclusion of children. No children were included in this study because the research topic is not relevant to children. Children under 18 years old generally live with an adult parent or guardian, and children with the special circumstance of living independently were beyond the scope of this study. Most studies of household food managers include only adults in their samples (e.g. Hanson, Sobal, & Frongillo, 2007).

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Figure 1. Conceptual model for access to food environment (adapted from Sharkey & Horel, 2009)

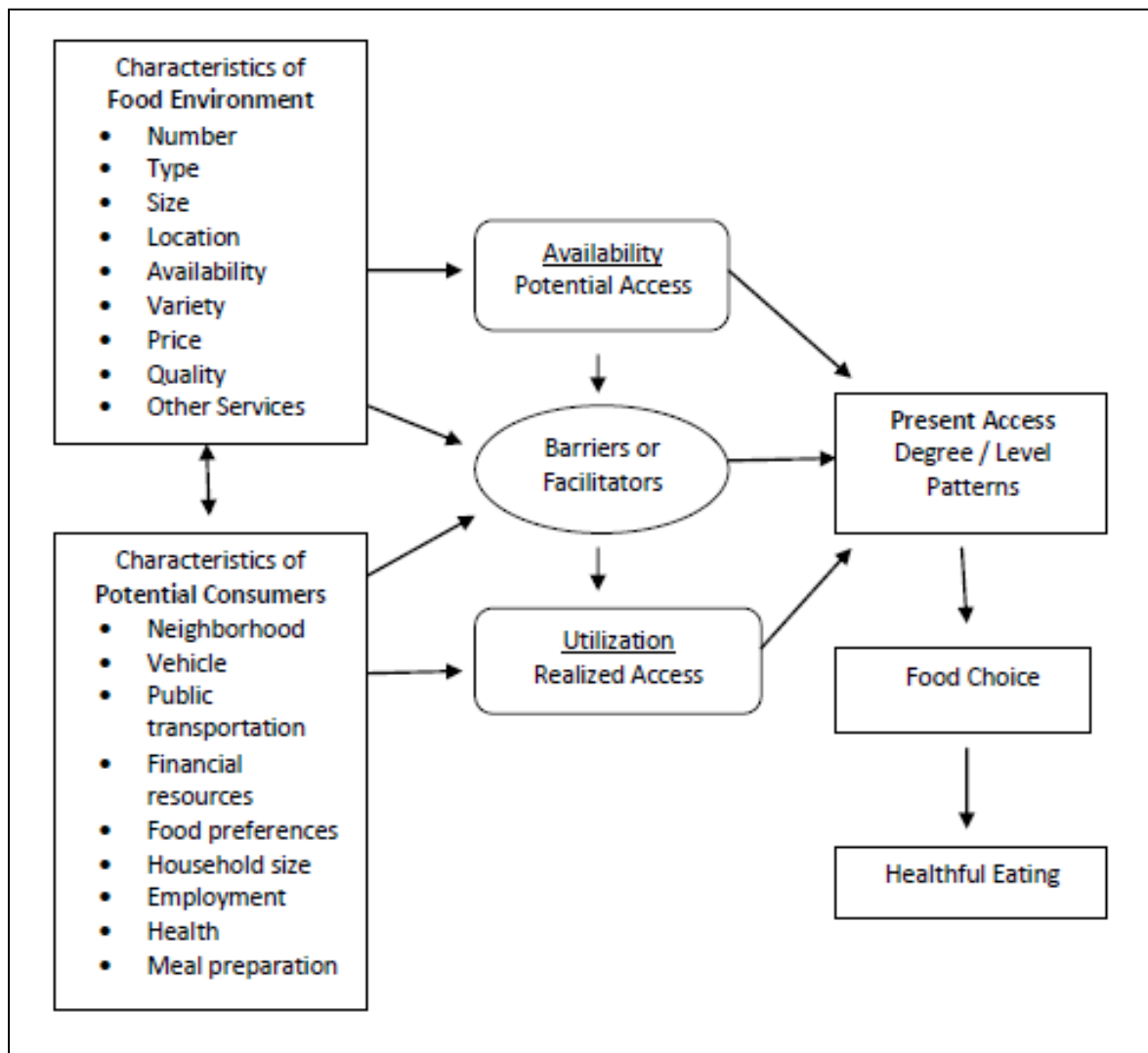


Table 1: Socioeconomic indicators in Central Appalachia				
		Lee County†	Central Appalachia‡	Appalachian Region‡
Population density (per sq. mile)		58.8	64.3	122.3
White non-Hispanic race		93.4%	95.7%	84.3%
High school graduate (age 25+)		71.3%	72.0%	82.9%
Per capita income		\$16,317	\$17,820	\$22,727
Persons below poverty level	26.1%	23.0%	15.6%	
† Source: U. S. Census Bureau, 2010 U.S. Census. ‡ Source: U.S. Census Bureau, 2006-2010 American Community Survey.				

Table 2: Data Collection Method by Specific Aim	
Specific Aim	Data Collection Method
1) Describe the community retail food environment (potential food access), including store proximity, food availability, pricing, and marketing.	GIS mapping of food outlet location and type (Appendix A). In-store observations, using modified NEMS-S (Appendices B and C).
2) Describe food access behaviors (realized food access).	Participant Questionnaire on Food Outlet Utilization (Appendix D). Go-along interview (Appendix G).
3) Explore psychosocial, economic, cultural, and environmental influences on realized food access.	Questionnaires (Appendix D and F): Demographics, household characteristics, food shopping patterns, food security. Semi-structured interview (Appendix H).

Table 3: Study Timeline

<p>[]</p> <p>Dissertation Proposal Defense (1 month – July, 2012)</p>
<p>[]</p> <p>Start up: IRB approval, on-site meetings with local partners, cognitive testing of instruments, preparation of materials and software (6 months – August, 2012 through January, 2013)</p>
<p>[]</p> <p>Data collection: Food outlet location, category, and in-store food surveys, recruitment, Interview One, Interview Two, Go-Along Interview (8 months – February, 2013 through September, 2013)</p>
<p>[]</p> <p>Data entry and analysis: Participant questionnaires, in-store food observations, GIS food outlet locations, transcription and analysis of interviews. (2 months – September, 2013 through October, 2013)</p>
<p>[]</p> <p>Writing and dissemination, dissertation defense (3 months – October, 2013 through December, 2013)</p>

Chapter Three: Manuscript One

Geographic Information Systems in
Nursing Education, Research, and Practice: A Systematic Review and Call to Action

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Abstract

Objectives: This systematic review was conducted to: (1) describe applications of Geographic Information Systems (GIS) technology in nursing education, research, and practice; (2) determine if GIS use is increasing; and (3) recommend ways to increase adoption of GIS among nurses. **Design and Sample:** CINAHL, Ovid Medline, and PubMed were searched for articles published between 2002 and 2013 combining GIS and nursing. Inclusion criteria were English-language full length original studies that demonstrated uses of GIS in nursing. Theoretical or planned uses of GIS were excluded. **Measurements:** Key themes and characteristics of the study's aims and uses of GIS were assessed. **Results:** A total of 39 articles were included in the review. There was no clear pattern of publication frequency by year. Thematic categories included: epidemiological surveillance, health disparities, community health practice, distribution of health services, nursing workforce, nursing education, and research methodology. Nine studies were in non-U.S. settings; there was a mix of urban- and rural-based studies; and ArcGIS was the most common GIS software used. **Conclusion:** GIS can be used in a wide variety of nursing applications, and offers important advantages in visualizing and analyzing data. Recommendations are provided to increase the adoption of GIS technology in nursing professions.

Keywords: GIS, geographic information systems, nursing education, nursing research, nursing practice, systematic review

Introduction

Understanding underlying causes of health problems is increasingly dependent on socioecological models that utilize a multilevel approach that includes individual, community, and broader level policy and economic influences of the environment in which people live and work (Institute of Medicine, 2002). Nursing science has long focused on the effect of environment and place on health outcomes. Florence Nightingale promoted modifications of patients' environments to promote healing (Dossey, 2000; Ervin, 2002). The metaparadigm of nursing holds environment as one of its four core concepts (George & Fund, 2011). Because of this focus, nurses are in a position to impact population health, and reduce health disparities through addressing determinants of health in the client's environment (DeGuzman & Kulbok, 2012).

An important dimension of the environment and place is space or geographic location. Maps, charts, and more recently, computer-based mapping systems are important tools used to describe geographic location. Geographic information systems (GIS) technology is a collection of computer-based software, hardware, processes, and people that adds the dimension of place to an almost limitless array of data (Wade & Sommer, 2006). Many professions, from ecology to business, use GIS to assist in analyzing and planning. GIS can help answer many basic questions about health issues. For example, where is disease occurring? Which populations are disproportionately affected? What else is happening in this population that may lead to health disparities? Similarly, GIS can help assess whether the distribution of health services and other benefits is equitable. The end products of GIS include customized maps and other

displays, as well as spatial statistical modeling and analysis (Cromley & McLafferty, 2012).

There have been numerous calls to increase the use of GIS in nursing (Endacott, Boulos, Manning, & Maramba, 2009; Moss & Schell, 2004). This literature review of GIS use specific to nursing can serve as a baseline of the range of uses, thus guiding recommendations for increasing nurses' adoption of this technology. To our knowledge, this is the first review of the literature of GIS use specific to nursing. A previous systematic review found 621 publications with GIS applications in health, but did not categorize articles by profession (Nykiforuk & Flaman, 2009). Additional aims of this paper are to emphasize the benefits of GIS to the nursing profession and its potential benefits for improving health of individuals, neighborhoods, and communities. We also provide practical suggestions on how GIS could be used in these nursing domains, incorporating Rogers' Diffusion of Innovations Theory (Rogers, 1995).

Methods

The research questions for this paper were, how are nurses using GIS in research, practice, and nursing education and has the number of published articles over the past 10 years indicated the use of GIS in nursing is increasing? Studies included in the literature review demonstrated applications of GIS in nursing practice, education, or research. Other inclusion criteria were: original research articles in peer-reviewed journals, full-text availability, published in English, at least one author was a nurse or the subject of the article was directly linked to nursing practice, education, or research, and articles published in 2002 through the spring of 2013. We searched three databases: CINAHL,

Ovid Medline, and PubMed. A total of 18 search combinations were used based on the terms “GIS,” “geographic information systems,” and “geospatial,” combined with “nursing,” “nursing practice,” “nursing education,” and “nursing research.” Titles and abstracts were scanned for keywords and other indications of studies with a spatial component. In addition, we scanned reference lists to identify additional articles for the review. Figure 1 outlines the process of selecting articles for review. A total of 118 articles were selected for initial review. Article abstracts were scanned first and ineligible articles were excluded. The remaining full text articles were then retrieved to determine inclusion in the review. The research team discussed and made final decisions about article selection and categorization by theme. Thirty-nine articles met full inclusion criteria and were included in this review.

Results

The 39 studies selected for this review, summarized in Table 1, were published between 2003 and 2012. There was no pattern of increase or decrease in yearly publications (Table 2), and the studies encompassed a broad range of topics in nursing practice, research, and education. The highest number of studies involved epidemiological surveillance (n=12). The remaining studies addressed health disparities (n=7), community health practice (n=6), distribution of health services (n=5), nursing workforce (n=4), nursing education (n=4), and research methodology (n=2). One study fit two categories. Nine studies were conducted internationally. Fifteen studies focused on urban locations, seven on rural locations, and seven included mixed urban-rural settings. ArcGIS was the most common GIS software used (n=24).

Epidemiological Surveillance

Five of the twelve epidemiological surveillance studies focused on communicable diseases. Two Brazilian studies mapped a city's distribution of leprosy and tuberculosis cases, respectively (Gauy, Hino, & Santos, 2007; Hino, Villa, Sasaki, & Santos, 2006). A third study from Brazil mapped zones in a city where socioeconomic status contributed to disparities in risk for tuberculosis (Vendramini et al., 2006). A Canadian study of Hepatitis C mapped proportions of cases assessed in specialized clinics and made recommendations to increase capacity (Hill, Butt, Alvarez, & Krajden, 2008). The fifth study analyzed the spread of hospital acquired infection by using GIS to study the movement of nursing staff and patients within a hospital (Kho, Johnston, Wilson, & Wilson, 2006).

Three of the seven remaining studies described the distribution of noncommunicable conditions. A hospital in Thailand mapped its catchment area of children with cleft lip/palate to better plan outreach and referral programs (Pradubwong et al., 2010). A statewide study in the U.S. examined the distribution of long-term ventilator-dependent children, recommending that isolated cases may need more efforts to coordinate support resources (Graham, Fleegler, & Robinson, 2007). A national study of older American Indians and Alaska Natives used GIS to analyze and display patterns of disability (Moss, Schell, & Goins, 2006).

Four studies aimed to identify populations at highest risk for noncommunicable conditions based on geographic and demographic indicators. A citywide study mapped diabetes risk factors and screening rates in order to plan locations for targeted diabetes

intervention programs (Kruger, Brady, & Shirey, 2008). Similarly, a statewide study of burn injuries revealed areas of highest risk (Edelman, Cook, & Saffle, 2010). A countywide study used GIS kernel spatial analysis to estimate preterm birth risk areas based on individual addresses (South et al., 2012). A study evaluating a campus tobacco-free policy collected primary GIS data in which observers counted cigarette butts and smokers, and then marked these counts on aerial images of the campus (Fallin et al., 2012). The resulting maps were user-friendly tools for communicating to stakeholders about tobacco use hotspots and for targeting education and enforcement programs.

Health Disparities

The seven articles in this category examined how neighborhoods where people live affect their health. Zenk and colleagues (2005 & 2009) examined urban racial disparities in access to healthy food retailers. Two studies tested associations of preterm births with neighborhood social and physical environments (Bloch, 2011; Giurgescu et al., 2012). Three additional studies examined air pollution as influences on respiratory and cardiovascular diseases in different neighborhoods (Choi, Afzal, & Sattler, 2006; Choi et al., 2011; Newcomb & Li, 2008).

In all of the studies, researchers recognized that maps and geospatial data analysis techniques added considerable value. The studies layered spatial data from multiple sources to better visualize the complex ways that neighborhoods influence health. Specialized GIS analysis tools also enabled added precision in testing associations. For example, Choi and colleagues (2011) were able to estimate weather patterns for an entire area based on weather station point data. Two of the other studies used GIS to calculate

individual study subjects' unique exposure to environmental variables (Choi et al., 2006; Giurgescu et al., 2012).

Community Health Practice

Nurses used GIS for enhancing community health nursing practice, such as community assessments, planning interventions, and participatory approaches in six studies. Riner, Cunningham, and Johnson (2004) described public health nurses' use of GIS maps to organize educational outreach during an infectious disease outbreak, and to communicate with the public and other stakeholders about the evolving outbreak. Wetta-Hall and colleagues (2004) used GIS as a low-cost strategic planning method for community organizations. Caley and colleagues (Caley, 2004; Caley, Shiode, & Shelton, 2008) described work to incorporate GIS into planning community interventions to improve birth outcomes. They described the steps necessary for planning community interventions, first by assessing the feasibility of GIS to analyze community social networks and other complex phenomena (Caley, 2004), and then by describing the process and challenges of using GIS in a multisectoral participatory planning group (Caley et al., 2008).

Two of the identified studies used GIS to identify optimal locations for community health activities. One used GIS to identify community sites frequented by low-income individuals, where diabetes prevention programs could be located (Gesler et al., 2004). The other incorporated GIS into a community assessment by identifying places to survey residents and evaluating the spatial distribution of sample respondents, in addition to mapping community health indicators (Faruque, Lofton, Doddato, &

Mangum, 2003). These studies demonstrated how GIS can enhance community assessments, but both research teams noted that it is best used as a complement to on-the-ground assessment techniques.

Distribution of Health Services

Five studies examined distribution of health care services, without specific emphasis on the supply of nursing workforce. Two studies in Africa used low-cost GIS applications to plan reproductive and perinatal services for women living in difficult-to-reach locations (Chen et al., 2011; Shaikh, 2008). The other studies examined access to end-of-life services (Madigan, Wiencek, & Schrier, 2009), cardiac interventional services (Graves, 2010), and heart failure services (Clark & Driscoll, 2009) in rural or economically disadvantaged areas of the U.S. and Australia.

Use of GIS enhanced these studies in several ways. Geocoding the addresses of healthcare facilities enabled them to be placed on maps, grouped by county or other unit, and compared with other aggregate data such as disease prevalence, population density, and income. GIS analysis also enabled the comparison of access to healthcare services across multiple county lines, whereas tabular data might limit comparisons to presence or absence within single counties. The focus by each of these five studies on economically-challenged regions also underscores the need to design low-cost GIS approaches.

Of note, the two African studies involved creating GIS data through global positioning system (GPS) measurements and low-cost mapping applications such as Google Earth, demonstrating that some lower cost and more readily available and user

friendly GIS software can be used to enhance spatial understanding of disease and services distribution.

Nursing Workforce

Similar to studies focused on distribution of health services, GIS was used to assess and improve nursing workforce distribution. The four nursing workforce studies were varied in their approaches to identifying equitable and efficient spatial distribution of nurses. Massey (2011) identified regions in Senegal with need for more midwives through spatial analysis of birth outcomes and existing workforce distribution. Ghosh, Sterns, Drew, and Hamera (2011) mapped the distribution of advanced practice psychiatric mental health nurses in the U.S., and found uneven distribution by region and by rural-urban status. Courtney (2005) examined nurse distribution by health professional shortage area (HPSA) designations, and recommended approaches to policy changes regarding nurse recruitment and HPSA definitions. Finally, a spatial study of nurses' commuting patterns found high travel time for some groups, indicating a possible barrier to recruitment and retention in some health care facilities (Rosenberg, Corcoran, Kovner, & Brewer, 2011).

