LINKING THE HOME AND NEIGHBORHOOD FOOD ENVIRONMENTS REGARDING DIETARY INTAKE AMONG RURAL ADOLESCENTS

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LINKING THE HOME AND NEIGHBORHOOD FOOD ENVIRONMENTS REGARDING DIETARY INTAKE AMONG RURAL ADOLESCENTS

THESIS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in the College of Agriculture, Food, and Environment at the University of Kentucky

By

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Lexington, Kentucky

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ABSTRACT OF THESIS

LINKING THE HOME AND NEIGHBORHOOD FOOD ENVIRONMENTS REGARDING DIETARY INTAKE AMONG RURAL ADOLESCENTS

Home availability of both healthful and unhealthful foods may influence consumption among rural adolescent populations. In conjunction, the availability of food in an individual’s local food environment has the potential to significantly impact what is procured for the home and eaten away from the home. The purpose of this study was to determine how in-store food availability and parental purchases influences home availability and, ultimately, dietary intake among adolescents. This study measured perceived home availability, using the University of Minnesota Project EAT Survey, and dietary intake, using the NHANES Dietary Screener Questionnaire, of (n=28) adolescent participants in two Kentucky counties during 2013. Availability of food in local stores was measured using the Nutrition Environment Measures Survey in Stores (NEM-S). The results of multiple linear regression analysis suggest that overall store availability does not significantly impact parental purchases. However, in-store availability of specific unhealthy food categories, such as snacks, junk food, candy, and pop, was associated with increased parental purchases of similar unwholesome items and a greater predicted intake of sugar. Therefore, it may be beneficial to develop interventions aimed at decreasing the availability of unhealthy food items in stores in order to improve diet quality among rural adolescents.

KEYWORDS: Local Food Environment, Home Availability, Purchases, NEM-S, Rural Adolescents

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**Chapter One: Introduction**

According to the most recent data from the National Health and Nutrition Examination Survey (NHANES), approximately 17% of children and adolescents are currently classified as obese (Ogden, Carroll, Kit, & Flegal, 2014). While data suggest the prevalence of obesity has plateaued over the past decade, obesity continues to be a major public health concern, especially among rural and geographically isolated adolescents (Liu et al., 2012). Although obesity is generally attributed to excessive caloric intake coupled with decreased physical activity, recent attention has focused on more upstream causes of obesity, such as where adolescents live and learn (An & Sturm, 2012) (Singh, Kogan, & van Dyck, 2008).

Researchers have discovered that the burden of obesity and its related comorbidities is unevenly distributed across demographic groups. Data suggest the prevalence of obesity among adolescents, age 10-18 years, in rural America is significantly higher (27.2%) compared to their urban counterparts (24.4%) (Wang & Beydoun, 2007). Other studies have shown the odds of becoming overweight or obese are significantly higher in children who live in rural communities (Lutfiyya, Lipsky, Wisdom-Behounek, Inpanbutr-Martinkus, 2007).

Recent studies have highlighted the influential roles both the food and home environments play on obesity rates. The food environment is defined as the community-level’s availability of food organizations and resources to an individual (McKinnon, Reedy, Morrissette, Lytle, Yaroch, 2009). In contrast, the home environment represents the food that is available for consumption within the home (Glanz, 2009). Research on the community food environment suggests that what is available for an individual in his
or her specific geographic location plays a highly influential role on what is purchased for the home and ultimately consumed (Caspi, Sorensen, Subramanian, & Kawachi, 2012). Community food environment research has focused on in-store food content and how the availability of both healthful and unhealthful items may sway consumers into buying various products. The accessibility and quantity of specific items has the potential to influence an individual’s intent and likelihood to procure such goods. Purchased food, typically bought by the primary caregiver, directly influences an adolescent’s home food availability. The home food environment plays a pivotal role in determining dietary intake among children and adolescents (Couch, Glanz, Zhou, Sallis, & Saelens, 2014). Taken together, the home and community food environments have the potential to significantly impact food purchasing choices and thus intake. The overall goal of this study was to understand the distinct role that store and home availability of food has on purchasing choices and dietary intake among rural adolescents.

**Problem Statement**

Individual choices about diet and physical activity are not solely responsible for the current obesity epidemic among the adolescent population. Research has begun to show how an individual’s food environment, both at the community level and in the home, plays an important role in determining diet quality. The availability of healthful food items has the potential to improve dietary intake, where as the availability of unhealthy choices may be detrimental to diet quality.

**Purpose**

While the literature clearly shows a relationship between the community and home food environments with dietary intake, no research has been conducted to link both
environments together. Therefore, the purpose of this study was to determine how in-store food content and parental food purchases impact home availability and, ultimately, intake among rural adolescents.

**Research Questions**

1. Does in-store availability of healthful and unhealthful items among Central Kentucky food stores influence purchasing habits among rural adolescents’ primary care providers?

2. Is there an association between self-reported home availability of food items and dietary intake, as measured by the NHANES Dietary Screener Questionnaire, among adolescents in Central Kentucky?

3. Is there an association between primary care provider food purchases within a one-week period, measured via store receipts, and adolescent dietary intake, as measured by the NHANES Dietary Screener Questionnaire, in Central Kentucky?

**Research Hypotheses**

1. As the availability of healthful items (i.e. fruits and vegetables) within stores increases, purchases of such items by primary care providers will increase, and procurement of unhealthful foods (i.e. sodas, candy) will decrease.

2. As the self-reported home availability of healthful food items, such as fruits and vegetables, increases, dietary intake of healthful foods among adolescents in Central Kentucky, as measured by the NHANES Dietary Screener Questionnaire, will increase.

3. When primary care providers in Central Kentucky purchase more healthful food, measured objectively via store receipts, dietary intake, as measured by the
NHANES Dietary Screener Questionnaire, of such food will increase among adolescents.

**Justification**

Approximately 17% of the child and adolescent population in the United States is classified as either overweight or obese (Ogden, Carroll, Kit, & Flegal, 2014). While these trends have plateaued, obesity remains a pertinent issue within this population since obese children are more likely to become obese adults and develop related comorbidities (Jounala et al., 2011).

The food and home environments have been shown to play influential roles in determining what an individual consumes on a daily basis (Berge et al., 2014) (Santiago-Torres, Adams, Carrel, LaRowe, & Schoeller, 2014). This relationship is especially strong among children and adolescents since they are typically restricted to consuming what foods are purchased and stored in the home. Parental purchases are strongly influenced by what is available in the local food environment and this has a significant impact on what adolescents eat and their overall health (Drewnowski, 2012). Therefore, it is of the upmost importance to determine how availability with the local food environment influences food purchases for the home and, subsequently, adolescent dietary intake.
Chapter Two: Literature Review

Introduction

The purpose of this study was to examine the relationship between in-store food availability, parental food purchases within a one-week period, home availability, and adolescent dietary intake. This literature review provides insight into current research on (1) obesity rates across the past decade, (2) the unequal burden of obesity between urban and rural locations, and (3) how the community and home food environments influence dietary intake and weight status. Due to the nature of the study, this review will focus specifically on data pertaining to children and adolescents.

The Socioecological Model

A wide variety of environmental factors, from the food supply to food prices, have been shown to influence dietary habits (French, Story, & Jeffery, 2001). The socioecological model (SEM) is a theoretical framework, which recognizes that multiple interrelated levels work together to form health behaviors. These levels include: Individual, Interpersonal, Organizational, Community, and Policy (CDC, 2013).