Nursing Education

Four articles described uses of GIS to evaluate content in nursing education programs and to identify existing GIS training for nurses. Faruque and colleagues (2004) trained nurse practitioner students and others to measure residential locations with handheld GPS devices, and to incorporate these data into developing health promotion programs. Hays, Davis, and Miranda (2006) described a student assignment to hand-mark

neighborhood features on pre-printed GIS maps, and also to use a city map website to add data to their community assessments. Riner and colleagues (2004) trained undergraduate nursing students in a community health course to use an interactive metro-area mapping website to create maps specific to a selected health problem (Riner et al., 2004). Stanhope and Turner (2006) used GIS maps to illustrate the spread of clinical nurse leader programs around the U.S. (Stanhope & Turner, 2006).

The three exemplars of training students identified benefits and challenges in incorporating GIS into nursing student curricula. One benefit was the ability to develop and present maps that were more accurate and professional-looking than hand-drawn maps used previously (Riner et al., 2004). Hays and colleagues (2006) found that students demonstrated enhanced understanding of the role of the community environment on health outcomes. The two urban sites had the advantage of online, public GIS mapping applications available for free (Hays et al., 2006; Riner et al., 2004). In contrast, the students in the rural community had to collect some GIS data on site using labor-intensive methods (Faruque et al., 2004). All three exemplars identified limited class time as an obstacle to training students to use available GIS software to its full potential.

Research Methodology

Two studies merit special mention for nurse researchers' use of GIS in developing and using GIS as a research methodology. Robinson and colleagues (2010) used GIS to geocode and map the locations of participants in a large cohort health study, thus better understanding the sample distribution and characteristics, and providing maps and associated geographically-linked participant data for further studies. Zenk and colleagues

(2011) tested the use of personal GPS tracking devices to provide accurate data about participants' daily travel patterns, enabling researchers to use GIS to better estimate their access and exposure to food and physical activity opportunities. Both of these studies illustrate potential use of GIS in research involving the role of space and place in health and health behavior.

Discussion

Two questions guided this literature review. The first question addressed how nurses are using GIS in research, practice, and nursing education. GIS has been used with success in a limited number of studies but in a wide variety of nursing applications. In addition to conventional public health uses of disease surveillance and program planning, nurses have used GIS in creative ways to engage communities, support policy decisions, and enhance direct patient care. Primarily, the review of literature showed that GIS was used in nursing to investigate birth outcomes, environmental exposures, access to care, distribution of services, and community health. Using GIS to add a spatial component to studies allowed the authors of the studies reviewed to communicate and persuade through the use of customized maps. As it is often said, a picture is worth a thousand words. While the variety of applications is encouraging, there is a paucity of peer-reviewed papers incorporating the use of GIS in the scientific nursing literature.

In answering the second question about the amount of published literature on GIS in nursing over the last decade, using a systematic search strategy, only 39 articles met our study inclusion criteria. In contrast, the review by Nykiforuk and Flaman (2009) found 621 articles where GIS was used by health researchers, although they did not limit

the time frame of the literature searched and used broader search terms such as health policy and bylaws. Nonetheless, while GIS has been gaining rapid adoption in many of the health sciences, the application of GIS has been much slower to be realized in nursing and the use in nursing does not appear to be dramatically increasing.

Rogers' Diffusion of Innovations (DOI) Theory (1995) can provide a framework to assess the adoption and use of GIS in nursing. Four components of diffusion of an innovation include: (1) the innovation or new idea; (2) methods for communicating about it; (3) time since introduction of the innovation; and (4) the social system into which it is introduced. GIS has been used in nursing for several years, however, it has been slow to gain popularity relative to other disciplines. GIS is typically not a common topic in the general or research nursing literature, or at nursing conferences. One explanation may be that GIS has limited applications in hospital-based, or clinical practices focused on care of the individual. Its usefulness may be better suited for public health nursing and health care administration.

Referring again to Rogers' DOI Theory, the likelihood of an individual adopting an innovation depends on his or her perception of five factors: (1) how much the innovation is better than the old technology or idea; (2) how well the innovation fits with the individual's values, needs, and past experiences; (3) the simplicity or ease of using or understanding the innovation; (4) the ability to try out the innovation before making a significant investment in adopting it; and (5) the ease of observing the innovation or its results. From the review of literature, it is evident that nursing has recognized that GIS is a worthwhile innovation by adding a spatial component to data and aiding in

interpretation. However, factors such as having the experience needed to integrate GIS into nursing education, practice, and research; complexity of use; and the initial investment in time and money, can pose major challenges for adoption. Additionally, it may be difficult for researchers new to GIS to conceptualize how this technology can be utilized to investigate spatial patterns relating to health issues, limiting its full adoption and application.

There are some limitations to this review. While a systematic process of identifying and selecting articles was used, some of the relevant literature may not have been included. We searched only articles published in English and utilized only three databases. However, the three databases are among the most comprehensive and widely used databases for health literature in the United States. It may be that nurses in other countries are using GIS more commonly to address health issues and our search strategies did not identify those publications. Searching databases that include European, Asian, Australian, and other foreign literature using the same criteria would be an interesting comparison to this review.

Recommendations

Nurses first must be able to understand the broad categories of health where health may be related to space. For example, migration or living in one geographic location may increase risk of certain diseases in populations. Health outcomes, risk factors, associations between risk factors and health outcomes, and health interventions, particularly environmental or built environmental interventions are increasingly associated with space and are health issues amenable to GIS (Cromley & McLafferty,

2012). Several additional recommendations can be made that are likely to increase the adoption and use of GIS in nursing to address health issues. Many of the recommendations cut across several domains of nursing and may include tips relevant to education, practice, or research.

- Attend GIS and Health Workshops.
- Offer survey courses on mapping and spatial data at both the undergraduate and graduate level.
- Add GIS courses and increase the emphasis on GIS in the Doctor of Nursing Practice (DNP) curricula. With the focus on populations and population health in DNP programs, there is potential for better understanding spatial influences and making improvements in health outcomes at the population level through DNP practitioners.
- Take online courses on GIS. Many courses are low cost or free and range from basic to advanced.
- Use GPS or GPS-enabled cameras while conducting community assessments and incorporate maps and pictures into the final assessment.
- Start simple using free, online, and easy to use mapping systems. For example, pre-made GIS maps can be embedded in websites and have functions limited to changing the scale, turning layers on or off, and simple queries (Mills & Curtis, 2008).
- Keep it fun. New users may like to create simple maps or use a GPS to collect and then map information. Have a goal of becoming conversant in GIS. Not everyone

has to be a GIS expert. GIS can be analogous to working with a statistician on a research team.

- Collaborate with others to build teams with different strengths. Include nurses and non-nurses with GIS expertise.
- Educate administrators and financial officers about the potential of GIS in health. Through advocacy of GIS use, change can be made regarding organizational priorities, policies, and allocation of resources.

Conclusion

GIS is being used by nurses in a wide array of research, practice, and education settings, however in limited numbers. GIS fits well into the nursing metaparadigm that includes a focus on environment in that nurses already include clients' environments in assessments.

This article has presented some important benefits of using GIS, challenges to implementing it, and also some solutions to overcoming potential challenges. Nursing continues to advance in defining itself as a discipline, improving practice to promote health and healing, and embracing new technologies that add value to its missions. GIS can add value to many areas of nursing, and should be prioritized as an innovative technology that will help nurses to lead important interdisciplinary research involving spatial location and health while advancing nursing science.

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Figure 1. Process for selecting articles for review

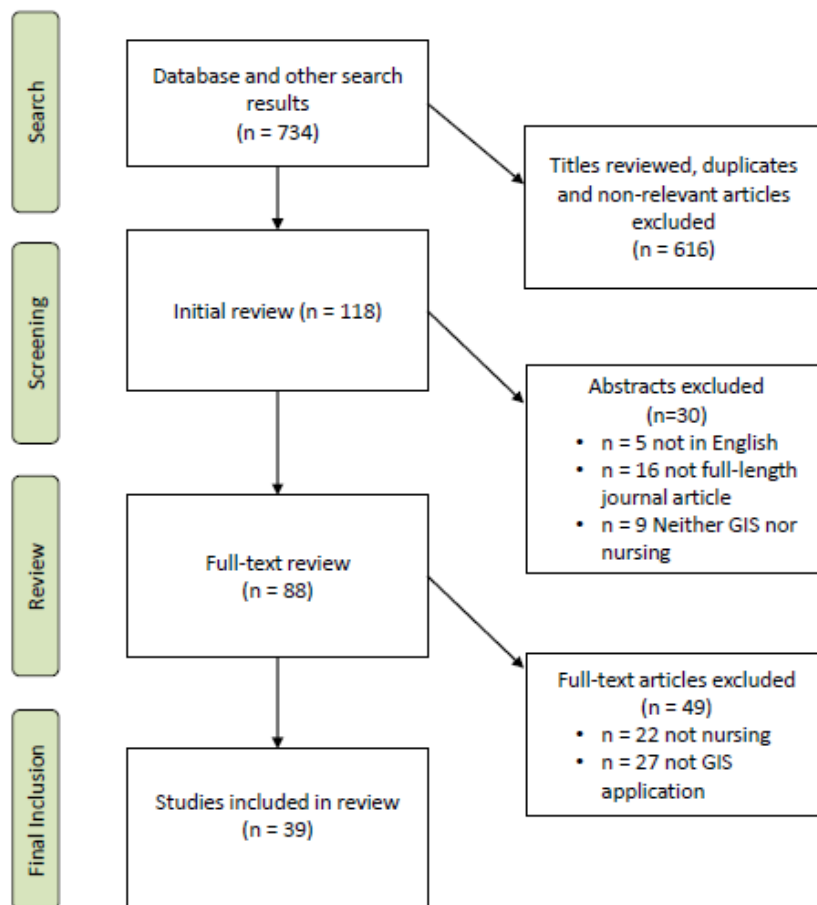


Table 1: Studies with GIS applications in nursing

Author (1st author)	Year	Study Category	Geographi c Area	Rural/ Urban Focus	GIS Softwar e	Study Focus
Bloch	2011	Health disparities	Philadelphi a	Urban	ArcGIS	Disparities in preterm births
Caley	2004	Communit y health practice	New York State	n/a	ArcGIS	Plan intervention for improving birth outcomes
Caley	2008	Communit y health practice	New York State	n/a	ArcGIS	Plan intervention for improving birth outcomes
Chen	2011	Distributio n of health services	Malawi	Rural	Google Earth	Availability and utilization of health resources by pregnant women
Choi	2006	Health disparities	Baltimore, MD	Urban	ArcGIS	Environmental exposures and health outcomes
Choi	2011	Health disparities	Maryland	Mixed	ArcGIS	Association of ozone and respiratory emergencies
Clark	2009	Distributio n of services	Australia	Rural	n/a	Access to heart failure management programs
Courtney	2005	Nursing workforce	Missouri	n/a	ArcGIS	Distribution of nurses in HPSA and non-HPSA counties

Author (1st author)	Year	Study Category	Geographi c Area	Rural/ Urban Focus	GIS Softwar e	Study Focus
Edelman	2010	Epidemiol ogical surveillanc e	Utah	Rural	ArcGIS	Geographic risk areas for burn injuries
Fallin	2012	Epidemiol ogical surveillanc e	Lexington, KY	Urban	ArcGIS	Evaluate compliance with campus tobacco-free policy
Faruque	2003	Communit y health practice	Hinds County, Mississippi (City of Jackson)	Urban	n/a	Design of a community health assessment
Faruque	2004	Nursing education	Issaquena County, Mississippi	Rural	n/a	Nursing students learning spatial data collection and analysis
Gauy	2007	Epidemiol ogical surveillanc e	Brazil	n/a	MapInfo	Leprosy case distribution
Gesler	2004	Communit y health practice	Southern USA	Rural	ArcGIS	Identify best sites for diabetes interventions
Ghosh	2011	Nursing workforce	USA - national	n/a	ArcGIS	Distribution of Psychiatric Mental Health - Advanced Practice Registered Nurses

Author (1st author)	Year	Study Category	Geographi c Area	Rural/ Urban Focus	GIS Softwar e	Study Focus
Giurgescu	2012	Health disparities	Chicago, IL	Urban	ArcGIS	Test association between neighborhood environment, psychological stress, and birth outcomes
Graham	2007	Epidemiol ogical surveillanc e	Massachus etts	n/a	ArcGIS	Distribution of pediatric chronic ventilator patients in communities
Graves	2010	Distributio n of services	Alabama and Mississippi	Mixed	ArcGIS	Distribution of cardiac interventional services
Hays	2006	Nursing education	Durham, NC	Urban	ArcGIS	GIS training for accelerated second-degree BSN community health course
Hill	2008	Epidemiol ogical surveillanc e	Canada	Mixed	n/a	Hepatitis C management
Hino	2006	Epidemiol ogical surveillanc e	Brazil	Urban	MapInfo	Distribution of tuberculosis cases
Kho	2006	Epidemiol ogical surveillanc e	Health care facility, USA	n/a	ArcGIS	Assessing provider behavior that increases risk of nosocomial infections

Author (1st author)	Year	Study Category	Geographic Area	Rural/Urban Focus	GIS Software	Study Focus
Kruger	2008	Epidemiological surveillance	Genesee County, Michigan	Urban	n/a	Diabetes prevalence, screening and treatment
Madigan	2009	Distribution of services	8 U.S. states	Rural	ArcGIS	Supply and demand for end of life care in rural areas
Massey	2011	Nursing workforce	Senegal	Mixed	n/a	Identify where more perinatal health workers are needed in order to improve health outcomes
Moss	2006	Epidemiological surveillance	USA - national	n/a	ArcGIS	Disability in older Native Americans
Newcomb	2008	Health disparities	Fort Worth, TX	Urban	n/a	Traffic exposure as risk factor for childhood asthma
Pradubwong	2010	Epidemiological surveillance	Thailand	Rural	ArcGIS	Prevalence and characteristics of cleft lip/palate
Riner	2004	Community health practice and Nursing education	Indianapolis, IN	Urban	n/a	Public health nurses' use of GIS for planning outbreak response activities; GIS training module in community health nursing course

Author (1st author)	Year	Study Category	Geographi c Area	Rural/ Urban Focus	GIS Softwar e	Study Focus
Robinson	2010	Research methodolo gy	Mississippi	Mixed	ArcGIS	Methods for retrospectively geocoding large cohort study
Rosenberg	2011	Nursing workforce	USA - national	n/a	n/a	Describe commute times by nurse demographic
Shaikh	2008	Distributio n of services	Somalia	Mixed	n/a	Reproductive health services for women living in camps for internally displaced persons
South	2012	Epidemiol ogical surveillanc e	Hamilton County, OH	Urban	ArcGIS	Spatial characteristics of preterm births
Stanhope	2006	Nursing education	USA - national	n/a	ArcGIS	Tracking of Clinical Nurse Leader education programs in U.S.
Vendramin i	2006	Epidemiol ogical surveillanc e	Brazil	Urban	MapInfo	Characteristics of persons with tuberculosis
Wetta-Hall	2004	Communit y health practice	Sedgwick County, KS	Mixed	ArcGIS	Academic - community partnership to conduct needs assessment and plan community programs

Author (1st author)	Year	Study Category	Geographi c Area	Rural/ Urban Focus	GIS Softwar e	Study Focus
Zenk	2005	Health disparities	Detroit, MI	Urban	ArcGIS	Access to healthy food; health disparities
Zenk	2009	Health disparities	Detroit, MI	Urban	n/a	Community factors of obesity
Zenk	2011	Research methodolo gy	Detroit, MI	Urban	ArcGIS	Test method of measuring individuals' activity spaces with GPS

Table 2. Number of published studies using GIS in nursing

Year of Publication	Frequency
2002	0
2003	1
2004	5
2005	2
2006	7
2007	2
2008	5
2009	3
2010	4
2011	7
2012	3
2013 (partial year)	0

Chapter Four: Manuscript Two

Potential and Realized Access to Healthy Foods in Rural Appalachia: A Mixed Methods
Study

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Abstract

This mixed methods study sought to measure potential access to healthy foods in food stores, to describe influences on lower-income women's realized food access and food purchasing behavior, and to describe how these consumers relate to food stores in a rural Central Appalachian county in Virginia. Cross-sectional data included locations of food stores and participants' homes, food store surveys, and in-depth interviews with women who managed food for their households. Of 50 total stores, 28 were sampled in the survey. Supermarkets, grocery stores, dollar stores, and convenience stores were analyzed. Supermarkets had better availability and total survey scores than grocery stores; quality and price scores did not differ significantly. Dollar stores had better availability scores than convenience stores, but lacked many healthy foods found in traditional food retailers. Nine women participated in interviews, which included go-along interviews while they shopped. They did most of their shopping at supermarkets and grocery stores. Their comments about stores aligned in many instances with the survey findings, though their criteria for selecting stores went beyond food availability, price, and quality. Their shopping styles varied, and they selected foods based on combinations of price, quality, convenience, and healthfulness. Possible directions for practice and research are discussed.

Keywords: food environment, food shopping, Appalachia, rural, obesity

Introduction

Central Appalachia is a region in the United States (U.S.) with widespread health disparities. Many of its counties, comprising parts of Virginia, West Virginia, Kentucky, and Tennessee, had obesity and diabetes rates in the top quintile nationally (Centers for Disease Control and Prevention [CDC], 2009). Most counties in this rural, mountainous area are considered economically distressed or at-risk, with high rates of poverty and unemployment (Appalachian Regional Commission, 2013). Both obesity and poverty are associated with low community availability of healthy food outlets such as supermarkets and large grocery stores (Beaulac, Kristjansson, & Cummins, 2009). Central Appalachia is an anomaly; most counties have high levels of spatial access to these food outlets (Economic Research Service, 2013). In order to address the risk factors for obesity and other health outcomes, more research is needed to explore other factors that affect food choice and behaviors.