Figure 2.1: The Socioecological Model (University of Oregon, n.d.)
In terms of food and eating patterns, the individual level focuses on a person’s knowledge, attitudes, and beliefs of maintaining a healthful diet. The next level, the interpersonal level, depicts how interpersonal relationships between an individual and his or her family and friends influence their dietary choices. For example, certain research suggests that parents and friends influence young adults’ attitudes towards food differently (Guidetti, Conner, Prestwich, & Cavazza, 2012). The organizational, or institutional, level encompasses an individual’s school, place of employment, and other networks, both social and professional. A broader spectrum of influence, the community level, incorporates the influence of society’s rules and cultural norms. The final level of the socioecological model reflects both state and national regulations and policies. In terms of eating habits, federal guidelines regulating the availability and safety of products, major food providers, supplemental food programs, and marketing strategies all indirectly influence what is purchased and consumed at the individual level. The socioecological model provides researchers with a structure to examine the national food system, its influence of dietary habits, and how those aspects can be manipulated to promote healthful eating.

**Overweight and Obesity**

Body mass index (BMI) is commonly used as the classification system to categorize individuals as either underweight, normal weight, overweight, or obese. BMI is calculated by dividing a person’s weight in kilograms by height in meters\(^2\) (kg/m\(^2\)). Obesity, defined as a BMI ≥ 30 kg/m\(^2\), continues to be a major public health concern and economists estimate obesity-related medical costs exceed $147 billion (Finkelstein, Trogdon, Cohen, & Deltz, 2009). According to the most recent estimates from the
Centers for Disease Control and Prevention (CDC), approximately 17% of children and adolescents, age 2-19 years, are classified as obese (CDC, 2014).

However, analysis of the most recent data from the National Health and Nutrition Examination Survey (NHANES) suggests that obesity rates have begun to plateau in the United States. After analyzing data of 9,120 individuals, of which 1,216 were between 12-19 years of age, from the 2011-2012 NHANES survey, researchers concluded that 31.8% of youth were classified as either overweight or obese. Compared to 2003-2004 data, current projections suggest that there has not been a significant change in the prevalence of obesity among adolescents over the past decade. (Ogden, Carroll, Kit, & Flegal, 2014). Analysis of the 1999-2000 to 2009-2010 NHANES data solidifies these findings (Ogden, Carroll, Kit, & Flegal, 2012). Although data suggest that rates have begun to plateau, certain demographics continue to face economic and social barriers to health equity. As such, obesity remains a pertinent and pressing public health issue.

**Obesity-Related Comorbidities**

Obesity is associated with a number of related disease and conditions including: type II diabetes mellitus, coronary heart disease, cancer (i.e. colon), hypertension, dyslipidemia, stroke, liver and gallbladder disease, osteoarthritis, and more (National Heart, Lung, and Blood Institute, 2012). In children and adolescents, a BMI-for-age in the 99th percentile may serve as an indicator for an increased risk in developing biochemical abnormalities and obesity in adulthood, ultimately leading to the development of these comorbidities (Freedman, Mei, Srinivasan, Berenson & Dietz, 2007).
*Diabetes*. At the most basic level, diabetes is classified as a disease where an individual’s blood glucose (sugar) levels remain higher than what is considered normal. According to the most recent data from the CDC, there are approximately 20.9 million Americans currently diagnosed with diabetes (CDC, 2013). Type II diabetes mellitus is the end process of a combination of insulin resistance, decreased beta cell (insulin-producing cell of the pancreas) function, and both lifestyle and genetic factors. Research has shown a highly correlated link between obesity and the development of type II diabetes. While the exact mechanism between obesity and diabetes is not yet explicitly known, certain researcher suggests that individuals with a greater amount of adipose tissue also have higher levels of fatty acids in their blood plasma. Elevated concentrations of such molecules have been found to block the secretion of insulin from the pancreas and decrease glucose uptake into the body’s cells (McKenney & Short, 2011), resulting in the development of type II diabetes.

*Coronary Heart Disease*. Atherosclerosis is the build up of plaque within the walls of the body’s arteries. Plaque is composed of cholesterol, fat, calcium, and other biochemical material (National Heart, Lung, and Blood Institute, 2014). Coronary heart disease (CHD) is a condition where plaque specifically builds up, and eventually blocks, the arteries that supply oxygen-rich blood to the heart itself. CHD is the number one cause of death amongst both males and females in the United States (National Heart, Lung, and Blood Institute, 2014). Obesity is connected with the acceleration of atherosclerosis. In the famous Framingham Study, obesity was found to be linked with a 2x and 2.4x increased risk of developing coronary artery disease among men and women,
respectively, after controlling for known risk factors of cardiovascular disease development (Mathew, Francis, Kayalar, & Cone, 2008).

*Cancer.* Obesity is associated with several types of cancer including: breast, esophageal, pancreatic, colon, kidney, and gallbladder. The percentage of cases specifically linked to obesity varies directly with the type of cancer in question (National Cancer Institute, 2012). For example, a recent meta-analysis discovered that an increased risk in developing endometrial cancer is highly related to body mass index (Jenabi & Poorolajal, 2015). As with diabetes, the direct link between obesity and cancer is still not completely understood; however, several theories have been proposed for this connection. Adipose tissue produces estrogen and excessive levels of estrogen in the body have been associated with the development of various cancers such as breast and endometrial. Obese individuals have a higher quantity of adipose tissue, which may lead to greater estrogen production. Additionally, pathways between fat cells and insulin levels, tumor growth regulators, and inflammatory processes may all directly contribute to an increased risk of developing cancer among obese individuals (National Cancer Institute, 2012).

*Hypertension.* Also known as high blood pressure, hypertension is defined as a condition where blood passes through the body’s arteries at a force that is considered higher than normal. Hypertension is a serious medical condition. When blood flows consistently flows through arteries at a higher pressure than normal, the blood vessels stretch beyond healthy limits, which can ultimately lead to damage and further medical problems (i.e. heart attack, congestive heart failure, stroke, kidney damage, etc.) (American Heart Association, 2014). Sodium intake is a primary contributor to
hypertension as sodium leads to fluid retention and, ultimately, high blood pressure. The body relies on the kidneys to excrete sodium from the body via urine. Obesity is associated with increased blood flow, cardiac output, and glomerular filtration rate. In contrast, renal sodium retention also increases due to initiation of the renin-angiotensin system, changes in the underlying structures of the kidneys, and the development of hyperinsulinemia (Re, 2009). These mechanisms each contribute to the development of hypertension and are the result of an individual’s obese status.

**Burden of Obesity**

*Socioeconomic Status.* It is commonly believed that individuals of lower socioeconomic standing are at an increased risk for becoming overweight and obese. In order to determine if this association truly existed, Wang et al. analyzed all available NHANES data to see how the relationship between socioeconomic status (SES) and obesity changed over time. Data from NHANES I, II, and III (1971-1975, 1967-1980, and 1988-1994, respectively) and annual NHANES data from 1999-2002 was assessed. Subjects were children (age 2-9 years) and adolescents (age 10-18 years). Poverty income ratios, defined as the ratio between a household’s income to the poverty line, were computed to determine a child’s SES status. In terms of defining overweight, researchers utilized the CDC’s 2000 growth charts and classified “at risk for overweight” as a BMI $\geq 85^{\text{th}}$ percentile and “overweight” as a BMI $\geq 95^{\text{th}}$ percentile (Wang & Zhang, 2006).

Overall, from 1971 to 2002, the prevalence of “at risk of overweight” and “overweight” among this age group increased from 15.5% to 29.2%. However, not all low-SES groups, such as those grouped based on age or sex, were found to be at an increased risk of becoming overweight. For example, a reverse association between SES status and
overweight was found in white but not black children. There was an overall increase in the prevalence of overweight amongst all adolescents, both in high- and low-SES groups, although the relationship between SES and overweight appears to have weakened over time. These observations imply that complex distinctions exist between age, sex, and racial groups, and that interventions aimed at combating obesity should focus on these groups rather than SES (Wang & Zhang, 2006).