Ecological models are often used to conceptualize interconnected social and environmental factors that influence food choices (Glanz, Sallis, Saelens, & Frank, 2005; Richard, Gauvin, & Raine, 2011). Sharkey and Horel (2009) refined this model to emphasize the central roles of food outlets and consumers in food choices. In the refined model, *potential access* referred to foods available in the community, including food outlet type, location, foods sold within, and other store amenities; *realized access* encompassed all levels of the ecological model, including personal, household, social, neighborhood, community, and policy-level factors that shape consumers' choices from among available foods in the community.

Although many studies have examined potential and realized food access separately, few have combined the two perspectives to consider a food environment at multiple levels of the ecological model. Systematic reviews of food environment studies found some evidence that living near a supermarket, far from a convenience store, is associated with healthier diet and weight (Walker, Keane, & Burke, 2010). In addition, racially or economically disadvantaged neighborhoods tend to have worse health outcomes and worse access to healthy food, in terms of both store type and foods sold inside (Lovasi, Hutson, Guerra, & Neckerman, 2009; Hilmers, Hilmers, & Dave, 2012). However, there is a lack of evidence that potential food access has a causal relationship with these health outcomes (Larson, Story, & Nelson, 2009; Walker et al., 2010). Likewise, there are many modes used to study realized food access, including neighborhood perception surveys, dietary assessments, and focus groups (Caspi, Sorensen, Subramanian, & Kawachi, 2012; Giskes, Van Lenthe, Avendano-Pabon, & Brug, 2011; Kelly, Flood, & Yeatman, 2011). One limitation widely found in systematic reviews is a lack of standardized measures for both potential and realized food access, resulting in reduced comparability and validation of study findings (Kelly et al., 2011; Lytle, 2009; Ohri-Vachaspati & Leviton, 2010). Several studies have compared objective measures of potential food access with quantitative surveys of perceived food access by community members, but addressed only a few aspects of food choice (Brown, Vargas, Ang, & Pebley, 2008; Drewnowski, Aggarwal, Hurvitz, Monsivais, & Moudon, 2012; Hartley, Anderson, Fox, & Lenardson, 2011).

Previous food access studies in Appalachia underscore the importance of assessing the multiple influences on food choices. Diet outcomes of Supplemental Nutrition Assistance Program (SNAP) recipients in Kentucky were positively associated with potential access to healthy foods and food outlets, and negatively associated with convenience stores (Gustafson, Lewis, Perkins, Damewood, et al., 2013; Gustafson, Lewis, Perkins, Wilson, et al., 2013). Studies of Appalachian adolescents have similarly found that beliefs, social norms, as well as potential availability of foods influenced eating patterns (Swanson, Schoenberg, Davis, Wright, & Dollarhide, 2013; Wu et al., 2007). Studies of food choices among Appalachian adults have found that food knowledge, intra-family norms, and community social networks were among the wide range of influences on food choices (Schoenberg, Howell, Swanson, Grosh, & Bardach, 2013; Brown & Wenrich, 2012; Tessaro, Rye, Parker, Mangone, & McCrone, 2007).

In order to advance food environment research, systematic reviews and research agenda reports have recommended more nuanced approaches, with the goal of understanding the complex circumstances in which individuals ultimately make choices about food (Lytle, 2009; Larson, Story & Nelson, 2009; Oakes, Masse, & Messer, 2009; Trickett et al., 2011). The diversity of rural communities in the U.S. makes these multi-level assessments especially valuable for identifying appropriate interventions (Melvin et al., 2013, Gustafson, Hankins, & Jilcott, 2011). Mixed methods approaches that combine quantitative assessments of potential food access and qualitative assessments of realized food access could provide new insights into how lower-income residents select foods within the context of their food environments (Freedman, 2009). The aims of this study

of a rural Appalachian county were to measure potential access to healthy foods in food stores, to describe influences on lower-income consumers' realized food access and food purchasing behavior, and to describe how these consumers relate to food stores in their communities.

Methods

The study took place during 2013 in a mountainous, rural, Central Appalachian county in southwestern Virginia, where rates of obesity and diabetes were in the highest quintile for U.S. counties (CDC, 2009). Two sets of data were collected in this study: 1) potential food access was assessed through retail food store characteristics including location and food store surveys; 2) realized food access was assessed through interviews with low-income consumers. The Institutional Review Boards of the University of Virginia and the Virginia Department of Health approved the research protocol.

Data Collection Procedures And Instruments

Objective measures of potential food access in retail stores.

Store identification and location. The study area for the food store observations included all retail food stores within the county, plus all grocery stores and supermarkets within a five-mile drive of the county border. The categorization of stores was similar to a rural food access study that used North American Industry Classification (NAICS) codes (Bustillos, Sharkey, Anding, & McIntosh, 2009). The store categories were: 1) Supermarkets, including supercenters, with 100 or more parking spaces, often corporate chains; 2) Grocery stores, with smaller buildings than supermarkets and fewer than 100 parking spaces, often independently owned; 3) Dollar stores, small general merchandisers

with discount price model; 4) Pharmacies, primarily selling medications but also selling household and personal items; 5) Convenience stores, small stores with or without gas pumps that carry limited lines of food and snack; and 6) Specialty or other stores, selling foods for off-premises consumption but not fitting in another category.

An established process of secondary data searches identified food store locations, followed by ground-truthing procedures (Sharkey, 2009). Ground-truthing involved systematically driving all roads in the study that were likely to have food outlets based on secondary data on stores and populated areas. The search for combinations of store types and town names used Google Maps, a free online search engine. Spreadsheets and paper maps displayed search results. Food stores were identified visually through business signs or advertisements outside the stores. Handheld GPS devices were used to record locations, and exterior store data was recorded on log forms.

Food store surveys were completed in a sample of stores. Participant interviews occurred before the store surveys, and the sampling plan reflected the participants' patterns of buying food almost exclusively at grocery stores and supermarkets. All grocery stores and supermarkets within the study area were surveyed. Smaller food outlets, such as dollar stores, pharmacies, convenience stores, and "other" types were surveyed in a pattern of every third store visited during ground-truthing procedures. Most store surveys were administered during a two-week period in the summer of 2013, in order to achieve temporal stability in price and stocking (Zenk, Grigsby-Toussaint, Curry, Berbaum, & Schneider, 2010). A delay for a subset of stores occurred due to a lengthy

process to obtain prior approval from one company to conduct the surveys. All stores allowed the survey to be completed.

Food store survey instrument. The aim of the store survey was to assess the accessibility of foods generally recommended for the prevention and management of obesity and other chronic diseases, including culturally specific foods, relative to the accessibility of less healthy foods. The Nutrition Environment Measures Survey in Stores (NEMS-S) is a widely used instrument that assesses the presence (availability), quality, and price of a list of standardized food items in a retail food outlet (Glanz, Sallis, Saelens, and Frank, 2007). After pre-testing this instrument in the community, modifications were planned in consultation with local key informants and a diabetes educator. The Rudd Center Revised NEMS-S (NEMS-S Rudd) contained most of these modifications, and was used previously in an Appalachian study (Andreyeva, Blumenthal, Schwartz, Long, & Brownell, 2008; Gustafson, Christian, Lewis, Moore, & Jilcott, 2013).

The instrument used in this study was a revised version of the NEMS-Rudd survey instrument. Revisions reflected culturally specific foods and local brands. For example, fresh collard greens and sweet potatoes were added, and cauliflower and celery were omitted. Canned Vienna sausages were substituted for tuna in oil. Frozen French fries and strawberries were added to the frozen vegetables as regular and healthy options, respectively. A new section on cooking oils, including olive oil and lard, was added. Price and availability of milk focused on gallon containers, the most commonly bought by families. The original NEMS-S Rudd also assessed whether stores accepted SNAP and Women Infants and Children Nutrition Program (WIC) benefits, and brief notes on

exterior and interior store conditions. A full version of the revised survey is available from the corresponding author.

The scoring system for the modified NEMS-S Rudd food store survey was based on the system for the original NEMS-S (Glanz et al., 2007). Food categories were scored for availability, price, and quality, and then scores were totaled for each food store in the sample. Availability scoring awarded points for healthier options. Point values were higher in the categories of fresh fruits and vegetables, milk, and fresh meat. Availability scores had a possible range of -3 to 35. Price scores reflected the relative accessibility within a store of a healthier option in comparison with a less healthy but similar alternative. For example, price per ounce of frozen vegetables was compared with price per ounce of frozen French fries. Price scores had a possible range of -6 to 17. Quality scores only applied to fresh fruits, vegetables, and meats. Quality scores could range -2 to 4 points. By adding these three scores, total store scores could range -11 to 56 points.

Subjective assessment of realized food access. A focused ethnographic approach involving three interview sessions was used to assess individual values, norms, and behaviors within a community cultural context (Richards & Morse, 2007). The aim of the interviews was to learn about the personal, social, and cultural influences that form resources or barriers to accessing healthy foods. The interviews took place over three sessions, including questionnaires and semi-structured formats, and are described in more detail elsewhere (Thatcher, in progress). Interview data pertaining to food shopping came mainly from: 1) a questionnaire on specific food outlets they favored for different food acquisition activities such as major shopping to restock, fill-in shopping for just a few

items, and buying prepared foods (Sherman, Spencer, Preisser, Gesler, & Arcury, 2005); 2) a *go-along* semi-structured optional interview conducted while participants shopped for food (Carpiano, 2008; Thompson, Cummins, Brown, & Kyle, 2012); a traditional semi-structured interview to elicit participants' experiences and attitudes about food choices in the context of their life circumstances.

A convenience sample was recruited through community agencies that served low-income families. Inclusion criteria for participation included self-identifying as lower-income, female, being the primary food manager for the household, having at least one minor child living at home, and living in the county or region for at least one year. Participants were paid \$10 per interview session. GPS locations were recorded within a half mile the participants' homes to assure confidentiality (Brownstein, Cassa, Kohane, & Mandl, 2005). A total of nine women participated; seven completed the go-along interview; the other two were unable due to scheduling difficulties.

Data Analyses

Quantitative data. Food store survey and spatial data were analyzed separately, and then combined. Store survey results were entered in Excel and then imported to SPSS software for analysis of descriptive statistics and *t*-tests to compare means. GPS location points for stores and interview participants were saved in ArcGIS 10.1 as shapefiles, and survey scores were joined to the store locations. These point data were displayed with road shapefiles on maps to estimate driving routes. The Network Analyst Extension's Cost Matrix tool was used to calculate road distances between participants and food stores.

Qualitative data. Analysis of interviews and field notes followed conventional content analysis methods, featuring inductive category production based on observations of study participants (Hsieh & Shannon, 2005). Interviews were transcribed verbatim, and field notes were included in the analysis. After reading texts multiple times, a coding template was developed and applied to text segments. Coded text segments from all participants were then aggregated by code. Rereading of these texts together in each code facilitated the grouping of codes into themes.

Mixed methods. Convergent parallel mixed methods design involves concurrent data collection and analysis of quantitative and qualitative study components. The results from these parts are interpreted together in a final assessment (Creswell & Plano Clark, 2011). Data were converged in three areas: spatial access to stores, store characteristics, and food selection. Participants' store selections were described in terms of distance from the stores, store survey scores, and comments made about these stores. Descriptions of participant food selection patterns were discussed in relation to the foods available in stores.

Results

Potential Food Access

Store locations and general characteristics. Fifty stores were identified in ground-truthing, including seven supermarkets, eight grocery stores, six dollar stores, four pharmacies, 24 convenience stores, and one "other" store. Google search results had 100% matching with ground-truthing for identification of supermarkets, grocery stores, pharmacies, and dollar stores. Convenience stores had much lower matching; 56% (n=13)

of the convenience stores and the one “other” store found in ground-truthing were not found in Google results. One problem with identifying stores through Google was that many did not list street addresses, but only town names, making positive matches more difficult.

Exterior and interior traits of the stores varied. Supermarkets all had well-maintained parking lots, exteriors, and interiors. Grocery stores varied in their appearance, some with some freshly painted buildings and brightly lighting inside, and others with litter in parking lots, faded exteriors, and relatively dimly-lit interiors with narrow aisles. Grocery stores included conventional grocers carrying a full product line of national-brand items, and discount grocers carrying varieties that are more limited and less-known brands. Convenience stores varied in appearance: some appeared well-maintained and freshly stocked, while a few had run-down exteriors, bars on windows, dusty cans on shelves, and unlit coolers. Many convenience stores served hot prepared food items ranging from countertop dispensers to short-order grills.

Foods available in stores. Of the 50 stores identified, 28 had in-store surveys completed: all supermarkets and grocery stores, three Dollar stores, one pharmacy, and nine convenience stores. SNAP was accepted at all supermarkets and grocery stores, and two of the three Dollar stores. WIC benefits were accepted at all supermarkets, and at all but two grocery stores. Some stores outside of the county were located in another state; of these, only one supermarket accepted the study area state’s WIC benefits. Convenience stores did not accept SNAP or WIC.

Overall survey scores for availability, price, quality, and total scores were highest in supermarkets, as noted in Table 1. Independent-samples t-tests were conducted to compare supermarkets with grocery stores, and Dollar stores with convenience stores. Supermarkets scored significantly higher than grocery stores for availability, price, and total score; quality did not differ significantly. Dollar stores scored significantly better than convenience stores in healthy food availability and total score, but there was no significant difference in price score or quality. Pharmacies and “other” stores were excluded from analysis due to low sample number.

Availability. Average availability scores for supermarkets were close to 33, the maximum score. Lower scores occurred only in stores where low fat milk comprised half or less of the shelf space, and where surveyed varieties of fresh vegetables were missing. Grocery stores had lower availability scores in these and other food categories. Shelf space for gallons of low fat milk in grocery stores ranged from 11% to 88% ($M = 39.0\% \pm 26.6$). Only two grocery stores stocked all 10 fresh fruits listed in the survey, and an average of 7.9 varieties (± 1.7) were available. Of the 11 fresh vegetable varieties, only five supermarkets sold all 11, and all grocery stores were missing one or two varieties. Reduced fat cheese was available in only one grocery store. Four of the eight grocery stores did not stock lean ground beef with fat content of 10% or lower. All grocery stores offered canned and frozen vegetables, canned fruit, canned tuna in water, dry beans, and 100% juice.

Dollar stores and convenience stores had much lower availability scores of healthy items in relation to less healthy foods. Dollar stores all offered low fat milk, but

space compared with whole milk ranged from 25% to 50%. None sold reduced fat cheese, fresh or frozen fruits and vegetables, fresh meat, or whole wheat pasta. Reduced fat chips, whole wheat bread, oatmeal, and olive oil were available at only some stores. Convenience stores had very limited availability of healthier food items: none stocked low fat milk, reduced fat cheese, frozen vegetables or fruit, whole grain rice or pasta, reduced fat chips, or olive oil. A small number of stores carried whole wheat bread, canned fruits, vegetables, tuna, or beans. All offered 100% juice in small bottles. Less healthy food varieties, such as frozen French fries, white bread, white pasta, canned pork and beans, Vienna sausages, and sugary cereals were more widely available in dollar and convenience stores.

Price. Average price scores also favored supermarkets' pricing of healthier options relative to less healthy alternatives within the same store. For stores where both options were available, price differences were assessed with paired sample t-tests. The cost of lean ground beef ($M = \$4.10 \pm 0.91$) was higher than regular ground beef ($M = \$3.35 \pm 0.61$), $t(10) = 5.671$, $p < .001$. Skinless, boneless chicken breasts ($M = \$3.67 \pm 0.82$) were higher than bone-in thighs or legs ($M = \$1.63 \pm 0.36$), $t(14) = 12.76$, $p < .001$. Canned tuna in water ($M = \$1.27 \pm 0.52$), was higher than similar sized Vienna sausage cans ($M = \$0.76 \pm 0.40$), $t(22) = 9.660$, $p < .001$. Per ounce, the cost of olive oil ($M = \$0.21 \pm 0.20$) was more than lard ($M = \0.06 ± 0.06), $t(27) = 5.175$, $p < .001$. Within stores, there were no significant differences in price between skim and whole milk; frozen broccoli and French fries per ounce; whole wheat and white pasta; brown and

white rice; Cheerios and Honey Nut Cheerios per ounce; baked and regular potato chips; fat-free pinto beans and canned pork and beans.

In comparing mean prices of similar items between supermarkets and grocery stores, no significant differences were found in the whole wheat bread reference brand, skim milk, apples, bananas, grapes, strawberries, lettuce, cabbage, frozen broccoli, chicken breast, canned pinto beans, canned green beans, canned pineapple, tuna, brown rice, oatmeal, baked chips, or olive oil. Variations in brand names, especially in discount grocery stores, made compiling food basket prices impracticable.

Quality. Only 27% (n=4) stores had perfect scores for quality of fresh fruits and vegetables. The rest had one or two produce selections in which some or most pieces had wrinkles, spots, or otherwise looked inferior. Surveyed fresh meats were all of acceptable quality.

Realized food access. The nine women who participated in interviews all met criteria for government programs aimed at low-income families. They all self-identified as White race, ranged in age from 25 to 60 years, and ranged in education level from less than high school diploma to college graduate. Three were employed at least part-time. Seven lived with their husband or partner, and their children under 18 and living at home ranged in number from one to six. One had no household access to a vehicle. Data from interviews and field observations are presented without identifiers in order to maximize protection of confidentiality in the context of a small rural community (Ramos, 1989).

Store selection. Grocery shopping comprised the vast majority of trips for food acquisition; most participants rarely ate away from home. Major shopping occurred only

in supermarkets and grocery stores; most fill-in shopping also occurred in these stores, plus occasionally in dollar stores. All stores listed by participants as typical destinations were included in the sample of retail food stores. Most participants chose stores based on proximity to their homes. Participants lived within a 10-mile drive of an average of 3.9 (SD = 1.6) grocery stores or supermarkets. Participants tended to travel farther but less frequently for major grocery shopping, compared with fill-in shopping, as noted in Table 2. All participants drove their cars to stores except for one participant, who lived within walking distance of a supermarket. Most trips originated from home, though some selected stores near their route to work or other activities.

Pairing quantitative food store survey results with qualitative interview data can provide additional understanding of participants' experiences in food stores, as illustrated in Table 3. For example, Supermarket A scored well for availability of healthy foods, but some participants thought the food selections inferior to similar stores in larger cities. Supermarket B was perceived by some participants to have better quality and selection than Supermarket A, but it was also seen as more expensive. The food store survey supported the difference in quality, but did not find difference in price structure for healthy versus regular food items. Participants generally saw Grocery Store A as having higher prices than the bigger stores, and the survey found unfavorable pricing for healthy items. However, some participants shopped at Grocery Store A almost exclusively in the meat department, and the store survey did not assess aspects of meat selection and pricing, which participants looked for. Grocery Store B had a lower availability score,

and this was consistent with participants saying they only went there for certain items.

The low quality score also concurred with participants' suspicion of the food quality.

Participants described their reasons for shopping at stores other than proximity. One participant rarely shopped at the nearest grocery store (Survey total score 30), commenting, "I don't think it's as good of quality. I think it's because, where it's a smaller store, they don't refresh it as soon as the other stores do." Instead, she drove three extra miles to do major shopping at a similar-size grocery store (Survey total score 30) with discounted prices and selected items she liked to buy. Another participant, with a higher education level and a preference for more gourmet foods, chose larger sized stores and valued the general atmosphere and selection of foods. She shopped often at the closest food store, a chain supermarket (Survey total score 40). She did all other regular shopping at another supermarket (Survey total score 38), passing one supermarket and two grocery stores (Survey total scores 40, 30, 28 respectively) on the road to get there.

Participants balanced store preference with distance. Five of the nine participants spoke about the desirability of shopping for food in larger cities far outside the county, which ranged from 41 to 67 miles drive from their homes. Reasons for preferring these stores included better prices in general, deeper price markdowns, greater selection, and access to stores where "extreme couponing" was possible. Strategies for accessing these stores included shopping there when traveling to the city for other activities, sharing rides, and arranging for companions to buy specific items ahead of time or by phone while the companion shopped.

Organizing shopping trips. Participants described their planning processes for food shopping, including when and where to go, who to bring, and which foods to buy. The six participants receiving SNAP benefits described buying most of their food at the beginning of the month when their accounts refilled. However, in describing their destinations or frequency of trips, SNAP recipients did not differ noticeably from non-SNAP recipients. Due to the small sample size, statistical assessment of these groups was not possible.

Shopping with children was an important point of decision for several participants. Several brought older children to help with shopping or to select a few treats. One participant allowed her children to add many items to the cart, and to pick out multiple candies in the check-out line. Most participants found shopping with children to be distracting, even to the point of breaking their planned food budgets:

If I take somebody with me, it's always, 'Can I get this? Can I get this?' Or just grabbing stuff and putting in the buggy, and it drives me insane. I know what I wanna get. I know what I need to get. When you're adding to it, that causes me issues, cuz you might made me lose my train of thought. You've made me wonder if I'm even gonna go over now.

Food selection. Participants all had different strategies to maximize food value when they shopped based on price and budget, quality, convenience, and healthfulness. Descriptions of these strategies, followed by specific food group selections, illustrate the themes and variations among the participants.

Price and budget. Maximizing volume of food purchased, and avoiding running out of food at the end of the month, was a major priority for participants with very limited food budgets. One participant, with six children and a limited income said, “It’s really the price. I’ve got to have more quantity than I do anything, because there’s so many of us.” She described buying the largest packages possible in the supermarket, and bought generic brands in all cases except where her children had explicitly favored a brand. Buying bulk-sized items, such as potatoes, condiments, and lard, were common strategies to stretch food budgets.

Fresh meat was very important, but expensive, for most participants. Most bought large packs priced lower per pound than small ones. At home, the women would separate the meat into smaller containers with enough for a family meal, and freeze them. One grocery store had the attractive service of taking large pieces and custom-cutting them for customers, though there was no visible butcher department in the store.

Participants used many other strategies to reduce food costs. Some used coupons from local newspapers, and at least one found coupons online. Participants scanned the ubiquitous entryway displays of marked-down foods, but in general did not make impulse selections, saying, “Usually the items that are kind-of on sale. Usually they’re not a lot cheaper, but they’re a little cheaper.” Several participants stocked up on staple items with the strategy, “When something’s on sale, I like to grab it.” Many participants spoke of price comparisons between stores. Some avoided traveling to multiple stores, citing, “if [store]’s having a big sale, by the time I drive from [town] to [store], I’m gonna be making it up in gas. I have to really kinda budget it out.”

The amount of money available for food affected participants' impulsivity of purchases. One participant with higher SNAP benefits than the others shopped without a list, filled two shopping carts and made several unplanned purchases. On the opposite end of the spectrum, another participant had low SNAP benefits, planned a shopping trip for specific items, and used her mobile phone to calculate each food's deduction from her total, exclaiming, "Jesus, we're running out of food stamps already."

Quality. Quality included the condition of the food in the store and its likelihood of going to waste at home. Several participants closely inspected the quality of different food products before purchasing them, including fresh meats, eggs, produce, and expiration dates. Several chose stores where they could easily return foods they found to be substandard. Not all participants selected foods this way. One selected a wilted head of lettuce in a small grocery store, without seeming to notice its condition.

Participants spoke of strategies to avoid spoiled food at home. One was to buy the most economical size that could be consumed before going bad. For example, a participant remarked about cherry tomatoes, "If I get too many at one time, they get ruined." She chose two individual-sized packs, and said, "Right size and look, they're washed and ready to eat." Some stores had pre-packaged produce with prominent WIC labels, but some items were smaller and appeared inferior in quality to the bulk produce. Another participant with a small family used frozen vegetables that could be easily portioned out, rather than fresh vegetables such as broccoli that was sold in large bunches.

Convenience. Many foods selected by participants were designed for convenience, even when less-processed substitutes were possible. The participants with less education and knowledge of cooking favored convenience foods, but those with higher education and more flexible incomes also bought these regularly. Child-friendly packages such as single-serve Spagettios and pudding cups were popular even with women who cooked from scratch regularly. One participant had switched to fewer individual packages in an effort to save money, for example, by packing containers of chicken nuggets for lunches instead of Lunchables, and buying one big bag of chips to be divided into smaller bags at home.

Processed meats were an inexpensive convenience food for many families. One participant pointed out, “it’s a lot more expensive to buy a whole chicken than it is to go get chicken nuggets or frozen chicken nuggets.” Others bought hot dogs regularly for their family’s meals; one was particular about ingredients, while another selected hot dogs based solely on price.

Healthfulness. The perceived healthfulness of foods was not a primary driver of food choices while shopping, in most cases. One participant admitted, “I know how to read the labels, I just—I don’t. It sounds really bad, but I just don’t.” Certain foods, such as low-fat milk and whole wheat bread, had been successfully integrated into some family’s eating habits, making these purchases more automatic for the participants. Some participants bought healthier items for themselves, and less healthy foods to fit their husbands’ tastes. Some healthier foods were seen as conflicting with the goal of feeding a

whole family on a limited income. This conflict was evident when a participant with a history of cardiovascular disease stated:

I need to eat healthy. I need to eat more fruits. I need to eat more vegetables. I need to eat more fish. I know I do, it's just spending \$9.00 on a pack of fish, I see it as that \$9.00 can buy me two packs of hamburger meat.

Discussion

This study adds to food environment research in several important ways. It described retail food stores' availability of healthy foods in rural Central Appalachia, a region that has had few studies of this kind. It assessed the behavior and experiences of lower-income women in interacting with retail food stores. Finally, it was the first known study of a rural U.S. food environment that combined these two approaches in a single analysis to provide an in-depth understanding of potential and realized food access in a community struggling with poverty and health disparities.

A large number of full service supermarkets and grocery stores were available within a 10-mile drive for many residents of this county. This differed from other rural studies, such as in Maine where distance was an obstacle to grocery shopping at high-quality stores (Hartley et al., 2011). Supermarkets and grocery store served as the main venue for food shopping, as opposed to other rural communities where dollar stores and convenience stores were important food sources (Bustillos et al., 2009; Sharkey, Dean, Nalty, & Xu, 2013). Study participants generally shopped close to home, but were willing to travel a few miles farther than the absolute closes grocery store or supermarket in order to access better selection or prices. They regularly crossed county or state lines if they

lived near a border, and occasionally traveled much greater distances to shop in larger cities. This expanded area of possible food shopping destinations agreed with studies of other populations that shop outside their “neighborhood” (Zenk, Schulz et al., 2011).

Participants’ opinions about foods sold in stores generally agreed with the findings of the food store surveys. Differences between stores in availability and quality were reflected in participant comments. However, participants in general thought grocery stores were more expensive than supermarkets, but no price difference was found in comparing average prices of individual items by store type. The atmosphere, service, and other non-food characteristics were also important to participants’ store selections. Grocery stores were often seen as less attractive interiors, but several participants enjoyed high level of service by employees. A study of urban low-income women found similar reasons for choosing to shop in a certain store (Zenk, Odoms-Young et al., 2011).

Participants’ organizational patterns affected their food selections at the store. Many participants showed skillful planning and shopping strategies that helped them to maximize food value and purchase nutritious foods even on very tight budgets. Strategies included buying large packs of meat to freeze, buying shelf-stable items in bulk, and buying small portions of produce to avoid spoilage. However, their concern over cost and potential for food spoilage led some to favor processed and convenience foods that were less healthy than the unprocessed counterparts. Less organized shopping practices, such as shopping without a meal plan and allowing children to pick out numerous items, created conditions for spending more and purchasing more low-nutrient foods. Reluctance to change habits, such as ignoring nutrition labels, selecting food by price

only, and favoring less healthy alternatives like lard. A previous go-along interview of food shopping routines in England found similar behavior variations (Thompson et al., 2012).

Implications for Practice

This study points to some possible targets for interventions to improve access to healthy foods. Assisting smaller grocery stores to expand healthy food availability, and increase quality, might attract more customers who already enjoy the outstanding service in these stores. Retail programs to increase sales of fresh produce to low-income families, including those with SNAP or WIC, should consider the importance of size and quality for shoppers who prioritize avoiding food waste. Education for consumers should address a wide range of organizational skills around food, including planning a shopping trip, making lists, inspecting for quality and nutrition, controlling costs, and storing food to minimize spoilage.

Implications for Future Research

This study helps move the research of local food environments towards more nuanced assessments that consider not only the potential food access, but the myriad ways that consumers respond to the foods and food stores. Future mixed methods studies should seek to refine methods of integrating quantitative and qualitative findings through convergent analysis to increase triangulated validation. Future directions for the study of rural Appalachian food access should include surveys that more precisely measure food choice influences and behaviors, in order to identify key factors and associations among factors.

Limitations

This study had limitations that threatened its validity and reduced its generalizability to other rural or Appalachian communities. The small sample size and convenience sampling increased the likelihood that the sample was not representative of the low-income population of the county. Nearly all the women had cars and lived in towns with relatively easy access to stores. Effort was made to recruit participants with higher barriers to accessing food such as lack of transportation and living in more remote areas of the county, and only late in the study was it recognized that a different recruiting strategy was needed to enroll a more diverse sample. The food store survey, while very similar to a previously tested instrument, was not field-tested or validated before used in this study, and the scoring criteria may have inadvertently introduced bias towards certain types of stores. A lack of comparison between food store survey scores in the study area and non-rural or non-Appalachian areas. The procedure of sampling one of every three small food outlets identified during ground-truthing procedures may have introduced geographic bias as the roads were driven systematically and not in random order.

Conclusion

Studying influences on individual food choices, in the context of foods available in the individual's community, can increase understanding of the dynamic factors that result in diet patterns, and ultimately in health outcomes. While community-level interventions to improve potential access to healthy foods may be a valuable strategy to improve population health and reduce food access disparities, designing effective interventions of this type may depend on understanding the unique personal, social, and

cultural attributes of the community members. Our study of a single county in rural Appalachia revealed unique assets and barriers to healthy choices while shopping for food. These findings suggest that supporting healthy eating among low-income Appalachian residents may include addressing stores' food stocks, as well as increasing knowledge and skills of individuals to eat healthfully on a small budget.

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Table 1: Food store survey scores								
	Super-market (n=7)*	Grocery Store (n=8)*	<i>t</i>	p	Dollar Store (n=3)*	Convenience Store (n=9)*	<i>t</i>	P
Availability	32.0 (1.2)	27.5 (2.3)	4.6 2	< 0.001	15.0 (2.0)	6.4 (3.2)	-4.23	0.00 2
Price	5.1 (2.3)	2.3 (2.8)	2.1 7	0.49	1.7 (2.1)	1.3 (1.4)	-0.32	0.75 7
Quality	3.0 (1.2)	2.1 (1.1)	1.4 8	0.162	0.0 (0.0)	0.1 (0.3)	0.56	0.58 8
Total	40.1 (2.0)	31.9 (2.9)	6.3 0	< 0.001	16.7 (2.5)	7.9 (4.5)	-3.18	0.01 0

Table 2: Participants' grocery shopping patterns

	Mean (SD)	Minimum	Maximum
Number of trips for major shopping	2.9 (1.3)	1.5	5.5
Number of trips for fill-in shopping	5.2 (2.5)	2	10
Distance to major shopping destination (miles)	7.5 (4.8)	0.5	17
Distance to fill-in shopping destination (miles)	4.4 (3.7)	0.2	17
Total travel per month (miles)	41.9 (30.7)	8.6	114.3

Table 3: Food store survey scores and participant comments. (Italics indicate field notes, not direct quotes)

Store	Scores		Participants' comments
Supermarket A	Total	38	<i>On using WIC benefits:</i> "[Supermarket A] is probably the easiest. They probably have the biggest variety of stuff. ... They have theirs labeled a little better."
	Avail	33	"[Supermarket A] has more of a selection."
	Price	4	"You can pretty much count on, cuz it's corporate owned and they have certain regulations that they have to go by."
	Quality	1	"It seems like such a hassle to run into [Supermarket A] for small things" <i>Can use competitor's coupons.</i> "Don't have to worry about going here and there and everywhere." "[Supermarket A] has taken out their seafood completely except for frozen, and they didn't have much to begin with." "Everything in [store] is squeezed onto one wall from lunch meats to cheese, to milk, to cut up meat, burger and chicken.... There's just not as much of a selection."
Supermarket B	Total	40	"Now that I know that they've got an actual butcher and seafood market, I wanna go see what it's all about"
	Avail	32	
	Price	4	"And now there's some people that will say that [Supermarket B] has better produce than [Supermarket A]. I think it's more expensive."
	Quality	4	<i>She considers the meats here better quality and selection than [Supermarket A].</i>
Grocery Store A	Total	30	"I only get my meats from [Grocery Store A]. It's more fresh."
	Avail	28	
	Price	-2	"It's kind of hit or miss. You go in there and they've got really good meat that's just come in or you go in and they haven't had a shipment in a couple days."
	Quality	4	"I just ran to [Grocery Store A] cause I live 4 blocks from [there]." "Their meat prices. That's really the only reason I go there." "It just doesn't look as clean because it's so dim and it's very cramped"

“And to me, [Grocery Store A] is a little more costly.”
*Said she’ll buy her produce at [Supermarket A]
 because it’s better selection and cheaper than
 [Grocery Store A].*

Grocery Store B	Total	30	“There are certain things that I only get there. ...they always, always, have ten boxes of the seasoning that you mix with water to make that gravy.” “It’s a lower grade meat” “For [canned foods] them to be so cheap, it’s like, what is it missing?”
	Avail	26	
	Price	3	
	Quality	1	

Chapter Five: Manuscript Three

Cultural and Economic Influences on Food Choice in Rural Appalachian Women

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Abstract

Objective: This qualitative sought to understand the context of food choices in the lives of lower-income women in rural Appalachia, in order to identify resources and barriers for healthful eating. **Design:** A focused ethnographic approach involving three interview sessions with each participant: (1) a set of questionnaires on household composition and resources, food shopping patterns, and household food security; (2) a go-along interview while the participant shopped for food; and (3) a semi-structured interview. **Sample:** 9 women, age 25-60 years, with 1-6 children in their homes. **Results:** Older female relatives teaching youth to cook was a key way to transmit lifelong cooking and food management skills. Though all women had at least basic nutrition knowledge, they sometimes prioritized cost and food preference over healthfulness. Feeding a family involved negotiating with spouses and children. Traditional Appalachian foods were important, and there was social pressure to not change these recipes to be healthier. Food security was a concern, and two important buffers were social connections and access to homegrown food. **Conclusions:** Recommendations for possible interventions include food skill training opportunities in school and community, promotion of modified traditional foods, and facilitation of informal social connections in rural communities.

Keywords: Appalachia, rural, food choice, families

Introduction

Significant health disparities exist in rural, economically vulnerable regions such as Central Appalachia. Comprising 82 counties in Virginia, West Virginia, Kentucky, and Tennessee, this region has some of the worst health disparities in the larger Appalachian region, and in the U.S. (Appalachian Regional Commission [ARC], 2009; ARC, 2013; Halverson & Bischak, 2008). Life expectancy is lower than most of the U.S., and in fact has fallen for both men and women in many of its counties in the past 30 years (Ezzati, Friedman, Kulkarni, & Murray, 2008; Kulkarni, Levin-Rector, Ezzati, & Murray, 2011). Obesity and other nutrition-related diseases are associated with this increased mortality, and most Central Appalachian counties were in the top quintile for obesity and diabetes prevalence in 2007 (Center for Disease Control and Prevention [CDC], 2009). Reducing obesity and other nutrition-related diseases is crucial to improving the health of this region. Understanding the determinants of food choices can guide interventions to improve diet outcomes, and ultimately health outcomes.