**Geographic Location.** In addition to SES, gender, age, geographic location, and race/ethnicity have all been predicted to moderate the distribution of obesity within the United States. Of particular interest is the possibility of an unequal weight distribution across varied developed environments. A systematic review of 20 studies, published between 1990 to 2006, sought to assess the prevalence of overweight and obesity between urban and rural environments. Participant characteristics (i.e. height, weight, race/ethnicity, etc.) were compiled from NHANES, the Behavioral Risk Factor Surveillance System (BRFSS), Youth Risk Behavior Surveillance System (YRBSS), and the National Longitudinal Survey of Adolescent Health. When comparing geographic differences, the combined prevalence of overweight and obesity was higher among adolescents, age 10-18 years, in rural areas compared to urban (27.2% and 24.4%, respectively). However, when looking at overweight prevalence by itself, rates in rural areas (11.2%) were similar to urban (10.2%). Consist with other studies, researchers suggested that regional differences should be factored in when developing interventions (Wang & Beydoun, 2007).

In an attempt to compare weight and physical activity between rural and urban U.S. populations, Patterson et al. analyzed self-reported data of approximately 32,440
adults, age 18+ years, from the 1998 National Health Interview Survey (NHIS). Participants were grouped as either rural or urban based upon their Metropolitan or Micropolitan Statistical Area (MSA) (created by the CDC). Race, sex, age, education, income, health status (i.e. good, fair, poor), history of smoking, and physical activity were included variables to predict obesity among the rural population. Researchers discovered the prevalence of obesity was significantly greater among rural adults compared to urban (20.4% vs. 17.8%). Rural women and minorities were found to have a higher prevalence of obesity compared to their urban counterparts. Additionally, being male, having less than a high school level education, reporting fair to poor health, and a prior history of smoking were all found to be significant predictors of obesity (Patterson, Moore, Probst, & Shinogle, 2004). However, the use of self-reported data, the cross-sectional design, use of MSA to determine residency, and a small number of survey respondents from rural areas limits the generalizability of these findings. Researchers acknowledged the complex interaction of demographical, cultural, and environmental factors that may affect obesity rates in rural America.

Another sample of 46,396 children from the 2003-2004 National Survey of Children’s Health (NSCH) was assessed to determine if rural residency placed children at a higher risk for becoming obese. NSCH is a telephone survey conducted by the National Center for Health Statistics and collects data in eight domains including: demographics, physical health status, parents’ health, and neighborhood characteristics. Children were separated into urban or rural classification depending up their addresses’ MSA label. Results showed children who were classified as overweight or obese were more likely to live in an MSA-designated rural community (Odds Ratio [OR]=1.3). Rural residency was
associated with a 25% increase of being obese. However, the use of self-reported data, use of MSA to classify children as rural/urban, and various confounding factors limit the broad application of these findings (Lutfiyya, Lipsky, Wisdom-Behounek, Inpanbutr-Martinkus, 2007).

Other researchers have used the NSCH to quantify urban-rural differences in weight status among adolescents. Liu et al. linked the NSCH to the National Center for Health Statistics’ 2003 Area Resource File to match 44,631 respondents, aged 10-17 years, with their county of residence. Urban versus rural residency was based on Urban Influence Codes (UICs) form the United States Department of Agriculture’s Economic Research Service. Analysis found that rural children were more likely to be white, come from low-income households, and have less educated parents. These children were significantly more likely to be overweight (16.5%) compared to urban children (14.3%). When geographic comparisons were made, the South was the only region with a significant higher prevalence of overweight in rural adolescents (19.6%) compared to urban (16.4%). However, social desirability bias due to self-reporting of adolescents’ weight may result in underestimation from other regions (Liu, Bennett, Harun, & Probst, 2008).

Finally, Jackson et al. examined the prevalence of obesity in rural locations using data from 1994-1996 and 2000-2001 CDC Behavioral Risk Factor Surveillance System (BRFSS). BRFSS is a telephone-administered survey that collects self-reported data on height, weight, sex, age, and educational attainment, which were then analyzed. Locations were classified as either urban or rural using Federal Information Processing Standards (FIPS) codes. In addition, rural locations were further divided into three
categories: (1) rural adjacent (to a metropolitan area), (2) large rural nonadjacent (with a city of ≥10,000), and (3) small rural nonadjacent (without a city of ≥10,000). Obesity prevalence was found to be lowest in urban counties and highest in small rural nonadjacent and rural adjacent. Researchers found that large rural nonadjacent counties had prevalence rates similar to urban counties. In addition, obesity prevalence increased within rural counties in every state (except Florida) between 1994-1996 and 2000-2001. Interestingly, while higher educational attainment was related with a lower obesity prevalence in urban counties, this association decreased in magnitude when compared to rural counties (5.1 percentage points lower in urban counties compared to 2 points lower). Overall, rural residency coincided with a higher obesity rates (Jackson, Doescher, Jerant, & Hart, 2005). However, study limitations such as self-reported height/weight, use of home telephone numbers to contact participants, and invisible degree of within-county variation that cannot be accounted for, limit the utility of these findings.

Ample evidence supports the existence of a positive relationship between rural residency and overweight/obesity risk. These findings highlight the complex nature of the obesity epidemic. Interventions must be designed to specifically target the rural child and adolescent population.
The Food Environment

The food environment can be divided into two categories: the community food environment, or the food sources (stores) within a community, and the consumer food environment, the foods available within those sources (Glanz, 2009).

Figure 2.2: The Food Environment (Story et al., 2008)

The community food environment falls under the “Physical environments (settings)” level of the model created by Story et al. to describe the various influences that determine an individual’s diet. The consumer food environment may be considered a subcategory of the same level.

While obesity is typically attributed to individual characteristics, specifically excessive caloric intake coupled with decreased physical activity, research has begun to examine how the external environment may influence weight gain. There are many ways to interpret the food environment. Generally, it defined as the community-level’s food
outlets and resources available to an individual, which includes the food provided from stores, restaurants, schools, and worksites (McKinnon, Reedy, Morrissette, Lytle, & Yaroch, 2009).

**Community Food Environment**

*Food Venue Availability.* Numerous outlet options exist for consumers to procure food items for the home. However, from supermarkets to convenient stores, the availability of healthful and unhealthful foods varies considerably among these venues. Research has found that both low-income and rural communities often have less access to chain supermarkets, generally considered more healthful stores due to a greater availability of fruits, vegetables, and other products (Powell, Slater, Mirtcheva, Bao, & Chaloupka, 2007) (Liese, Weis, Pluto, Smith, & Lawson, 2007). Additionally, there are several factors that influence an individual’s choice in food store such as distance from place of residence and price.

While there exists an abundance of studies on urban environment, limited research exists focusing on the physical makeup of food stores in rural communities. In order to determine the distribution of food outlets by type in rural areas, Liese et al. gathered information from the Licensed Food Service Facilities Database for one county in South Carolina. Store type was verified via ground truthing with verification from secondary data sources of food store addresses. Stores were categorized as either supermarkets, grocery stores, or convenience stores based upon their annual sales and relative availability of food. Of the 77 store identified, 16% were classified as supermarkets, 10% grocery stores, and 74% convenient stores (Liese, Weis, Pluto, Smith, & Lawson, 2007). Results suggest that residents of rural communities have a smaller
availability of stores to choose from and that the variety of foods obtainable in those stores may be considerably less compared to higher-income, urban environments. Other studies have shown that disparities exist across local food environments with regard to food store type and number (Moore & Diez Roux, 2006). The type of food venues available within communities directly influences what stores households are able to shop for food in.