Other rural food access studies have identified spatial access to foods, financial resources, and cultural factors as important in healthy food choices. In many rural areas, long driving distance and a lack of public transportation pose barriers to purchasing healthy foods at affordable prices (Bustillos, Sharkey, Anding, & McIntosh, 2009; Hartley, Anderson, Fox, & Lenardson, 2011). Persistent poverty is associated with higher obesity in rural counties (Bennett, Probst, & Punkam, 2011). Cultural norms associated with rural lifestyles, including rapid temporal shifts from physically demanding jobs to

sedentary lifestyles, may encourage less healthy food choices (Schoenberg, Hatcher, & Dignan, 2008).

Recent research in Appalachia underscores the need for information specific to the region in order to understand the assets and challenges to eating healthfully. Studies on Appalachian adults identified social and cultural pressures to eat in ways that promoted overweight, including cultural norms about preferred foods, shifts away from home food production, and a rapid shift in economies from active occupations to sedentary ones but without an accompanying change in diet habits (Mudd-Martin*, 2014; Schoenberg et al., 2013). Family food preferences and intra-family role dynamics also influenced household food patterns (Schoenberg et al., 2013; Brown & Wenrich, 2012). Additionally, studies on Appalachian adolescents found social norms that contributed to unhealthy eating patterns (Swanson, Schoenberg, Davis, Wright, & Dollarhide, 2013; Wu et al., 2007; Williams, Taylor, Wolf, Lawson, & Crespo, 2007). The multi-level influences on food choices identified in previous studies highlights the need for additional research to further illuminate Appalachian social determinants of health.

This paper explores the attitudes and experiences of rural Appalachian lower-income women in order to identify resources and barriers to eating healthfully. The study was part of a larger project to assess a rural Appalachian community's food environment, that also included data collection of store locations and in-store food availability (Thatcher, in progress). A conceptual model of food access by Sharkey and Horel (2009) framed food choices as results of dynamic relationships between diverse factors in the lives of potential consumers and the characteristics of the food outlets available to them.

Multiple levels of influences on individual consumers included health, household composition and material resources, food habits, transportation options, and neighborhood characteristics. Other research has added to the characteristics of consumers that influence their food choices, such as experiences over an individual's lifetime, food beliefs, cooking and food managing skills, and capacity to make satisfactory food choices (Bisogni, Jastran, Shen, & Devine, 2005). The wide array of possible influences on individual food choices prompted this open exploration of the experiences of a population facing many health and economic obstacles.

Methods

Setting

The study took place in a county in southwestern Virginia, within the Central Appalachia region. Like much of the region, the county was rural, more than 90% non-Hispanic white, and high poverty (Pollard & Jacobsen, 2012). Adult obesity and diabetes prevalence were some of the highest in Virginia (CDC, 2009). Despite these health disparities, the county had adequate access to supermarkets and large grocery stores, as measured by the U.S. Department of Agriculture (Economic Research Service, 2013).

Approach and Sample

The study used a focused ethnographic approach. Like traditional ethnographies, the goal is to understand norms, behaviors, values, and social arrangements of a group of people with cultural similarities (Richards & Morse, 2007). Focused ethnographies examine the cultural context of pre-specified topics through short but intensive field data collection methods such as interviews (Knoblauch, 2005). The

study design included three one-on-one interview sessions for each participant. The Institutional Review Boards of the University of Virginia and the Virginia Department of Health approved the research protocol.

A convenience sample of lower-income women was recruited through Women Infants and Children Nutrition Program (WIC) clinics, Head Start preschools, and food banks. Study eligibility included women who self-identified as household food managers, had low incomes (i.e., were enrolled in programs like WIC or Supplemental Nutrition Assistance Program [SNAP]), had at least one child under age 18, and had lived in the county or nearby for the past year. An original enrollment goal of 20 anticipated a wide diversity of geographic and economic traits in the sample. However, recruiting women with high levels of geographic isolation and poverty proved difficult despite efforts to raise awareness of the study in more sparsely populated areas of the county. The final sample of nine women was smaller than standard size guidelines, but the extensive data collected during three interview sessions with a fairly homogenous group ended with theoretical saturation, in that later interviews added little new findings compared with the first interviews (Mason, 2010). The Table 1 presents demographic information about the sample. All participant data were collected in 2013.

Interviews

Three interview session guides were developed: 1) A set of questionnaire to assess personal and household structure and resources, household food security, and food acquisition patterns; 2) A go-along semi-structured interview guide while the participant shopped for food; and 3) A traditional semi-structured interview in a private setting.

Interview guides were pretested with local agency personnel in order to adjust the questions and language to the target population.

Interview one. Three questionnaires comprised this session. An assessment of personal and household demographics and material resources was based on Sharkey and Horel's (2009) framework, and customized for a rural Appalachian sample through collaboration with academic and community partners. A second questionnaire assessed destinations for food purchases by asking participants to recall specific locations and frequency of travel for major food restocking, fill-in shopping, buying fast food, and other activities. A similar recall method was used in another rural study (Sherman, Spencer, Preisser, Gesler, & Arcury, 2005). The U.S. Household Food Security Scale (U.S. Department of Agriculture, 2008) was attached to the questionnaire, though questions were skipped if the response to initial questions indicated adequate food security.

Interview two. The go-along format aimed to learn about participants' interactions with the food outlets as they shopped for food. Go-along interviews fit well in the context of a focused ethnographic study as they combine field observations with interviewing (Carpiano, 2008, Thompson, Cummins, Brown, & Kyle, 2012). Participants were given a choice to have the interviews recorded through a lapel microphone attached to their clothes, or through the investigator's written field notes only. This interview was not required in order to proceed to Interview Three; it was anticipated that some participants might feel uncomfortable appearing in public with a community outsider, or

have schedule conflicts. Two of the nine participants skipped this interview, due to scheduling difficulties.

Interview three. A final interview guide included broad open-ended questions that focused on personal, social, and community factors of food choices identified in Sharkey and Horel's (2009) conceptual framework, as well as previous study findings. Box 1 contains sample questions from this interview guide. Additional questions were also developed for each participant to clarify and confirm data collected in the previous interviews.

Interview procedure. The aim of the interview process was to learn about each woman's experiences and attitudes about food access, in the context of her unique life circumstances. During each interview, the investigator encouraged participants to attend to their children whenever needed, and a friendly conversational tone was maintained throughout the interviews. Participants were encouraged to diverge from prewritten questions to share their own stories and experiences.

The investigator met singly with each participant at her home or a community agency site during Interviews One and Three. Interview One ran less than 45 minutes in most cases, with a range of 17 to 80 minutes. Interview Two was not timed. Interview Three usually ran less than 60 minutes, and ranged 35 minutes to 90 minutes. Participants were paid \$10 cash per interview. All recorded interviews were transcribed verbatim; only field notes were taken at five of the Interview Two sessions.

Analysis. Qualitative analysis followed conventional content analysis methods using the Framework process (Hsieh & Shannon, 2005; Ritchie & Lewis, 2003). Analysis

began after each interview, by reviewing notes and recordings to find initial themes. Questions at follow-up interviews with the same participant were created to clarify or build on an earlier idea. Later, transcripts and notes were read multiple times with comments written in the margins. Codes were created inductively from this process, and segments of significant text were highlighted and coded systematically from each set of interviews. Additional codes were added after starting this process, and all previously transcripts were then re-analyzed with the new code list. Text segments were then copied from individual transcripts and grouped by code in Word and Excel documents. Some data segments were placed in two more codes, and cross-referenced. After reading all segments together in each code, a code index was compiled and themes were developed to organize codes into groups. For example, the codes of typical food, household composition, and child food preference were grouped into the theme of home food patterns, while food safety net and community food culture were under the theme of community. While thematic interpretation and writing, segments were read again in the original transcript to ensure optimal understanding of the speaker's meaning. Prominent themes detailed by two or more participants are described here.

Validity of the analysis was supported during and after data collection. After each interview, tailored questions were developed for subsequent interviews with the participant, to clarify and confirm information. During analysis, the primary investigator and two researchers independently read several transcripts, and met to resolve coding discrepancies.

Results

Personal Knowledge and Beliefs

Food knowledge and skills. All participants mentioned their mothers and other female relatives as important sources of knowledge about cooking and food. Seven had grown up helping a lot in the kitchen, including some who had assumed primary cooking responsibility from a young age. Taking home economics classes was not specifically assessed, and few participants volunteered that they learned about cooking at school. Two women had little hands-on training while growing up, and continued to have difficulty with household food management:

I know how to cook some stuff, but then there's some things—like, my mom, she used to make meatloaf, homemade and all of that. I wouldn't have the clue of how to do it. I'm one that, I like to take the least amount of time of cooking as possible.

During their adult lives, several participants talked about continuing to learn about cooking, food, and nutrition. Common sources included jobs in childcare, volunteering, cooking classes, internet or smartphone applications, television, and other mass media. Of four participants who were asked, all denied having received any significant education from a pediatrician or nurse. This was somewhat surprising, given that five participants were currently enrolled in WIC, a program that includes multiple nutrition education sessions. One reported receiving a “little paper with the food groups on it”, and another recalled a pediatrician instructing her to “[j]ust keep doing what you're doing” regarding the malnourished foster children in her care.

Meaning of healthy food. Participants' descriptions of eating healthfully included eating or avoiding certain foods, limiting portions, feeling good, and concern for children's nutrition. All the participants were able to list healthy foods, most commonly fresh fruits and vegetables, white meat such as chicken or turkey, and fish. Only one listed whole wheat bread. Milk and cheese were added in regard to children. Several participants added the caveat that they couldn't afford to eat many of these foods, or at least chose not to:

[E]ating healthy means eating foods that are good for you, like bananas and apples and oranges and fruit, probably yogurt, and probably actually like turkey meat, but we don't eat any of that [laughter].

Some described limiting unhealthy foods, such as excess fat, salt, and sugar. Strategies for limiting fat included buying low-fat milk, draining grease when cooking meat, and avoiding added fats when cooking. Eating smaller portions was a component of healthy eating that several participants struggled with, but asserted was their individual responsibility:

I would like to not eat as much. That's my biggest downfall is I eat—I don't do the whole one-cup. I know what I need to do. My weight is nobody's fault but my own. It's not McDonald's fault.

Traditional and new foods. Local food cultural traits described in the interviews included traditional foods, church dinners, aversion to change, and convenience foods. Traditional foods included fried chicken, soup beans with cornbread, biscuits, cooked

greens, and sweet iced tea. Some participants who were newcomers to the county felt pressure to master these recipes, and to adapt their cooking to local styles.

Food was a means of cultural transmission as well as social organization. Traditional ingredients were also meaningful. Loyalty to certain brands, such as flour, cornmeal, and mayonnaise, were seen as symbols of loyalty to a social group. A participant described teaching her daughters to make cornbread from a family recipe, saying, “Now if he made it with wheat flour or a different cornmeal, then that healthy could be passed down.” Some church dinners were a venue for reinforcing these norms. A participant described feeling pressure to establish her own specialty dish, and to bring it to church suppers every time in order to fit in socially:

You just have to know, you know, who’s got the best this and who’s got the best that. You start trying to make it healthy, and it’s almost like oh, do I want to do that, or just do things the way they’ve always been done?

Balancing tradition and health was often difficult. One participant who was proud to cook in traditional styles had successfully lost weight through changing her eating habits. Another participant who had motivators to make healthy changes, including significant health concerns, enjoying new cuisines, having children who enjoyed eating healthfully, still found healthy changes difficult to enact and maintain: “If I could bring myself to do it, they would follow suit. I have no excuses on why—real excuses on why I don’t do it, I just don’t. I’m set in my ways. That’s all it is.” Personal or family health concerns were perceived by several participants as a motivator to prioritize healthier foods:

I am seeing people changing the way they cook. Either they've been diagnosed with diabetes or they've got to lose a little bit of weight or whatever the situation. And they're trying to change it, but it's so hard to, even if it's for health reasons, with a lot of people in this area. Again, tradition is tradition.

Though most participants professed strong values about eating what was available and "not being picky", many of them hesitated to alter traditional recipes. The attitude of some was, "I'm open to try it, as long as the end result is the same." Several mentioned their husbands' preference for traditional and higher fat foods. Others lacked knowledge or confidence to make substitutions. Experiments by different participants with lean ground beef, olive oil, and brown rice had ended in disappointment. However, several participants were pleased with methods introduced in a community cooking class, such as baking with reduced sugar and substituting applesauce for oil. Some participants who had lived in different cities and had more flexible budgets enjoyed experimenting with new foods.

Locally grown food. Gardening, raising livestock, hunting, and gathering wild foods were important sources of healthy foods for low-income families, and also maintained traditional foodways, or community modes of producing and distributing food (Cannuscio, Weiss, & Asch, 2010).

Cooperative labor among extended family was a key to successful gardens for four of the five participants who ate fresh produce in the summer, and had canned and frozen produce in other seasons. Several depended on older generations for skills like canning and saving seeds:

My husband tilled the garden the other day ... before my father-in-law planted some stuff. They grow a lot of it, but if we want it, we're responsible for breaking the beans and then [mother-in-law] will can 'em for us. ... If we don't help out, we don't get them.

However, not all participants had access to these foods because they lacked resources such as social connections, land, equipment, and training.

Hunting and locally raised livestock were important supplements to store-bought meat for five participants. Several women had hunted and butchered meat themselves, sharing in a family tradition of hunting; others received it from family and friends.

Foods grown or gathered locally also supported cultural traditions. Several participants preferred the taste of home-grown produce to what was available in stores, even when frozen. Homemade jams, relishes, meat jerky, were specialties among both older and younger generations. Edible wild foods were local delicacies:

People are out in the woods searching for mushrooms. ... Yeah, they're actually pretty good. I never had 'em before today, and a girl brought some to work. They only come in once a year so everybody gets super excited about it.

Household food management. Making food last through a month was a primary concern for several participants with very limited food budgets. Strategies at home to maximize food resources included buying in bulk, cooking in bulk, planning menus for a week or month, using cheaper cuts of meat, and frequent use of cheap starchy foods like potatoes, bread, and pasta. One surprising finding was that three of the most financially

challenged women purchased bottled water for themselves or their families because they did not trust the safety of their municipal or well water.

Participants with restrictive food budgets often commented about the challenges of buying and keeping perishable foods, compared with shelf-stable foods. Those with SNAP benefits usually ran short of fruits, vegetables, and milk towards the end of the monthly benefit cycle. A common strategy was to buy large packs of fresh meat, sold at a lower price per pound, and split them into single meal-sized packages in a freezer at home. However, acquiring a varied supply of meat required advanced planning for the expense and storage:

[I]t's like one month you buy nothing but meat because you want enough food to get you through, and then the next month you've got no room in your freezer because it's full of meat, so you get things like spaghetti sauce that you couldn't get the previous month.

Freezer capacity was very important to nearly all the participants for store-bought meat, large monthly grocery purchases, and home-grown produce or meat. Five participants owned extra freezers, and another two wished they did. One participant bought frozen foods for another reason, stemming from child custody problems:

'Cuz DSS, if Welfare's called, the first thing they look at is what's in your fridge and what's in your freezer. ... To make sure that you have enough food to feed them. Canned food's a plus, but they want to see stuff you make meals with. So usually I buy TV dinners...

Eating most meals at home was a cost-saving strategy for nearly all the participants. Eating out or buying ready-to-eat foods was uncommon. Most participants took pride in making dinners for their families on a nearly daily basis, and appreciated the control they had over how their family's food was prepared. Several tended to cook from scratch most nights. Some planned for occasional easy meals, such as fish sticks and French fries, that were treats for their family but less expensive than eating fast food. For other participants, meals often included processed convenience foods, such as canned pasta, hot dogs, chicken nuggets, frozen entrees, frozen fried potatoes, pizza, or instant gravy. Packed lunches for adults or children often included prepackaged reheatable items like frozen entrees, canned soup, or chicken nuggets. Breakfasts consisted of quick foods like cold cereal, sweetened instant oatmeal, frozen sausage biscuits, or instant pancake mix. One woman talked about making fruit smoothies in the past, but no longer owned a blender.

Participants described typical dinners:

- “Usually I like to fix macaroni and cheese and corn, and sometimes green beans. Then I’ll fix those Banquet dinners, like that turkey and gravy, or Salisbury steak. The girls really like that stuff.”
- “Fried chicken, and mashed potatoes, and corn, green beans.”
- “Barbecue pork chops and corn, green beans, and rolls.”
- “We mainly just go with the veggies and the meats.”

Vegetables and fruit were desirable foods for participants, but cost limited the amount and varieties they purchased. Vegetables were a primary part of dinners for most

participants, along with meats and starches. The preferred vegetables were often starchy types such as corn, lima beans, or black-eyed peas. Non-starchy vegetables such as cabbage, tomatoes, collard greens, carrots, green beans, and broccoli were purchased fresh, canned, or frozen. Several bought fresh produce at the beginning of the month, and relied on canned and frozen produce at the end. Bananas, clementine oranges, and apples were common fruits that participants bought for themselves and their children. One bought bananas, but rarely other fresh fruit except with the WIC check specific for produce: “[T]here’s one thing that I love fixin’, but unless I can get it on my WIC, I hardly do ever get it. It’s Granny Smith apples. I like makin’ fried apples.” Several women bought produce only in season, when it was best quality and lower price. Those with WIC used the small monthly benefit for produce, but the strategy with SNAP was to create filling meals rather than buy specific food groups: “I’m so concerned with buying meat and things to make meals with, with the food stamps that we have, that I don’t really have any extra for fruits and veggies.”

Food security. Strategies for maintaining adequate food for the household included SNAP and WIC program, home-produced food, informal social networks, and food banks. Six participants received SNAP benefits, and five received WIC. Dependence on these and other income supports varied. One participant received plentiful SNAP and other benefits, and decided not to look for a job because it would shorten her months receiving the assistance. Another worked two part-time jobs but depended on scanty SNAP benefits to feed her family. While she aimed for independence from government assistance, she acknowledged, “But honestly if it wasn’t for food stamps, we’d live off

Ramen and toast. And how healthy is that?” A participant who depended on food banks criticized policymakers’ lack of awareness about food security struggles:

The government is more, I don't know. It's like they have—I don't even know how you say it—a blindfold on. They don't understand. If they was to come and live in our shoes for two weeks, they would understand what we go through.