_Food Store Choice._ Other research has focused on why and how community members choose certain stores for food shopping. Cannuscio et al. sought to analyze how individuals living in an urban setting interact with their surrounding food environment. Researchers utilized the Nutrition Environment Measures Survey in Stores (NEMS-S) to assess 373 food stores in West and Southwest Philadelphia. NEMS-S is a tool that takes into account available food items, healthy alternatives to traditional food items, quality of fresh produce, and price to assign each store an individual score. A higher score indicates a food outlet with a greater availability and quality of healthful foods. Stores were divided into six categories: large chain supermarkets, medium-size grocers (nonchain), corner/convenient stores, chain pharmacies, dollar stores, and “other” stores (i.e. butcher shops). After scores were calculated, the research team went door-to-door within the 30 block area the study was conducted to survey residents. Interestingly, researchers discovered that, while 89.3% of those survey indicated that a corner/convenient store was closest to their place of residence, a mere 1% elected to primarily conduct their food shopping there. The majority (94.5%) chose a supermarket as their go-to store for food shopping. Mean NEMS-S scores were significantly higher for respondents’ primary food store choice compared to the outlet closest to their home, indicating that the primary food
purchaser tended to shop at stores that offered a wider range of healthful foods as opposed to shopping where it would be geographically convenient. These results signify that shoppers may be choosing to shop near the home if their local supermarket offers a sufficient diversity of healthful food items. However, this study did not take into account that individuals rarely shop for food at only one location and was conducted in a population dense, urban environment, which may limit its generalizability to rural communities (Cannuscio et al., 2013).

Others have attempted to objectively determine what factors influence shoppers to choose one food store over another. Krukowski et al. worked to develop a questionnaire to assess the primary factors consumers consider when deciding what food outlets to frequent. The Food Store Selection Questionnaire (FSSQ) was developed after an extensive literature review, in-depth discussion amongst research experts, and a pilot test utilizing wide array of community members across Arkansas. The final survey, which totaled 49 items, asked participants to both rate each item on a 5-point scale (1=not important at all, 5=very important) and then to choose the top two reasons (of all items listed) for choosing a particular food store. Reasons often cited as the most important in decision making include low prices, variety and quality of fresh fruits and vegetable, freshness of meat, and store cleanliness. While proximity to place of residence was also listed as an important factor, researchers discovered that there were other reasons consumers found equally, if not more, important. Although the sample size utilized in this study was small (n=100), predominantly female, and only included households without special diet restrictions, researchers effectively showed that there were multiple reasons
primary food purchasers chose specific stores (Krukowski, Sparks, DiCarlo, McSweeney, & Smith West, 2013).

In a similar qualitative study, Krukowski et al. conducted focus groups to assess the primary reasons motivating primary food shoppers to choose specific stores. Additionally, researchers sought to discover if choices differed across racial and geographic demographics. Five focus groups of primary caregivers, both Caucasian and African American from urban and rural communities in Arkansas, were completed. Participants were asked semistructured, open-ended questions, sessions were transcribed, and answers were coded around ten themes. With regards to decisions about where to shop, participants reported that safety, cleanliness of the building, customer service, availability of nonfood products, and brand availability were the five key store characteristic influencing their choice. In addition, proximity to the home, price, food diversity, and quality were also found to be prominent factors. The main difference between rural and urban participants was that primary food purchasers in rural areas believed their communities lacked supermarkets and, therefore, they either had to spend more money at local stores for products they identified as substandard or travel greater distances to neighboring towns to purchase the goods they need (Krukowski, McSweeney, Sparks, & Smith West, 2012). Overall, rural residents may have to conduct a cost-benefit analysis to determine whether or not traveling to nearby communities to shop at larger stores is advantageous.

Food Availability in Stores. While the presence of food stores influences where individuals can and cannot shop, what is specifically available within those stores directly determines what can be purchased and ultimately what is available for consumption in
the home by adolescents. The current body of literature shows that individuals with access to supermarkets have a greater ability to purchase healthful foods compared to those with primary access to convenience stores.

In the same study by Liese et al., researchers also sought to compare the availability of food items between supermarkets, grocery stores, and convenient stores. Foods that were assessed included fruits and vegetables (i.e. apples, cucumbers, oranges, tomatoes), meats/eggs/seafood, canned fish, bread (high-fiber vs. low-fiber), and milk. Not surprisingly, nearly all survey items were available for purchase at supermarkets. Similarly, ten out of the 21 survey items were found in grocery stores; however, the availability of such products was often lower compared to supermarkets. Convenient stores often had none, or only a few, of the items measured in the study. Additionally, convenient stores were often found supply the less healthful version of foods compared to the nutritionally desired version. For example, 85% of convenient stores stocked low-fiber bread compared to only 4% that offered a high-fiber version (Liese, Weis, Pluto, Smith, & Lawson, 2007). As previously discussed, this study found that 74% of all food stores identified were classified as convenient stores. The greater availability of these stores compared to supermarkets has the potential to limit the diversity and healthfulness of food purchased by primary care givers for the home.

Andreyeva et al. assessed the availability and price of both healthy and regular food items across different neighborhoods and store types in New Haven, Connecticut. Researchers utilized NEMS-S to measure the availability, price, and quality of foods within seventy-five stores that agreed to participate. Stores varied between both low-income and high-income neighborhoods. A greater availability of healthful options (i.e.
brown rice, whole-grain pasta) was found in grocery stores compared to convenient stores. Although the majority of stores all carried several healthy food options (i.e. baked potato chips, canned vegetables, bottled water, 100% fruit juice), convenient stores were found to often only carry the regular option of typically foods as opposed to healthier alternatives. Surprisingly, low-income neighborhoods were found to have a greater availability of fruits and vegetables. However, produce quality was discovered to be worse in such areas (Andreyeva, Blumenthal, Schwartz, Long, & Brownell, 2008).

In order to summarize the healthfulness of food stores in the United Kingdom, Black et al. developed a measurement tool that could be used to assign a score to each outlet. Scores were based upon nine unique variables: price, quality, variety, shelf space, store placement, promotion, healthier alternatives, single fruit sale, and nutrition information. After assessing 601 different food stores, researchers concluded that large supermarkets created shopping environments that allow shoppers to select from a variety of healthy options compared to other stores (Black et al., 2014). Overall, it appears that a quantity, variety, and quality of healthful foods vary across different food store types. Certain stores, such as supermarkets, may not be available in particular geographic region, which may worsen dietary intake.

**Nutrition Environment Measures Survey in Stores (NEMS-S)**

The Nutrition Environment Measures Survey in Stores (NEM-S) is a tool used to assess the overall availability of healthful foods compared to unhealthful items within food outlets. NEMS-S takes price, availability, and quality of food into account when evaluating stores. NEMS-S has been show to have a high degree of test-retest and inter-rater reliability (Glanz, Sallis, Saelens, & Frank, 2007).
Numerous studies have used NEM-S to assess stores within the local food environment. Cannuscio et al. showed that convenience and corner stores had the lowest average NEMS-S score compared to other types of food outlets. Researchers also discovered that consumers were most likely to shop at supermarkets near their place of residence if those stores had high NEM-S scores (Cannuscio et al., 2013). A study in rural Minnesota used NEMS-S and to measure the availability of food in 3 grocery stores and five convenience stores. Grocery stores were found to contain a wider variety of healthy alternatives but were not always available at a lower price compared to the less healthy counterpart. Additionally, convenience stores were found to be less likely to stock fruits and vegetables and often did not carry healthier products than those found in grocery stores (Pereira, Sidebottom, Boucher, Lindberg, & Werner, 2014).

Other researchers have utilized NEMS-S to compare measured versus perceived food environment availability. Moore et al. assessed 226 food stores in Baltimore, Maryland with the NEMS-S survey. Individuals who identified as white and had higher levels of education and income were shown to report higher availability of healthy food items in conjunction with higher direct measures of availability via NEMS-S. Individuals who lived in areas with directly measured lower availability, including minorities and those with low educational attainment, often reported lower availability of healthy foods (Moore, Diez Roux, & Franco, 2011).

Additionally, other studies have explored whether demographic factors of the local food environment play a role on availability and price (measured using NEMS-S). Certain research suggests that household income is associated with NEMS-S Availability score. Specifically, high-income neighborhoods may have access to a wider range of
healthy food options compared to lower income areas. However, the quality and price of healthy items was not found to be drastically different when available in both neighborhoods. Although larger stores (i.e. supermarkets) were found to be positively associated with NEMS-S Price score, indicating lower prices for healthier items could be found in these outlets (Krukowski, Smith West, Harvey-Berino, & Prewitt, 2010).

Gustafson et al. focused on how NEMS-S score of an individual’s local food environment impacts their dietary intake. In a study assessing the neighborhood and consumer food environments on dietary outcomes among Supplemental Nutrition Assistance Program (SNAP) participants in Kentucky, researchers found that individuals living within 0.5 miles of a store that had received a high NEMS-S score had greater odds of consuming a daily minimum of one serving of vegetables and five servings of meat. Additionally, those that live within 0.5 miles of a high NEMS-S scoring store had approximately one point higher on diet variety (Gustafson et al., 2012). In another study, Gustafson et al. discovered that shopping at a food store with a high NEMS-S score was associated with lower odds of consuming sugar-sweetened beverages (Gustafson, Christian, Lewis, Moore, & Jilcott, 2013).

Overall, NEMS-S has been used in a multitude of ways and has been show to be both reliable and valid.

**Home Availability Influence on Intake and Weight Status.** The home environment represents the food that is available for consumption within the home (Glanz, 2009). There exists a substantial amount of evidence linking home availability with increased consumption of healthful foods.
Bryant et al. showed that home availability of fruit and vegetable was associated with increased intake amongst African-American mothers and their infants. Participants were recruited from the Infant Care Project, a longitudinal study of African-American mother/infant pairs. Researchers utilized the Exhaustive Home Food Availability Inventory to objectively measure all available food and beverage items with each home. This unique measure scans barcodes of food items in order to obtain descriptions and nutrient information of each item from a previously collected database. Participants’ home environments (n=80 households) were assessed between one to three times, for a total of 218 inventories recorded. In addition, 24-hour diet recalls were obtain from both mother and infant at the initial home visit and later via telephone interview. Findings showed that a higher availability of fruits and vegetables within the home was associated with a greater intake among infants. This study suggests that children’s diet are more dependent upon home food availability compared to adults and, therefore, it may be possible to increase healthful food intake by increasing its presence in the home. Due to the observational nature of this study, causality cannot be inferred (Bryant, Stevens, Wang, Tabak, Borja, & Bentley, 2011).

Couch et al. examined the relationship between the home food environment (HFE), diet quality, and weight status of children. Participants from the Neighborhood Impact on Kids (NIK) study were recruited. Of all households contacted, 669 child-parent pairs (one per household) were included for analysis. At the initial assessment period, in addition to child/parent anthropometric data collection, parents were asked to complete a survey that included demographic information, household-level characteristics (i.e. income, parent’s education level), parenting style/feeding practice, and home food
availability. Survey items were taken from various previously validated scales. Items from the Active Where Parent-Child Survey assessed the home availability of high-calorie/nutrient-poor foods (eight items) and low-calorie/nutrient-dense foods (four items). Later, participants were called on three random days (both weekdays and weekends) to collect 24-hour recalls. During the initial visit, parents were trained to estimate portion sizes. Child-parent pairs completed the recall together. Responses were averaged and analyzed for both calorie/nutrient intake and food group servings. In addition, a Dietary Approaches to Stop Hypertension (DASH) score was calculated based upon actual versus recommended intakes of eight food groups: grains, fruits, vegetables, meat/poultry/fish, eggs, nut/seeds, diary, sweets, and fats/oils. A maximum score of ten was possible for each subgroup with scores closest to 80 representing higher dietary quality.

Results showed a positive association between the home availability of unhealthful food items (i.e. candy, cookies, regular sodas, etc.) and high-calorie beverage intake and a negative association with both fruit and vegetable (F/V) intake and DASH Score. In comparison, HFE availability of healthful food items (i.e. F/V, unsweetened cereals, baked chips, etc.) was found to be positively associated with higher DASH scores. Multivariate analysis showed that the HFE variables examined explained approximately 28% of child BMI variation and 9-21% of child dietary quality variation. This study provides evidence to suggest that changing the HFE may have the ability to positively alter children’s diets quality. However, this study only recruited participants from two major metropolitan areas and participants were highly educated with a
household income of >$50,000, which limits the generalizability of these finding. Self-report bias may of additional concern (Couch, Glanz, Zhou, Sallis, & Saelens, 2014).

A study analyzing data from Project EAT (Eating Among Teens) was conducted to (1) determine if an association existed between parental report of home availability and adolescent intake and (2) to determine if there was an association between parental intake and adolescent intake, with a major focus on fruits, vegetables, diary foods, and soft drinks. Approximately 902 adolescents provided data for typical food intake using the 149-item Youth Adolescent Food Frequency Questionnaire. Parental dietary intake and report of home availability was conducted using the 5-a-Day Power Plus Program survey. Collected data showed that the majority of adolescents and parents were not meeting the daily recommendations of fruits, vegetables, or dairy groups (based upon the Food Pyramid guidelines). Parents reported that fruits and vegetables were usually in the home (90.4%). Intake of fruits and vegetables was positively associated with home availability of these items among adolescent girls but not boys. Among girls, there was an inverse relationship between intake and availability of soft drinks and dairy foods. Additionally, median intake of fruits and vegetables for girls increased when parents stated they consume >4 servings of such foods daily. Sampling method and non-response rate were noted in the published findings of this study (Hanson, Neumark-Sztainer, Eisenberg, Story, & Wall, 2005).

Utilizing data from the 1,130 participants in the Project EAT-I, II, and III studies, researchers attempted to identify modifiable risk factors that were associated with prolonged fruit and vegetable intake into young adulthood. At each interval, participants were asked to complete a survey and food frequency questionnaire (FFQ). The survey
included questions to assess predicted personal, behavioral, and socioenvironmental factors of fruits and vegetable intake and sociodemographic information. Participants were asked to answer questions on a Likert-type scale. The 2007 Willett FFQ was used to determine fruit and vegetable intake at interval III while the youth version was used at intervals I and II. This FFQ assess fruit take with 11 items (nine items on the youth version) and vegetable intake with 26 items (19 items on the youth version). Researchers found that a greater availability of fruits and vegetables in the home and a lower availability of unhealthy food items were both 5-year and 10-year longitudinal predictors of fruit and vegetable consumption in young adulthood. Results indicate that the availability of healthful food items (particularly fruits and vegetables) in the home may influence on adolescent consumption later on in life. Parents play a key role in bringing such food into the home. However, this study assessed broad aspects of healthy eating as opposed to specific items related to fruits and vegetables. In addition, attrition from the original Project Eat sample may have influenced the representativeness of this study (Larson, Laska, Story, & Neumark-Sztainer, 2012).