Six participants had experienced at least occasional low food security during the last year, meaning they had enough food, but reduced quality or variety. Four of the six said this did not affect how they fed their children. Only one participant had actually skipped a meal or reduced her food intake due to lack of money. Three participants went monthly to a food bank, and 3 others had gone at least once. Most spoke positively about the social interactions and the foods they received:

I never used the food bank before, but I used them this month. They were really nice about it and they gave us some decent stuff and we were able to use most of it. Salad mix and stuff went bad because I can only eat so much salad.

The role of food banks varied by individual. One participant with a working spouse went monthly to a food bank, even when there was food in the house. In contrast, another participant with a working spouse saw her situation as better than others:

This week, I can feed my family. Next week might be a completely different story. There's so many people that every week is a next week out here, and it's sad to see the line sometime at the food pantry, and to hear [volunteer] go, “All right, we've only got enough for X amount more.

Locally produced food was an important food security buffer among low-income families. Some kept stores of canned or frozen food that lasted through the year. Others knew they could always pick up food from extended family or “church family”. Even when money was tight for everyone involved, this healthy food was always available. For participants with limited social networks, running low on food sometimes created significant stress:

Like yesterday, mom gave me a little bit of cash that she had stored away and I spent all of it on bananas and strawberries and milk and grapes and ... things [child] likes to eat. Then when you do have a little bit of extra money and you get like a treat or something, I don't feel like I can indulge in it...

Experiencing food insecurity in the past also affected food behavior for some participants and their children. Foster children in several families, who had suffered neglect or hunger, continued defensive eating behaviors long afterwards: “[They] will try to gorge themselves, although that they’ve known for a year and a half there’s always food.” Two participants had themselves experienced food insecurity as children, and continued to fear scarcity:

I grew up really poor. And I always ate, but it really, necessarily wasn't what I would want to eat. But it was what we had in the house to eat, and so now I kind of hoard food...

Family dynamics. Participants saw unique nutritional needs in their children. One limited processed snack foods and encouraged drinking water because she had children taking medications. However, another with a child receiving early intervention

services maintained a diet based mostly on convenience. Others strived to balance health concerns with children's preferences: "I'm not a health nut but I don't let her have a lot of sugar either." One participant had started buying more fresh fruits to feed her children, and found she started eating more fruit too. One mother criticized her childcare provider for feeding the children mostly processed foods:

[T]heir bodies need different stuff. They burn fat differently and they need a certain amount of calories or they fall over exhausted and they need good things and not breaded crap. It angers me.

A common value among the participants was that children should not be picky and be willing to try new foods. Though most let their children have prepackaged snacks at home, they rejected cooking special meals to please the children. The women also perceived a high level of control over their children's food intake, in that most food was prepared at home under their supervision. However, some felt they lacked the will to enact healthy eating changes in the home.

The two participants who had not learned cooking while growing up showed similar permissive attitudes towards feeding their children, as well as teaching their children food skills. They favored processed foods at meals and allowed their children to choose foods to eat at home and while grocery shopping, including candy. When asked what they hoped their children would grow up knowing about food, one said the most important value around food she hoped to impart was to not be a picky eater and to try new foods, including vegetables. The other said she hoped her daughters would learn to cook, but her view on teaching them was, "I try to learn 'em stuff, and when I want 'em to

do something, they don't wanna do it. Then, when they decide that they want to do it, then they will." In contrast, the other mothers with school-aged children actively involved them in the kitchen. One participant said, "I want my girls to be able to feed themselves, to do their own laundry, to take care of themselves financially so yeah you start young in my kitchen."

Traditional gender roles were prevalent in the experiences of the study participants, as well as their expectations of their children. The participant who successfully taught her daughters to cook said her son "couldn't burn water. I tried for years to teach that boy how to cook. ... My husband doesn't cook, never has. His father never cooked." Even in homes where both spouses worked, participants saw cooking as their job, and the kitchen as their domain. One young mother said that her husband's willingness to cook after she gave birth distinguished him as "Not the typical guy... He's always very good and very supportive."

Most of the participants stated their belief that families should eat together at least at dinner time. Several stated that they wanted their kids to value the tradition of praying and talking together over a meal. Having a larger family made eating together more of an established pattern. Though after-school activities kept some families out of the house in the evenings, they made a point of eating together whenever possible. One mother said she used to do family meal times when her husband and children were together, but the family had been split and now she and one child ate more informally. She added that even at holidays her extended family was unlikely to eat together at a table due to lack of space in the home.

Discussion

This study expands the understanding of influences on food choices and household food management in lower-income rural Appalachian women. A wide variety of interconnected components, including personal, social, cultural, and material factors, represented resources and barriers to healthy food access and choices.

Knowledge and skills related to household food management and preparation tended to be transmitted primarily through intergenerational, hands-on training within families. Additional opportunities for adult learning existed in the community. Women who had not learned how to cook as children had lower food management skills, tended to be more permissive in feeding their own children, and had few plans for teaching their children to cook. Food knowledge and skills may be an important lifelong asset for healthy eating, especially for low-income individuals. These assets are able to endure through external changes such as loss of income, housing instability, or additional mouths to feed (Bisogni et al., 2005). A longitudinal study found that frequent cooking as an adolescent was associated with enjoyment of cooking as a young adult, though there was no effect on consumption of healthier foods (Laska, Larson, Neumark-Sztainer, & Story, 2012).

All participants had at least basic knowledge about what constituted a healthy diet, such as fruits, vegetables, lean meats, less fat, and smaller portions. However, many stated that healthy foods were too expensive, and personal preferences about food types and portions often conflicted with their definitions of healthy foods. Some strived to achieve a balance between healthfulness and food preferences, and were more highly

motivated by health concerns such as weight and symptoms related to unhealthful foods like sugar. Beliefs about food may not translate directly into food choices if there are limitations in an individual's perceived capacity to make decisions and act on them (Bisogni et al., 2005). Differences in the participants' self-efficacy appeared to play a role in how closely their food beliefs aligned with their food behavior.

Strong historical traditions in terms of preferred foods persisted in the participants, particularly those with strong extended family or other social networks in the county. Studies found similar traditional foodways in other parts of Central Appalachia (Smith, 2003; Davidson, 2013). Traditional foods may play important roles in improving dietary behavior in rural Appalachian communities, through use of whole grains, legumes, dark green vegetables, and fruit. However, cooking methods for these foods tended to add unhealthy amounts of fat, sugar, and salt. Modifications to make traditional recipes healthier could help, but acceptance of these changes may be difficult due to the very strength of the food traditions.

Practices of food management to maximize value were similar to findings in other studies. Freezers and bulk purchases was similar to a community in Maine where the distance to shop was much farther (Yousefian, Leighton, Fox, & Hartley, 2011). The experiences of participants receiving SNAP were similar to other studies that found meat was a primary part of the diet, fresh vegetables and fruit were bought cautiously and often not available at home, and less nutritious foods were relied on when SNAP funds ran out (DeBono, Ross, & Berrang-Ford, 2012; Wiig & Smith, 2008).

Though perceptions of water quality were beyond the original study focus, the unexpected finding that families were spending limited food budgets on bottled water merited exploration. Extensive mining activity has long been recognized as a water quality threat (Hendryx, Wolfe, Luo, & Webb, 2011; Shiber, 2005). Public water safety incidents, like food recalls, may have lasting damage on consumer confidence (De Jonge, Van Trijp, Renes, & Frewer, 2007).

Food insecurity was a worry for some families in the study, and a reality for a few. Socially isolated participants faced a double burden to their food security of having no feasible way to participate in gardening, and having few people to ask for food or money to buy food. Social isolation has been found to be a major risk factor for food insecurity in adults (Tarasuk, 2001). Individuals experiencing food insecurity are likely to seek aid first from extended family (Ahluwalia, Dodds, & Baligh, 1998; Swanson, Olson, Miller, & Lawrence, 2008). Participants generally found going local food banks to be preferable to running out of food, and the acceptability of going was increased by knowing volunteers or having other social connections at the food bank.

Local food production was a powerful resource to increase access to healthy foods and ease stress about food security. Social connectivity, especially through extended family, played a key role in local food production. McEntee (2010) suggested dual conceptualizations of rural local food: *contemporary* food movements to establish alternatives to industrial food production and promote community, and *traditional* food practices to increase access to fresh and affordable food without a particular ideology. This population's food localism fit in the latter concept.

Though children in foster care were not a population of interest when planning this study, anecdotes by several parents of persistent overeating raised questions about this caring for this vulnerable group. Childhood abuse and neglect has been found to be a predictor of adult obesity (Alvarez, Pavao, Baumrind, & Kimerling, 2007), and food insecurity in young children is a predictor of childhood obesity (Metallinos-Katsaras, Must, & Gorman, 2012). Food insecurity has been shown to negatively affect children's mental health (McIntyre, Williams, Lavorato, & Patten, 2013; Melchoir et al., 2012). However, studies of the biobehavioral mechanisms that link child maltreatment with obesity were not found.

Family dynamics were important influences on food choices. The mothers' styles of feeding their children ranged from signs of authoritative style to indulgent (Hoerr et al., 2009). Permissive parental feeding styles is associated with higher consumption of low-nutrient foods and childhood overweight (Hennessey, Hughes, Goldberg, Hyatt, & Economos, 2012). The emphasis on families sitting together for evening meals is an important resource for promoting healthy eating within families. Studies have shown that shared meals are associated with healthier weights in children (Hammons & Fiese, 2011). Intra-family dynamics of power status and gender roles gave the mothers nearly all the responsibility for food management, while negotiating with husbands and children about food preferences. These finding correlate with earlier studies of Appalachian family eating patterns (Brown & Wenrich, 2012).

Implications for Research and Practice

In order to increase opportunities for healthy food choices, economically vulnerable rural communities need access to effective and low-cost interventions. Customizing interventions to meet the needs of specific populations may increase likelihood of success (Webber & Quintiliani, 2011). Though this study was limited to a small sample in one county, recommendations based on the findings are also supported in the literature.

Strengthening school-based home economics education may reduce the long term food behavior disparities in individuals who lack opportunities to learn food management from older family members. Learning food management skills as youth may be an important tool to reduce obesity and other chronic diseases (Lichtenstein & Ludwig, 2010; Slater, 2013). Programs outside of schools, sponsored by cooperative extension offices, faith-based groups, and other community organizations may be able to fill gaps in school curricula.

Increased focus on food choices during health care visits may prompt families to make healthier food choices. Nutrition educators working with families may also benefit by screening for parental feeding styles (Hennessey et al., 2012). Rural health care providers are less likely than their urban counterparts to provide nutrition counseling to women of reproductive age (McCall-Hosenfeld & Weisman, 2011). A key concern is how to increase this service in cost-effective ways to low-resource communities.

Other interventions to increase knowledge, skills and resources to produce and prepare healthy foods may help equalize opportunities for rural residents with social or

financial barriers to healthy food access. To promote local food production, material as well as educational support may be needed. Farmers markets, community gardens, community kitchens, meat processing facilities, and seed exchange libraries are examples of material supports (Behrman, Berger, & Moreland, 2013; Cohen, Andrews, & Kantor, 2002). Training activities for local food production and household food management should seek to maximize participation among residents with low social and financial resources; provision of childcare, meals, and transportation may allow more vulnerable individuals to attend. In this study, a community-based cooking class was well-received and prompted attendees to express confidence in modifying recipes to make healthier food. Other studies in rural Appalachia have also found cooking classes to be perceived as appropriate interventions (Schoenberg et al., 2013; Tessaro et al., 2006). Farmers markets should strive to serve low-income families, such as accepting SNAP Electronic Benefit Transfer cards and offering children's activities (Schmit & Gomez, 2011). Safety net food providers, such as food pantries, should assess community needs in order to maximize healthy food access through the month.

Rural communities may have fewer formal organizations to provide food assistance, leaving informal social assistance to fill a larger role than in urban areas (Swanson, Olson, Miller, & Lawrence, 2008). Building resources to enhance social connectivity in rural communities may have effects on food security. Economically disadvantaged individuals may be more oriented to prosocial behaviors, such as helping others and sharing scarce resources, than more wealthy individuals (Piff, Kraus, Cote, Cheng, & Keltner, 2010). Gulley (2006) described a successful academic-community

partnership to build community capacity in youth with a health promotion goal in southwest Virginia. Providing training and leadership development opportunities for individuals who are committed to their communities but wield little formal power may empower them to organize healthy food programs, lead cultural trends towards healthy choices, and provide informal support to a broad social network (Laverack, 2006). Likewise, programs and physical structures that facilitate social connections may lead to reduced disparities in food access among the most isolated and vulnerable community members.

Further qualitative studies of cultural meanings of specific types of traditional Appalachian foods may help guide interventions to promote these foods as healthy alternatives to convenience foods (Engelhardt, 2001). Foods associated with class hierarchies elevated processed and non-indigenous foods as symbolizing a higher social class (Engelhardt, 2001). Overcoming negative historical associations of traditional foods may assist in promoting their re-adoption.

Limitations

This study has important limitations. The small sample size and convenience sampling method produce a high likelihood of selection bias. The sample may not have been representative of the more vulnerable families in the study county, in terms of geographic isolation or economic situation. Social desirability may have biased interview responses. The use of tailored follow-up questions during the second and third interview were attempts to member-check data. Generalizability of the results to other populations

may be limited. However, a qualitative study in a different part of Central Appalachia described similar findings (Schoenberg et al., 2013).

Conclusion

Low-income rural communities in Central Appalachia may face multiple challenges to healthy populations, but there are also important assets already present that can help make healthy food more accessible. This study of nine lower-income rural Appalachian women found assets and challenges that went well beyond simple availability of foods, poverty, and knowledge of nutrition. Strengthening overall food management skills in individuals, promoting healthy culturally specific foods, and building for social connections may play key roles in improving healthy food access and food security in rural communities.

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Box 1*Sample semi-structured interview questions*

- How did you learn about cooking and food?
- What is a typical grocery shopping trip like for you?
- How do you stretch your food budget?
- How would you describe eating healthfully?
- How do other household members affect how you buy and prepare foods?
- How are your food choices shaped by your other responsibilities, such as work, childcare, and other household roles?

Table 1: Demographic information

	<i>Mean (Range)</i>
	n
Age	33.8 years (25-60)
Race / Ethnicity	
Non-Hispanic White	9
Marital status	
Living with husband / partner	7
Single / other	2
Household composition	
Total	4.2 (2 - 8)
Children	2.3 (1 – 6)
Household income (annual)	
Less than \$20,000	6
\$20,000 - \$40,000	3
Education level	13.4 years (11-16)
Less than high school	1
High school graduate	4
Some college	2
College graduate	2
Employment status	
Full time	1
Part time	2
Homemaker	6
Length of residence in county	18.3 years (3 months - whole life)
No vehicle in household	1

Chapter Six: Conclusion

The purpose of this dissertation was to explore the influences on potential and realized food access in an economically disadvantaged rural Appalachian community. This work has revealed a wide range of complex interactions that affect choices of food from what is available in the community.

This study used geographic information systems (GIS) as an approach to enhance data collection and analysis by adding spatial context. In Chapter Three, the manuscript, *Geographic Information Systems in Nursing Education, Research, and Practice: A Systematic Review and Call to Action*, made a case for the usefulness and importance of GIS in a range of nursing activities. The many GIS interfaces provide opportunities for nurses to use this technology easily, through free and user-friendly online applications, or to learn advanced skills to create custom analyses.

Chapter Four demonstrated an innovative mixed methods analysis of a food environment, including quantitative spatial and store survey findings and qualitative interviews with consumers. Very few food environment studies have used this type of convergent analysis to examine the nuanced interactions between food outlets and consumers. This study found good availability of healthy food in the rural Appalachian community, but that lower-income consumers based their food selections on a range of criteria, including price, quality, convenience, and healthfulness.

Chapter Five continued to describe the attitudes and experiences of lower-income women in making food choices, but expanded the discussion to a wide range of personal, social, and community circumstances. In-depth interviews with room to focus on

unexpected topics revealed important influences on food choices that illustrated unique characteristics of the Appalachian region. Personal knowledge, beliefs about food, household food patterns, family dynamics, cultural traditions, and food security all played important roles in the women's experiences with food access.

This study's findings generated a number of possible interventions to improve access to healthy food. Improving healthy food availability and quality, especially in grocery stores and smaller food stores, may encourage more purchases of healthy foods. Policies to make healthy food more affordable, through retail business models as well as nutrition support programs for consumer, is vital to allowing low-income consumers the flexibility to prioritize healthfulness over quantity of food. Teaching consumers, from an early age and through adulthood, about cooking and other food management skills, is essential to having a population capable of making healthy food choices in cost- and time-effective ways. There are many existing assets in a rural Appalachian community, such as strong social connections, traditional foodways, and local food production, that could be promoted in order to promote healthy eating and food security.

Further research should be done to test associations between the factors of food choice identified here. There may be important variables that were not identified, and the relationships between the factors was not clear. One future course of research is to design surveys for individuals that further assesses these multiple levels of food choice influences. Additional studies using mixed methods should also be done, in order to strengthen the framework for designing and analyzing these quantitative and qualitative data together.

This study sets a foundation for future work to address health disparities and food access in rural communities. Strengthening of skills for the research methods used here, including GIS, food retail assessment, and qualitative approaches, will build future opportunities to conduct similar studies. Additional skill sets, such as community-engaged research methods, intervention design and evaluation, and development of training curricula could be very helpful in working with rural and other underserved communities to make healthy eating easier to accomplish.

Appendix A

Food Outlet Identification Form

GPS Store Locations

Date _____

County _____

Name of Researcher/s _____

Store Name	Category Code #	Category name	GPS Waypoint Number	Latitude	Longitude	Road	Town (if known)	Surveyed?*	Comments

* For stores being surveyed only every 3rd one, mark “1” and then “2” when you encounter a store of that category. You’ll need to look back in your log to remember which number you’re on. For the 3rd store, stop and survey it. If you complete the survey, mark “✓”. If you attempted the survey, but were unable to complete it (i.e. refused by store manager), write “unable” and the reason in the Comments.

Appendix B

Nutrition Environment Measure Survey - Stores (NEMS-S

Yale Rudd Center Revised Version

Modified for Esther Thatcher's doctoral dissertation study:

Sociocultural and Economic Influences on Food Access in Rural Appalachia

Rater Name _____

Store Name _____ Store Location _____

GPS identification number _____

GPS Coordinates _____

Start time ____ : ____ am pm End time ____ : ____ am pm

Store Type ☐ Convenience Store +/- gas (1) ☐ Drug store (4)

☐ Supermarket or supercenter (2) ☐ Dollar store (5)

☐ Small grocery store (3) ☐ Other (6) _____

Comments _____

Number of cash registers: ☐ 1 ☐ 2 ☐ 3+WIC store certification ☐ Certified ☐ Not certified ☐ Unknown _____SNAP / EBT store certification ☐ Certified ☐ Not certified ☐ Unknown _____Appearance of premises ☐ Acceptable ☐ Not acceptable _____

Comments _____

Measure Complete c

Measure # 1: MILK

A. Reference Brand
 Store brand (preferred) _____ ☐ Yes ☐ No
 Alternate brand name _____
 Comments _____

B. Availability _____ Comments _____

1. a. Is low-fat (skin or 1%) available? ☐ Yes ☐ No _____
 b. If not, is 2% available? ☐ Yes ☐ No _____

2. Shelf space for Conventional (non-organic) cows milk (measure only if low fat milk avail)

Type	Pint	Quart	Half Gallon	Gallon
a. Skim	_____	_____	_____	_____
b. 1%	_____	_____	_____	_____
c. Whole	_____	_____	_____	_____

C. Pricing for Reference brand milk

Type	Gallon	Half gallon	Comments
a. Skim or 1% (lowest fat available)	\$____. _____	\$____. _____	_____
b. Whole	\$____. _____	\$____. _____	_____

Alternate Items:

2%, gallon \$____. _____ _____

2%, half gallon \$____. _____ _____

Measure Complete c

Measure # 2: CHEESE

Availability and Price

Use cheese in block. Select 8-10 oz bars if available. If cheddar is not available, select Mozzarella or American cheese and note in Comments.

Item	Not available	Ounces	Price	Comments
Reduced Fat Cheddar				
Kraft 2% milk Cheddar	<input type="radio"/>	_____	\$____. _____	_____
Alternate Items:				
Cracker Barrel Cheddar, Reduced Fat	<input type="radio"/>	_____	\$____. _____	_____
Other _____	<input type="radio"/>	_____	\$____. _____	_____
Regular Option Cheddar				
Kraft Cheddar	<input type="radio"/>	_____	\$____. _____	_____
Alternate Items:				
Cracker Barrel Cheddar	<input type="radio"/>	_____	\$____. _____	_____
Other _____	<input type="radio"/>	_____	\$____. _____	_____

Measure #3: FRUIT

Availability & Price

Produce Item	Not available	Price	Unit			Quality			Comments
			#	pc.	Lb.	A	B	C	
1. Bananas	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
2. Apples <input type="radio"/> Red delicious	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
<input type="radio"/> _____									
3. Orange <input type="radio"/> Navel	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
<input type="radio"/> _____									
4. Grapes <input type="radio"/> Red seedless	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
<input type="radio"/> _____									
5. Cantaloupe		\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
6. Peaches	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
7. Strawberries	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
8. Honeydew Melon	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
9. Watermelon <input type="radio"/> Seedless	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
<input type="radio"/> _____									
10. Pears <input type="radio"/> Anjou	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
<input type="radio"/> _____									

11. Total types: (# of fruits available) _____

Measure #4: VEGETABLES

Availability & Price

Produce Item	Not available	Price	Unit			Quality			Comments
			#	pc.	Lb.	A	B	C	
1. Carrots <input type="radio"/> 1 lb bag	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
<input type="radio"/> _____									
2. Tomatoes <input type="radio"/> Loose	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
<input type="radio"/> _____									
3. Sweet peppers									
<input type="radio"/> Green bell	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
<input type="radio"/> _____									
4. Brocco <input type="radio"/> Bunch	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
<input type="radio"/> _____									
5. Lettuce <input type="radio"/> Green leaf	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
<input type="radio"/> _____									
6. Green beans	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
7. Cucumbers									
<input type="radio"/> Regular	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
<input type="radio"/> _____									
8. Cabbag <input type="radio"/> Head	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
<input type="radio"/> _____									
9. Sweet Potatoes	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
10. Russet Potatoes	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
11. Green <input type="radio"/> Collard Greens	<input type="radio"/>	\$____.____.____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	C_____
<input type="radio"/> _____									

12. Total types: (# of vegetables available) _____

Measure # 5: FROZEN FRUITS AND VEGETABLES

(Please select frozen foods without sauce and regular cut vegetables. Use 16-oz (=1 lb) package if available).

Food product	Not available	Price/pckg	# oz/pckg	Comments
1. Peas				
Green Giant peas sweet baby	<input type="radio"/>	\$ ____ . ____	____	____
Alternate Items:				
Other: _____		\$ ____ . ____	____	____
2. Green Beans				
Green Giant green beans		\$ ____ . ____	____	____
Alternate Items:				
Other: _____		\$ ____ . ____	____	____
3. Broccoli				
Green Giant broccoli	<input type="radio"/>	\$ ____ . ____	____	____
Alternate Items:				
Other: _____		\$ ____ . ____	____	____
4. French fries				
Ore Ida 19-oz. bag	<input type="radio"/>	\$ ____ . ____	____	____
Alternate Items:				
Other: _____		\$ ____ . ____	____	____
5. Frozen Whole Strawberries				
		\$ ____ . ____	____	____

Measure #6: CANNED FRUITS AND VEGETABLES

(Select 14.5-oz cans if available; as an alternative,
select the cheapest item of regular no-sauce canned vegetable).

Food product	Not available	Price/can	# oz/can	Comments
1. Canned Pineapple in Juice (
		\$ ____ . ____	____	____
2. Corn				
Green Giant whole kernal	(\$ ____ . ____	____	____
Alternate Items:				
Other: _____		\$ ____ . ____	____	____
3. Green beans				
Green Giant green beans	c	\$ ____ . ____	____	____
Alternate Items:				
Other: _____		\$ ____ . ____	____	____
4. Raisins				
Cheapest option: _____	<input type="radio"/>	\$ ____ . ____	____	____

Measure #7: MEAT

Availability & Price

A. **Beef** (Select packages of approximately 1-2 lb size)

Item	Not available	Price/lb.	Comments
Beef Healthier Option:			
Lean ground beef, 90% lean, 10% fat (Ground Sirloin)	<input type="radio"/>	\$____.____	_____
Alternate Items:			
Lean ground beef (<10% fat	<input type="radio"/>	\$____.____	_____
Other: _____	<input type="radio"/>	\$____.____	_____
Beef Regular Option:			
Standardized ground	<input type="radio"/>	\$____.____	_____
beef, 80% lean, 20% fat	<input type="radio"/>		
Alternate Items:			
Standard alternate ground beef (<10% fat	<input type="radio"/>	\$____.____	_____
Other: _____	<input type="radio"/>	\$____.____	_____

B. **Chicken** (Select packages of approximately 1-2 lb size)

Chicken Healthier Option:			
Chicken Breasts Boneless Skinless			
Tyson chicken breast boneless skinless	<input type="radio"/>	\$____.____	_____
Alternate brand: _____	<input type="radio"/>	\$____.____	_____
Chicken Regular Option:			
Chicken Thighs with Bone & Skin			
Tyson chicken thighs with bone and skin	<input type="radio"/>	\$____.____	_____
Alternate brand chicken thighs: _____	<input type="radio"/>	\$____.____	_____
Alternate brand chicken wings _____	<input type="radio"/>	\$____.____	_____
Alternate brand chicken drumsticks _____	<input type="radio"/>	\$____.____	_____

Measure #8: MEAT ALTERNATIVES

Availability & Price

A. Canned Meat

Item	Not available	Price/can	Comments
Canned Tuna Healthier Option:			
Bumble bee tuna in water, 6-oz can	<input type="radio"/>	\$____.____	_____
Alternate Items:			
Starkist tuna solid in water 6-oz can	<input type="radio"/>	\$____.____	_____
Other: _____	<input type="radio"/>	\$____.____	_____
Canned Meat Regular Option:			
Libby's Vienna Sausage, 5-oz can	<input type="radio"/>	\$____.____	_____
Alternate Items:			
Other brand Vienna Sausage ~5- oz can	<input type="radio"/>	\$____.____	_____
Other: _____	<input type="radio"/>	\$____.____	_____

B. Beans

Canned Beans Healthier Option

Luck's Pinto Beans, no added fat 15.5 oz ☐ \$____.____.____.

Alternate Items:

Luck's Kidney Beans, no added fat 15.5 ☐ \$____.____.____.

Other: _____ ☐ \$____.____.____.

Beans Regular Option

Baked beans with lard/pork, 15.5 oz can ☐ \$____.____.____.

Dry beans

Dry Luck's Pinto Beans 1 pound bag ☐ \$____.____.____.

Other brand 1 pound bag: _____ ☐ \$____.____.____.

Measure #9: BEVERAGE (Grocery store)

Availability & Price

Soda:

Item:	Size	Not available	Price/pack	Comments
Cheapest soda: _____				
	3 L	<input type="radio"/>	\$____.____.____.	_____
	2 L	<input type="radio"/>	\$____.____.____.	_____
	12 pack	<input type="radio"/>	\$____.____.____.	_____
	Other	<input type="radio"/>	\$____.____.____.	_____

Healthier Option:

Diet Coke 12 pack 12 oz. ☐ \$____.____.____.

6 pack 12 oz. ☐ \$____.____.____.

Alternate brand of d 12 pack 12 oz. ☐ \$____.____.____.

soda: _____ 6 pack 12 oz. ☐ \$____.____.____.

Regular Option:

Coke 12 pack 12 oz. ☐ \$____.____.____.

6 pack 12 oz. ☐ \$____.____.____.

Alternate brand of 12 pack 12 oz. ☐ \$____.____.____.

sugared soda: _____ 6 pack 12 oz. ☐ \$____.____.____.

B. Juice

Healthier Option:

Minute Maid 100% juice (64 oz., half gall ☐ \$____.____.____.

Alternate Items:

Other brand: _____ (64 oz., half g ☐ \$____.____.____.

Regular Option:

Minute Maid Juice Drink (64 oz. half gall ☐ \$____.____.____.

Alternate Items:

Other brand: _____ (64 oz., half g ☐ \$____.____.____.

C. Bottled Water

Deer Park 6 pack 16.9 oz ☐ \$____.____.____.

Alternate Items:

Other brand: _____ 6 pack 16.9 oz ☐ \$____.____.____.

Measure #10: BEVERAGE (Convenience Store)

Soda:

Item:	Size	Not available	Price/pack	Comments
Cheapest soda: _____				
	12 oz.	<input type="radio"/>	\$ ____ . ____	_____
	20 oz.	<input type="radio"/>	\$ ____ . ____	_____
Healthier Option:				
Diet Coke	12 oz.	<input type="radio"/>	\$ ____ . ____	_____
	20 oz.	<input type="radio"/>	\$ ____ . ____	_____
Alternate brand of d	12 oz.	<input type="radio"/>	\$ ____ . ____	_____
soda: _____	20 oz.	<input type="radio"/>	\$ ____ . ____	_____
Regular Option:				
Coke	12 oz.	<input type="radio"/>	\$ ____ . ____	_____
	20 oz.	<input type="radio"/>	\$ ____ . ____	_____
Alternate brand of	12 oz.	<input type="radio"/>	\$ ____ . ____	_____
sugared soda: _____	20 oz.	<input type="radio"/>	\$ ____ . ____	_____

B. Juice

Healthier Option:

Minute Maid 100% juice 15.2 oz ☐ \$ ____ . ____ _____

Alternate Items:

Other brand: _____ 15.2 oz ☐ \$ ____ . ____ _____

Regular Option:

Minute Maid Juice Drink 15.2 oz ☐ \$ ____ . ____ _____

Alternate Items:

Other brand: _____ 15.2 oz ☐ \$ ____ . ____ _____

C. Bottled Water

Deer Park 16.9 oz. ☐ \$ ____ . ____ _____

Alternate Items:

Other brand: _____ 16.9 oz ☐ \$ ____ . ____ _____

Measure # 11: BREAD

Item	Not available	Loaf size (oz)	Price/loaf	Comments
Healthier Option:				
Whole Grain Bread (100% whole and whole grain bread)				
Nature's Own 100% whole wh	<input type="radio"/>	_____	\$ ____ . ____	_____
Alternate Items:				
Sara Lee 100% Whole Wheat	<input type="radio"/>	_____	\$ ____ . ____	_____
Other: _____	<input type="radio"/>	_____	\$ ____ . ____	_____
Cheapest loaf of 100% whole grain: _____			\$ ____ . ____	_____
# of varieties of 100% whole wheat and whole grain bread (all <input type="radio"/> 0 <input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3+				
Regular Option:				
White Bread (bread made with refined flour)				
Bunny Giant White Enriched B	<input type="radio"/>	_____	\$ ____ . ____	_____
Alternate Items:				
Sara Lee White Bread	<input type="radio"/>	_____	\$ ____ . ____	_____
Other: _____	<input type="radio"/>	_____	\$ ____ . ____	_____
Cheapest loaf of white bread: _____			\$ ____ . ____	_____

Measure #12: GRAINS

A. Rice

Item	Not available	Pckg size (oz.)	Price/pckg	Comments
Healthier Option: Brown Rice				
Uncle Ben's brown whole grain	<input type="radio"/>	_____	\$_____	_____
Alternate Items:				
Carolina rice brown long grain	<input type="radio"/>	_____	\$_____	_____
Other: _____	<input type="radio"/>	_____	\$_____	_____
Regular Option: White Rice				
Uncle Ben's rice converted long grain	<input type="radio"/>	_____	\$_____	_____
Alternate Items:				
Carolina rice enriched long grain	<input type="radio"/>	_____	\$_____	_____
Other: _____	<input type="radio"/>	_____	\$_____	_____
B. Pasta				
Healthier Option:				
Whole Grain pasta				
Mueller's whole wheat spaghettia thin	<input type="radio"/>	_____	\$_____	_____
Alternate Items:				
Barilla Pasta Penne Whole Grain	<input type="radio"/>	_____	\$_____	_____
Other: _____	<input type="radio"/>	_____	\$_____	_____
Regular Option:				
Regular Spaghetti				
Mueller's Spaghetti thin	<input type="radio"/>	_____	\$_____	_____
Alternate Items:				
Barilla Pasta Penne	<input type="radio"/>	_____	\$_____	_____
Other: _____	<input type="radio"/>	_____	\$_____	_____

Measure #13: CEREAL

Healthier Option:

Healthier cereals <7 g sugar per serving and whole grain (>2 g fiber/serving)

Item	Not available	Pckg size (oz.)	Price/pckg	Comments
Cheerios (plain)	<input type="radio"/>	_____	\$_____	_____
Alternative Items:				
Kellogg's corn flakes	<input type="radio"/>	_____	\$_____	_____
Other: _____	<input type="radio"/>	_____	\$_____	_____
# of varieties of healthier cereals:	<input type="radio"/> 0	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3+
Regular Option:				
Cereals' > 7 g sugar per serving and not whole grain (select most comparable size to healthier option available)				
Cheerios Honey Nut	<input type="radio"/>	_____	\$_____	_____
Alternative Items:				
Froot Loops	<input type="radio"/>	_____	\$_____	_____
Other: _____	<input type="radio"/>	_____	\$_____	_____
Oatmeal (Plain, non-flavored)				
Quaker quick oats	<input type="radio"/>	_____	\$_____	_____
Alternative Items:				
Quaker instant oatmeal regular	<input type="radio"/>	_____	\$_____	_____
Other: _____	<input type="radio"/>	_____	\$_____	_____

Measure #14: CHIPS

Availability & Price

Healthier Option:

Low-fat chips, no more than 3g fat/1 oz serving (select the smallest pkg available)

Item	Not available	Pckg size (oz.)	Price/pkg	Comments
Baked Lays Potato Chips	<input type="radio"/>	_____	\$____.____	_____
Alternative Items:				
Other: _____	<input type="radio"/>	_____	\$____.____	_____

Regular Option:

Regular chips: more than 3g fat/1 oz. serving (select most comparable size to healthier option available)

Lays Potato Chips Classic	<input type="radio"/>	_____	\$____.____	_____
Alternative Items:				
Other: _____	<input type="radio"/>	_____	\$____.____	_____

Measure # 15: COOKING ITEMS

Healthier Option:

Item	Not available	Pckg size (oz.)	Price/pkg	Comments
Olive Oil: cheapest, smallest, container: _____	<input type="radio"/>	_____	\$____.____	_____
Alternative Items:				
Vegetable Oil: _____	<input type="radio"/>	_____	\$____.____	_____

Regular Option:

Lard: smallest container _____	<input type="radio"/>	_____	\$____.____	_____
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Appendix C

Scoring System for NEMS-S Rudd Version (Revised)

<u>Measure</u>	<u>Availability</u>	<u>Price (based on regular price)</u>	<u>Quality</u>
Milk	NO lowfat/skim = 0 points; YES lowfat/skim = 2 points, plus: Proportion (gallons) lowfat / whole: > 50% lowfat = add 1 point	Lower for lowfat = 2 points Same for both = 1 point Higher for lowfat = -1 point	n/a
Cheese	YES reduced fat cheddar = 2 point Only regular cheddar = 1 No cheddar = 0	Lower for lowfat = 2 points Same for both = 1 point Higher for lowfat = -1 point n/a = 0	
Fruit	10 varieties = 3 points 5-9 varieties = 2 points 1-4 varieties = 1 point 0 varieties = 0 points	(enter price for price basket)	100% acceptable = 2 points 1 unacceptable = 1 point >1 unacceptable = 0 points
Vegetables	11 varieties = 3 points 6-10 varieties = 2 points 1-5 varieties = 1 point 0 varieties = 0 points	(enter price for price basket)	100% acceptable = 2 points 1 unacceptable = 1 point >1 unacceptable = 0 points
Frozen Fruit and Vegetable	YES any frozen vegetable = 2 points French fries available but not frozen vegetables = -1 point YES frozen strawberries = add 1 point	Price per ounce of cheapest frozen vegetable, compared with price per ounce of French fries: If all available vegetables cheaper per oz than FF = 2 points	

		At least 1 veg cheaper = 1 point Other = 0	
Canned Fruit and Vegetable	3-4 types available = 2 points 1-2 types available = 1 point 0 types available = 0 points	(enter price for price basket)	
Meat	YES lean ground beef = add 2 points Regular ground beef only = add 1 point YES chicken breast = add 2 points Chicken thighs/drumsticks only = add 1 point	Beef: If price difference (lean – regular) is $\leq \$1.00$ = 1 point If $> \$1.00$ = 0 points Chicken: If price difference (breast – thigh) is $\leq \$1.00$ = 1 point If $> \$1.00$ = 0 points	Beef: any unacceptable = -1 point Chicken: any unacceptable = -1 point
Meat Alternatives	Of healthy choices (tuna, canned pinto beans, dry beans): 3 types available = 2 points 1-2 types available = 1 point 0 types available = 0 points	Price of 6oz can of tuna, divided by price of 5 oz Vienna sausage: ≤ 1.5 = 2 points $1.5 - 2.0$ = 1 point > 2.0 = 0 points	
Beverages (Grocery store)	YES 100% juice = 1 point 100% juice not available = 0 points	Ratio of 2L cheapest soda price, divided by 64oz 100% juice price ≥ 0.30 = 1 point < 0.30 = 0	
Beverages (Convenience stores)	100% juice available = 1 point Not available = 0 points 12oz soda available = +1 point 12oz soda not available = 0 point	Ratio of 20oz Coke/Diet Coke divided by price of 100% Juice (16 oz): $0.8 - 1.0$ = 1 point < 0.8 = -1 point	
Bread	YES whole grain bread = 2 points	Ratio of price of cheapest white / cheapest WW.	