**Summary**

While obesity rates among children and adolescents have begun to plateau, it remains a prominent public health issue. Obesity is a highly complex issue, possibly affecting various populations more than others. Current research indicates that individuals living in rural locations may be at an increased risk for becoming obese. In addition, more evidence has begun to surface linking the community food environment as another possible mediator. The availability of healthy food outlets has been shown to link healthier dietary intakes and weigh status in some studies, while no association has
been seen in others. A correlation has also been seen between home availability of healthful foods and intake of such foods.

The home environment is dependent upon the foods available for purchase in an individual’s surroundings. Though there have been numerous studies focusing on both the community and home food environments, none have linked the availability of foods in the community with what consumers actually purchase. Therefore, the purpose of this study is to assess the connection between the availability of foods within a low-income, rural community and parental purchases within a one-week period, as well as to determine the association between subsequent home availability and adolescent intake.
Chapter Three: Methodology

Research Design

This study used a cross-sectional survey design. Adolescent-parent (or legal guardian) dyads were contacted via telephone to complete the University of Minnesota Project EAT survey on home availability and eating out behavior as well as the National Health and Nutrition Examination Survey (NHANES) 2009-2010 Dietary Screener Questionnaire to assess the adolescent’s diet. In addition, parents and adolescents were asked to collect receipts from all food-related purchases made within the one-week period of the study.

Subjects

Kentucky adolescents living in either Woodford or Webster County were recruited to participate in this study. School districts in both counties granted permission to post flyers within middle and high schools, distribute an informational flyer in all homeroom classes, and email parents and students about the study. Due to the nature of this study, a convenience sample was utilized.

Eligibility criteria were established for both adolescents and parents prior to recruitment. Adolescents were required to (1) be between the ages of 13-18 years, (2) reside in their county for at least one full year prior to participation, (3) speak English, and (4) could not have any major health conditions that would dramatically influence their dietary intake. Additionally, one parent or legal guardian must have agreed to participate with them. Parents or legal guardians were required to (1) conduct at least 25% of the home’s food shopping, (2) speak English, and (3) have no known major health conditions that would dramatically alter their daily intake, and (4) their adolescent
had to provide assent to participate. If interested, individuals could call or text the principle investigator or complete an online survey to acquire more information on participation. The primary investigator or a trained graduate student reviewed all eligibility criteria for interested participants.

Once eligibility was established, a total of 28 adolescent-parent dyads (n=28) were able and willing to participate. All adolescents were between 13-18 years old and white.

Measurements

Data from this study were obtained using a variety of measurement tools. Adolescents and parents completed several surveys via telephone at the beginning of the study period, which were used to assess self-reported home availability and dietary intake. Also, once food receipts were collected, trained graduate students used the Nutrition Environment Measures Survey (NEMS) to assess store availability of healthful food items.

University of Minnesota Project EAT Survey

Questions from the University of Minnesota (UMN) Project EAT survey were used to capture the perceived home availability of a variety of food items. The Project EAT survey attempts to assess how both the home environment and family influences impact dietary intake, physical activity, and weight-related behaviors among adolescents. The survey asks participants to respond to a variety of statements about at-home food availability (i.e. “I have fruit juice in my home”). Possible responses include: Never, Sometime, Usually, and Always. This study collected data on home availability for the
following food categories: fruits, vegetables, dark bread, chocolate or candy, junk food, chips or salty snacks, milk, fruit juice, and soda pop.

**NHANES 2009-2010 Dietary Screener Questionnaire**

The NHANES 2009-2010 Dietary Screener is a 26-item questionnaire, which was used to assess dietary intake of adolescent participants. Items cover a variety of food and drink categories and estimate consumption frequencies over the previous month. This study utilized the questionnaire to assess intake of fruits and vegetables, added sugars, whole grains (fiber), dairy (calcium), red meat, processed meat, and sugar-sweetened beverages. In addition, responses can be converted into “real world” quantities (i.e. cups, grams, teaspoon, etc.) to further assess dietary intake. The psychometric properties of the screener have been established for the majority of items (but not every item) (National Cancer Institute, 2014).

**Nutrition Environment Measures Survey in Stores (NEMS-S)**

The Nutrition Environment Measures Survey in Stores (NEMS-S) is used to assess and score various food outlets on their availability of healthful food items. NEMS-S takes availability, pricing, and placement of healthy food into account when calculating the score of a particular food outlet. Categories of the survey include: milk, fruits, vegetables, ground beef, hotdogs, frozen dinners, baked goods, beverages, bread, chips, baked chips, and cereal. A greater availability of healthier options within these categories and lower prices for such options leads to an overall increase in the outlet’s NEMS-S Score, with possible scores ranging from -9 to 54. The NEMS-S survey has been utilized in retail outlets, food stores, and restaurants (Nutrition Environment Measures Survey,
n.d.). Previous studies have found a high rate of test-retest and inter-rater reliability (Glanz, Sallis, Saelens, & Frank, 2007).

**Procedures**

Once interested participant eligibility was established, adolescents and parents provided contact information and stated which days/times would be most convenient for them to complete both the University of Minnesota Project EAT survey and the NHANES 2009-2010 Dietary Screener Questionnaire. A trained research assistant administered each survey via telephone to both adolescent and parent, respectively. Phone surveys took approximately 30-40 minutes per participant to complete. Responses were recorded using Research Electronic Data Capture (REDCap) (Harris, Taylor, Thielke, Payne, Gonzalez, & Conde, 2009).

The primary care giver was instructed to keep all receipts related to food purchases (i.e. food stores, restaurants, fast-food chains) during the one-week duration of the study. Additionally, participants were given a both a GPS device to wear and travel diary to record where they purchased food, a description of the food, time of day, and whom they were with at the time of purchase. Information regarding stores names from the travel diary and location via the GPS device was utilized to identify specific food stores visited by participants. Once stores were identified, a trained research assistant went to each respective store to complete the NEMS-S survey and subsequently calculate each stores NEMS Score.

At the end of the week, the primary care giver was provided with an envelope to mail all collected receipts and travel logs. Graduate research assistants analyzed and coded all survey responses and food purchases (via store receipts).
Data Analysis

Demographic information, including age, race, gender, and income, was collected from all study participants. Dietary intake, BMI, and age were treated as continuous variables. Demographic characteristics, food behaviors, and frequency of shopping was dichotomized and treated as categorical variables. Multivariate regression analysis was used to compare NEMS-S Score and in-store availability of assessed food items to both purchase behaviors and predicted nutrient intake. The correlation between in-store availability of food items and purchase behaviors were assessed using Pearson R Coefficients. A significance level of 0.05 (α=0.05) was used. STATA data analysis and statistical software version 12.1 was used to analyze the data.
Chapter Four: Results

A total of 28 eligible adolescents were recruited to participate in this study. Descriptive statistics were obtained for the study sample (Table 4.1). Of all adolescent subjects, 32% were male (n=9) and 68% were female (n=19). Mean age was 14.4 years ± 0.56 for male participants and 15.1 years ± 0.41 for female participants (p=0.36).

Of male participants, 63% were normal weight, 25% were overweight, and 13% were obese. In comparison, 58% of female participants were normal weight, 37% were overweight, and 5% were obese. There was no significant difference in BMI distribution between genders (p=0.72).