	Whole grain bread not available = 0 point	If ≥ 0.5 , 1 point. Else 0	
Grains	YES brown rice = +1 point YES whole grain pasta = +1 point ONLY white rice a/o pasta = +1 point	?	
Cereal	YES Cheerios = +1 YES Oatmeal = +1 Junk cereal only = -1 No cereal available = 0	PPO lower for Cheerios than HNC = 1 PPO higher for Cheerios than HNC = -1	
Chips	YES Baked Chips = 2 points	Same or lower per ounce for baked = 2 points Higher per ounce for baked = -1 point	
Cooking items / Oils	YES olive oil = 2 Vegetable oil only = 1 Lard available = -1 (subtract from above)	If PPO of Olive Oil minus PPO of lard is: $\leq \$0.10$ = 1 point 11-20 cents = 0 points $> \$0.20$ = -1 point	
TOTAL POSSIBLE SCORE	From -2 to 31 points	From -6 to 16 points	From -2 to 4 points

Appendix D

Interview One, Part One:
Questionnaire for Demographics and Household Food Patterns

PARTICIPANT CODE NUMBER: _____

ITEM	RESPONSE (circle response choice, or write answer as close to verbatim as possible)	PROMPTS / Notes to interviewer
1. Name		Fill in from consent. Will only be used for record keeping.
2. Address		Will only be used for GIS analysis of distance to food outlets.
3. Age	_____ years	
4. Race / Ethnicity: Do you consider your race or ethnicity to be...	White Black Hispanic Other	Ask only if unsure
5. Marital status	Single, Married, Long-term partner, Separated, Divorced, Widowed	
6. Education level: How many years of education have you had?	_____ years HS grad / Some college / College grad	# years completed in K-12 or college; circle graduation status
7. Employment: Are you currently employed?	Circle answer to right. Ask how long participant has had this employment status. _____ Months / Years	Full time Part time by choice Part time, but want to be full time Homemaker Unemployed Disabled

8. Do you have health insurance? What type?	(Circle all that apply) Medicaid Medicare Private / Other None	
9. Household structure: # in household		Include all children and adults who ordinarily sleep in the home.
10. Household structure: relationship of member to participant, gender, and ages of household members		List each member
11. Do you provide care for any disabled adults or elders in your home or living in another place?		Includes any adults with disabilities that affect Independent Activities of Daily Living (IADL), or children with disabilities; List IADL or ADL performed in caretaking role
12. Household income including all sources (estimate)		Less than \$20,000 (<\$1,666/mo) \$20,000 - \$40,000 (\$1,666 - \$3,333/mo) More than \$40,000 (>\$3,333/mo)
13. Are you the main person who shops for food in your home?		Short-answer free response
14. Do you prepare your own food?		
15. Do you prepare food for others in the home?		
16. Do you drive?		Yes / no
17. How many days a week do you usually		(Ask only if participant drives.)

drive a vehicle on public roads?		
18. Do you rely on other people to drive you places? What types of people drive you places? (Circle all that apply)		Other household members Friends or family not living in household Commercial taxi service Public transportation (i.e. shuttle van) Informal transportation service Other
19. Do you walk or use other transportation like a moped to go places?		
20. How long have you lived in Lee County? (years or months)		
21. How long have you lived in Virginia, Tennessee, Kentucky, or West Virginia? (years or months)		(Asking about residence in Central Appalachia)
22. Do you eat food that you raise or collect yourself? Do you have a garden? If yes, describe.		
23. Do you hunt and eat the meat or fowl you catch? How often?		
24. Do you fish and eat what you catch? How often?		
25. Do you can food or otherwise process food at home for later use? Please list foods.		
26. In your home, is there indoor plumbing? 27. Source of water? (Spring, well, town)		Yes or no

28. Hot water? 29. A sink with running water in the kitchen? 30. A flush commode? 31. A working bathtub or shower?		
32. What is your source of electricity?		
33. Are there times when your home does not have electricity? (When?)		
34. In your home, is there a working stove? 35. Is there an oven? 36. Is the stove / oven electric, gas, or other? 37. Do you have a microwave?		Yes or no
38. Do you have a working refrigerator? 39. A working freezer? 40. A chest or deep freezer?		
41. Do you participate in ongoing nutrition programs? Please list.		SNAP (food stamps) WIC Reduced-cost school lunch program (for children) Lee County Extension nutrition programs Other
42. Do you get any of your food from community organizations? Please list.		Food banks Churches Other

Appendix E

Interview One, Part Two:
Participant Questionnaire on Food Outlet Utilization

PARTICIPANT CODE NUMBER _____

Say to participant: “Now I’d like for you to tell me where you go to buy groceries or other food. I’ll give you a few different situations, and you can tell me one or two places where you usually go.”

Food Access Activity	NAME and LOCATION INFORMATION (street address, town, county, close-by places)	FREQUENCY (x times per day/ week/ month/ year)
Food shopping (major restocking) “Where do you do most of your shopping?”		
Fill-in food shopping (picking up a few items needed immediately) “If you just need to run in and buy a few food items, where do you go?”		
Buying specialty foods (i.e. farm produce, meats) “Do you go somewhere different to buy specialty foods, like farm produce or meats?”		
Buying fast food “Where do you go for fast food?”		
Buying other prepared food (i.e. convenience store, roadside stand) “Where do you go for other hot or prepared food, like a convenience store or roadside stand?”		

Eating out (sit-down or buffet) “Where do you go for a sit-down or buffet restaurant meal?”		
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Appendix F

Interview One, Part Three
Sample Questions from USDA Household Food Security Survey Module

PARTICIPANT CODE NUMBER: _____

Household Stage 1: Questions HH2-HH4 (asked of all households; begin scale items).

[IF SINGLE ADULT IN HOUSEHOLD, USE "I," "MY," AND "YOU" IN PARENTHESES; OTHERWISE, USE "WE," "OUR," AND "YOUR HOUSEHOLD."]

HH2. Now I'm going to read you several statements that people have made about their food situation. For these statements, please tell me whether the statement was often true, sometimes true, or never true for (you/your household) in the last 12 months—that is, since last (name of current month).

The first statement is "(I/We) worried whether (my/our) food would run out before (I/we) got money to buy more." Was that often true, sometimes true, or never true for (you/your household) in the last 12 months?

- ☐ Often true
- ☐ Sometimes true
- ☐ Never true
- ☐ DK or Refused

HH3. "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- ☐ Often true
- ☐ Sometimes true
- ☐ Never true
- ☐ DK or Refused

HH4. "(I/we) couldn't afford to eat balanced meals." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- ☐ Often true

- ☐ Sometimes true
- ☐ Never true
- ☐ DK or Refused

Appendix G

Go-Along Interview Guide

Protocol: Ask participant to select a store where she usually does grocery shopping for major restocking. The interviewer and participant will meet at the store at a time when the participant is shopping, if possible. Start interview outside of the store:

- What do you like / dislike about this store?
- What are some things about this store that make it easier or hard to shop at this store?
- Are there things about the outside appearance of the store that you like?
- Are there things about the outside of the store that you dislike?
- What are some advertisements on or near the store that you notice?

The interviewer and participant will then enter the store together:

- What are some food items that catch your eye when you first walk into the store?

The interviewer will instruct the participant to follow her usual route around the store. As the participant enters different sections or aisles of the store, ask questions such as:

- What are foods you usually shop for in this section / aisle?
- What are some foods that you like, but this store/aisle/section doesn't offer?
- How do you decide on one variety or brand over another?
- What are some messages you notice, on food packages or on signs?
- Do you pick up a sales flyer in the store?
- Do you look for flyers or coupons before you go shopping? Do you pay much attention to these? Do you plan your shopping around what's on sale?

Appendix H

Semi-Structured Interview Guide

Sample questions and prompts:

Bring a copy of the field notes from Interview Two (Go-Along Interview) with initial themes noted. Ask the participant if these themes are similar to what she remembers of the activities and conversation during Interview Two.

- 1) What are some favorite foods for you or your family?
- 2) What is important to you about the foods you eat and serve to your family?
- 3) How would you describe the food available in or near Lee County? How do stores compare with other counties?
- 4) How do you decide where to shop for food? What are some stores close by that you rarely go to? Why?
- 5) During our first interview, you mentioned going often to (___) grocery store / supermarket. What do you like about this store? What do you dislike? (May repeat question with other outlets)
- 6) Tell me about a grocery shopping trip that is typical for you.
 - a) Prompts: Route: starting place, stops along the way? Mode of transportation? Other people involved in trip?
- 7) Could you describe a typical month in terms of your food shopping or getting food from different sources?
- 8) How do you decide what food to buy?
- 9) How do you make your food dollars stretch?
- 10) Do you ever make extra batches of food and freeze it?
- 11) If you run short on food, what do you do?

- a) Prompts: Food bank or other charity, community meals, friends or family?
- 12) Tell me about what you typically do to prepare food. Tell me about what you fixed last night for dinner. Is that fairly typical? What do you do at other times? Do you start with boxed or packaged foods, or do you cook from scratch?
- 13) How do the other people living in your household shape the way you buy and prepare food?
- 14) In what ways are your food choices and eating patterns shaped by where and when you work? Child care and household responsibilities? Do you eat regular meals? Snack in between? Work through lunch?
- 15) Do you and the people in your household eat the same thing, or do you prepare special foods or meals for others?
- 16) How would you describe eating healthfully?
- 17) What makes it harder / easier for you to choose foods based on their healthfulness? Price? Time to prepare food?
- 18) If you could design a program or store to help you eat more the way you want to, what would that program or store be like?

Appendix I

Recruitment Flyer

Food Access Study Research Volunteers Needed

We would like to interview Lee County residents about things that make getting food easier or harder.

All information is **CONFIDENTIAL**. Your name and other identifying information will not be shared.

Who can participate:

Women, age 18-65,
with at least 1 child at home

Participants will be paid \$10
per interview

(3 interviews total)

If you are interested, please call Esther Thatcher at 434-996-0156 or email ejm4p@virginia.edu

Principal Investigator: Esther Thatcher, RN, MSN

(PhD student in the School of Nursing, University of Virginia)

UVA IRB SBS 2012-0390-00, VDH IRB 40165

Food Access Study	Esther Thatcher	434-996-0156	ejm4p@virginia.edu
Food Access Study	Esther Thatcher	434-996-0156	ejm4p@virginia.edu
Food Access Study	Esther Thatcher	434-996-0156	ejm4p@virginia.edu

APPENDIX J

Script for Verbal Recruitment by PI

Hello, my name is Esther Thatcher. I'm a graduate student at University of Virginia in Charlottesville, and I'm doing a research study about food access in Lee County. I would like to interview local residents about their experiences in getting food, and about things in their lives that make it easier or harder to eat the way they want to. I am looking to do a series of 3 interviews that last about 1 hour each, and will pay \$10 cash per interview. Would you be interested in participating in this study?

No: Well thank you anyway. Have a great day!

Yes: Great! So the next step is to ask you a few questions to see if you have all the characteristics we are looking for in this study group. Are you ready? (Proceed with Eligibility Screening Form)

APPENDIX K

Screening Form for Eligibility to Participate in Study

Are you female?	YES	NO
Do you speak English?	YES	NO
Are you between 18 and 65 years of age?	YES	NO
Have you lived in Lee County for at least the past year?	YES	NO
Name of town where you live (post office name) _____		
In your home, do you provide care for at least one child under age 18 also living there? The child does NOT need to be yours by birth or by custody.	YES	NO
Do you consider yourself the main person in the household who shops for food?	YES	NO
Does your income make you qualified to get WIC or Food Stamps, also known as “SNAP”? (You don’t have to be currently enrolled in one of these programs.)	YES	NO

APPENDIX L

Informed Consent Agreement

Please read this consent agreement carefully before you decide to participate in the study.

Purpose of the research study: To understand the experiences of lower-income women in managing food for their household. This study focuses on two areas: where women go to get food, and what affects their choices about food at home.

What you will do in the study: If you decide to volunteer, you will be asked to participate in three interviews.

1) In the first interview, the researcher will meet you at a quiet place that is easy for you to get to, such as a room in a library or clinic, or it can take place at your home. You will be asked questions about where you get food, the resources you have at home to store and prepare food, and how the cost of food affects your food choices. This interview will be audio recorded to make sure your answers are written correctly.

2) In the second interview, the researcher will meet you at a grocery store of your choice, and will ask questions about your experiences in the grocery store while walking around together. You have a choice to be audio recorded, by wearing a small microphone attached to your shirt, or you can choose to not be audio recorded.

3) The third interview will again be done in a quiet place such as a room at a library, clinic, or in your home. The researcher will ask you question about foods that you often eat or make for your family, your food shopping habits, how you make the most of your food budget, and other responsibilities in your life that take up your time and energy. This interview will be audio recorded to make sure that we may get your own words accurately.

Time required: The study will require about 3 hours of your time in total. Each of the three interviews will take approximately 1 hour.

Risks: Some of the questions may cause discomfort or embarrassment. If the questions are upsetting to you, the researcher will stop the interview and assist you to seek people who can help you.

Benefits: There are no direct benefits to you for participating in this research study. The study may help us understand how to design programs that make healthy eating easier in rural communities.

Confidentiality: The information that you give in the study will be handled confidentially. Your information will be assigned a code number. The list connecting your name to this code will be kept in a locked file. This list must be kept for 5 years and then will be destroyed. Audio recordings will not have your name mentioned, and will be

kept for 5 years and then may be stored in an archive that is accessible to other researchers. Any presentations or published reports from this study will not reveal your name or address. Because Lee County has a small population, we will take extra precautions to prevent you from being identified in this study: for example, your exact age and the town you live in will not be mentioned. However, confidentiality cannot be guaranteed and there is a small chance that other people will know what you have reported.

Voluntary participation: Your participation in the study is completely voluntary. The services you receive through Lee County Health Department or Head Start are not affected by your participation in the study.

Right to withdraw from the study: You have the right to withdraw from the study at any time without penalty. If you withdraw, the audio recordings and field notes from your interviews will be destroyed. If you decide you want to withdraw from the study you will still receive payment for the interview session. If at any time during the interview session you feel uncomfortable or if you want to comment but do not want it recorded please let the researcher know and she will stop recording.

How to withdraw from the study: You may withdraw by simply telling the researcher to stop the interview. The researcher will not ask you questions about why you are withdrawing. You may also skip any question during the interview, but continue to participate in the rest of the study.

Payment: You will receive \$10 in cash at the end of each of the interviews. If you complete all 3 interviews, you will receive a total of \$30.

If you have questions about the study, contact:

Esther Thatcher, PhD(c), MSN, RN

School of Nursing

University of Virginia

P.O. Box 800826

Charlottesville, VA 22908

Telephone: (434) 996-0156

Email: ejm4p@virginia.edu

Faculty Advisor: Pamela Kulbok, DNSc, RN

School of Nursing

University of Virginia

P.O. Box 800782

Charlottesville, VA 22908

Telephone 434-924-0128

Email: pk6c@virginia.edu

If you have questions about your rights in the study, contact:

Tonya R. Moon, Ph.D.

Chair, Institutional Review Board for the Social and Behavioral Sciences

One Morton Dr Suite 500

University of Virginia, P.O. Box 800392

Charlottesville, VA 22908-0392

Telephone: (434) 924-5999

Email: irbsbshelp@virginia.edu

Website: www.virginia.edu/vpr/irb/sbs

Agreement:

I agree to participate in the research study described above.

Signature: _____ **Date:** _____

You will receive a copy of this form for your records.