There was a significant difference in adolescent fiber consumption (p=0.0004) with male adolescents consuming an average of 17.5 ± 2.03 grams/day and female adolescents consuming 11.1 ± 0.45 grams/day. Additionally, a statistically significant difference in calcium consumption was observed with males consuming 1547 ± 233.24 mg/day and females consuming 781.1 ± 52.86 mg/day. Males were also found to consume more fruits and vegetables, other than French fries, (3 ± 0.4 cups) compared to females (1.8 ± 0.17) (p=0.004). Other dietary habit categories were not found to be statistical significant. Males consumed an average of 17.3 ± 5.06 teaspoons of added sugar per day and females consumed 15.2 ± 1.72 teaspoons/day (p=0.48). Average intake of whole grains was 1.2 ± 0.63 oz/day for male and 0.5 ± 0.08 oz/day for females (p=0.09). Finally, average intake of added sugars from sugar-sweetened beverages (SSBs) was 9.5 ± 5.01 teaspoons/day for males and 8.6 ± 1.79 teaspoons/day for females (p=0.83). Parents were also asked to complete the NHANES 2009-2010 Dietary Screener Questionnaire and dietary habits were calculated.
In addition to dietary habits, adolescents were also asked about frequency of family meals and how often they assist with grocery shopping. Among male participants, 11.1% reported having family meals 1-2 times per week, 22.2% reported 3-4 times per week, 11.1% reported 5-6 times per week, and 55.6% reporting having family meals 7 or more times per week. In comparison, among female participants, 5.3% reported family meals 1-2 times per week, 26.3% between 3-4 times per week, 21.1% between 5-6 times per week, and 47.4% of 7 or more times per week. There was no significant difference in frequency of family meals between males and females (p=0.8606). In terms of assisting with grocery shopping, 33.3% of male never assisted with shopping during the previous week, 55.6% assisted once, and 11.1% assisted more than one time. 36.8% of females did not assist with grocery shopping the previous week before the survey, 31.6% assisted once, and 31.6% assisted more than once.
Table 4.1: Study Sample Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Adolescent</th>
<th>Parent</th>
<th>p-value*</th>
<th>Total of Parent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male (N=9)</td>
<td>Female (N=19)</td>
<td></td>
<td>(N=25)</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>14.4 (0.56)</td>
<td>15.1 (0.41)</td>
<td>0.36</td>
<td>44.2 (6.25)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Body Mass Index</td>
<td></td>
<td></td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>63%</td>
<td>58%</td>
<td></td>
<td>46%</td>
</tr>
<tr>
<td>Overweight</td>
<td>25%</td>
<td>37%</td>
<td></td>
<td>41%</td>
</tr>
<tr>
<td>Obese</td>
<td>13%</td>
<td>5%</td>
<td></td>
<td>14%</td>
</tr>
<tr>
<td>Dietary Habits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiber (g) range 8.1-28.6</td>
<td>17.5 (2.03)</td>
<td>11.1 (0.45)</td>
<td>0.0004</td>
<td>14.8 (3.99)</td>
</tr>
<tr>
<td>Calcium (mg) range 500-2763</td>
<td>1547 (233.24)</td>
<td>781.1 (52.86)</td>
<td>0.0012</td>
<td>961.2 (463.28)</td>
</tr>
<tr>
<td>Added sugars (tsp) range 3.1-55</td>
<td>17.3 (5.06)</td>
<td>15.2 (1.72)</td>
<td>0.48</td>
<td>13.8 (7.15)</td>
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<tr>
<td>Whole grain (oz) range 0.1 - 5.8</td>
<td>1.2 (0.63)</td>
<td>0.5 (0.08)</td>
<td>0.09</td>
<td>0.6 (0.48)</td>
</tr>
<tr>
<td>Fruit/Veg minus french fries (cups) range 0.5-4.8</td>
<td>3 (0.4)</td>
<td>1.8 (0.17)</td>
<td>0.004</td>
<td>2.5 (0.71)</td>
</tr>
<tr>
<td>Added Sugar from SSB (tsp) range 0 - 49</td>
<td>9.5 (5.01)</td>
<td>8.6 (1.79)</td>
<td>0.83</td>
<td>7.2 (7.69)</td>
</tr>
<tr>
<td>Family Meals prepared each week</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 or more</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>60.00%</td>
</tr>
<tr>
<td>5-6</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>24.00%</td>
</tr>
<tr>
<td>3-4</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>16.00%</td>
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<tr>
<td>1-2</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.00%</td>
</tr>
<tr>
<td>Family Meals eaten per week</td>
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<td></td>
<td>0.8606</td>
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</tr>
<tr>
<td>1-2</td>
<td>11.10%</td>
<td>5.30%</td>
<td></td>
<td>8.00%</td>
</tr>
<tr>
<td>3-4</td>
<td>22.20%</td>
<td>26.30%</td>
<td></td>
<td>20.00%</td>
</tr>
<tr>
<td>5-6</td>
<td>11.10%</td>
<td>21.10%</td>
<td></td>
<td>32.00%</td>
</tr>
<tr>
<td>7 or more</td>
<td>55.60%</td>
<td>47.40%</td>
<td></td>
<td>40.00%</td>
</tr>
<tr>
<td>Assist with grocery shopping in the past week/Adolescent was with parent grocery shopping</td>
<td></td>
<td></td>
<td>0.3794</td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>33.30%</td>
<td>36.80%</td>
<td></td>
<td>32.00%</td>
</tr>
<tr>
<td>One time</td>
<td>55.60%</td>
<td>31.60%</td>
<td></td>
<td>48.00%</td>
</tr>
<tr>
<td>More than one time</td>
<td>11.10%</td>
<td>31.60%</td>
<td></td>
<td>20.00%</td>
</tr>
<tr>
<td>Fast-Food for dinner</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>N/A</td>
<td>N/A</td>
<td>42.86%</td>
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<tr>
<td>1-2 times/month</td>
<td>N/A</td>
<td>N/A</td>
<td>42.86%</td>
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<tr>
<td>1 time/week</td>
<td>N/A</td>
<td>N/A</td>
<td>14.29%</td>
<td></td>
</tr>
<tr>
<td>2-3 times/week</td>
<td>N/A</td>
<td>N/A</td>
<td>14.29%</td>
<td></td>
</tr>
<tr>
<td>Fast-food on weekends</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>N/A</td>
<td>N/A</td>
<td>16%</td>
<td></td>
</tr>
<tr>
<td>1-2 times/month</td>
<td>N/A</td>
<td>N/A</td>
<td>36%</td>
<td></td>
</tr>
<tr>
<td>1 time/week</td>
<td>N/A</td>
<td>N/A</td>
<td>32%</td>
<td></td>
</tr>
<tr>
<td>2-3 times/week or every day</td>
<td>N/A</td>
<td>N/A</td>
<td>16%</td>
<td></td>
</tr>
</tbody>
</table>

*P-value is obtained using the Chi-Square test of independence. Caution should be used when sample size is small.
Results for perceived home availability, as assessed using the University of Minnesota Project EAT survey, are shown in Table 4.2. Among adolescents, the majority reported that they “Always” had access to fruits and vegetables and potato chips or salty snacks (64.3% and 35.7%, respectively). Additionally, the bulk of participants reported that they “Usually” had access to junk food (42.9%) but only “Sometimes” had access to fruit juice (42.9%), chocolate or other candy (50.0%), soda pop (35.7%), and dark bread (35.7%).

Table 4.2: Descriptive of home availability among KY adolescents

<table>
<thead>
<tr>
<th></th>
<th>Male (N=9)</th>
<th>Female (N=19)</th>
<th>Total of Adolescents (N=28)</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruits and vegetables available in the home</td>
<td></td>
<td></td>
<td></td>
<td>0.399</td>
</tr>
<tr>
<td>Sometimes</td>
<td>0 (0.0%)</td>
<td>3 (15.8%)</td>
<td>3 (10.7%)</td>
<td></td>
</tr>
<tr>
<td>Usually</td>
<td>2 (22.2%)</td>
<td>5 (26.3%)</td>
<td>7 (25.0%)</td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>7 (77.8%)</td>
<td>11 (57.9%)</td>
<td>18 (64.3%)</td>
<td></td>
</tr>
<tr>
<td>Junk food available in home</td>
<td></td>
<td></td>
<td></td>
<td>0.1203</td>
</tr>
<tr>
<td>Sometimes</td>
<td>4 (44.4%)</td>
<td>2 (10.5%)</td>
<td>6 (21.4%)</td>
<td></td>
</tr>
<tr>
<td>Usually</td>
<td>3 (33.3%)</td>
<td>9 (47.4%)</td>
<td>12 (42.9%)</td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>2 (22.2%)</td>
<td>8 (42.1%)</td>
<td>10 (35.7%)</td>
<td></td>
</tr>
<tr>
<td>Fruit juice availability in home</td>
<td></td>
<td></td>
<td></td>
<td>0.0146</td>
</tr>
<tr>
<td>Sometimes</td>
<td>1 (11.1%)</td>
<td>11 (57.9%)</td>
<td>12 (42.9%)</td>
<td></td>
</tr>
<tr>
<td>Usually</td>
<td>1 (11.1%)</td>
<td>4 (21.1%)</td>
<td>5 (17.9%)</td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>7 (77.8%)</td>
<td>4 (21.1%)</td>
<td>11 (39.3%)</td>
<td></td>
</tr>
<tr>
<td>Potato chips or salty snacks availability in home</td>
<td></td>
<td></td>
<td></td>
<td>0.0533</td>
</tr>
<tr>
<td>Never</td>
<td>2 (22.2%)</td>
<td>2 (10.5%)</td>
<td>4 (14.3%)</td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>4 (44.4%)</td>
<td>2 (10.5%)</td>
<td>6 (21.4%)</td>
<td></td>
</tr>
<tr>
<td>Usually</td>
<td>0 (0.0%)</td>
<td>8 (42.1%)</td>
<td>8 (28.6%)</td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>3 (33.3%)</td>
<td>7 (36.8%)</td>
<td>10 (35.7%)</td>
<td></td>
</tr>
</tbody>
</table>
Table 4.2 (continued)

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total of Adolescents</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N=9)</td>
<td>(N=19)</td>
<td>(N=28)</td>
<td></td>
</tr>
<tr>
<td><strong>Chocolate or other candy availability in home</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.301</td>
</tr>
<tr>
<td>Never</td>
<td>2 (22.2%)</td>
<td>1 (5.3%)</td>
<td>3 (10.7%)</td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>5 (55.6%)</td>
<td>9 (47.4%)</td>
<td>14 (50.0%)</td>
<td></td>
</tr>
<tr>
<td>Usually</td>
<td>0 (0.0%)</td>
<td>4 (21.1%)</td>
<td>4 (14.3%)</td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>2 (22.2%)</td>
<td>5 (26.3%)</td>
<td>7 (25.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Soda pop availability in home</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.0258</td>
</tr>
<tr>
<td>Never</td>
<td>3 (33.3%)</td>
<td>1 (5.3%)</td>
<td>4 (14.3%)</td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>5 (55.6%)</td>
<td>5 (26.3%)</td>
<td>10 (35.7%)</td>
<td></td>
</tr>
<tr>
<td>Usually</td>
<td>0 (0.0%)</td>
<td>8 (42.1%)</td>
<td>8 (28.6%)</td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>1 (11.1%)</td>
<td>5 (26.3%)</td>
<td>6 (21.4%)</td>
<td></td>
</tr>
<tr>
<td><strong>Dark bread availability in home</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.4076</td>
</tr>
<tr>
<td>Never</td>
<td>0 (0.0%)</td>
<td>2 (10.5%)</td>
<td>2 (7.1%)</td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>2 (22.2%)</td>
<td>8 (42.1%)</td>
<td>10 (35.7%)</td>
<td></td>
</tr>
<tr>
<td>Usually</td>
<td>3 (33.3%)</td>
<td>5 (26.3%)</td>
<td>8 (28.6%)</td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>4 (44.4%)</td>
<td>4 (21.1%)</td>
<td>8 (28.6%)</td>
<td></td>
</tr>
</tbody>
</table>

*p-value is obtained using the Chi-Square test of independence. Caution should be used when sample size is small.
Table 4.3 shows the relationship between family meals per week, neighborhood food resources in the primary care giver’s travel pattern, and food store selection with dietary intake among both adolescents and parents. No significant associations were found between any variables.

Table 4.3: Family Meals and Neighborhood Food Resources in travel pattern and the association with dietary intake among adolescents and parents

<table>
<thead>
<tr>
<th></th>
<th>Fiber β</th>
<th>95% CI</th>
<th>Calcium β</th>
<th>95% CI</th>
<th>Added Sugar (tsp) β</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Family Meals per week</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n=53)</td>
<td>0.5</td>
<td>(-1.18, 2.17)</td>
<td>-39.6</td>
<td>(-221.67, 142.46)</td>
<td>3.32</td>
<td>(-0.84, 7.49)</td>
</tr>
<tr>
<td><strong>Food Resources in travel pattern (n=15)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convenience/Pharmacy</td>
<td>0.11</td>
<td>(-0.14, 0.35)</td>
<td>-5.77</td>
<td>(-31.25, 19.71)</td>
<td>0.11</td>
<td>(-0.32, 0.54)</td>
</tr>
<tr>
<td>Fast-food</td>
<td>0.04</td>
<td>(-0.05, 0.13)</td>
<td>-2.13</td>
<td>(-11.43, 7.17)</td>
<td>0.02</td>
<td>(-0.14, 0.18)</td>
</tr>
<tr>
<td>Gas station</td>
<td>0.15</td>
<td>(-0.23, 0.53)</td>
<td>-13.02</td>
<td>(-51.49, 25.44)</td>
<td>0.08</td>
<td>(-0.55, 0.72)</td>
</tr>
<tr>
<td>Grocery/Supermarket</td>
<td>0.04</td>
<td>(-0.21, 0.29)</td>
<td>-10.21</td>
<td>(-34.90, 14.48)</td>
<td>0.14</td>
<td>(-0.28, 0.56)</td>
</tr>
<tr>
<td>Other restaurant</td>
<td>0.01</td>
<td>(-0.03, 0.06)</td>
<td>-1.73</td>
<td>(-6.27, 2.81)</td>
<td>0.03</td>
<td>(-0.05, 0.11)</td>
</tr>
<tr>
<td><strong>Food Store Selection</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grocery/Supermarket</td>
<td>-2.46</td>
<td>(-9.82, 4.90)</td>
<td>-268.74</td>
<td>(-1005.71, 488.22)</td>
<td>0.24</td>
<td>(-12.71, 13.20)</td>
</tr>
<tr>
<td>Fast-food</td>
<td>2.22</td>
<td>(-3.85, 8.28)</td>
<td>-431.41</td>
<td>(-983.31, 120.49)</td>
<td>-3.4</td>
<td>(-13.89, 7.08)</td>
</tr>
<tr>
<td>Gas station</td>
<td>1.7</td>
<td>(-4.07, 7.46)</td>
<td>-41.58</td>
<td>(-633.28, 550.12)</td>
<td>3.25</td>
<td>(-6.36, 12.85)</td>
</tr>
<tr>
<td>Table 4.3 (continued)</td>
<td>Whole Grain (oz)</td>
<td>Fruit/Veg minus FF</td>
<td>Sugar from SSB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------</td>
<td>-------------------</td>
<td>--------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>β</td>
<td>95% CI</td>
<td>β</td>
<td>95% CI</td>
<td>β</td>
<td>95% CI</td>
</tr>
<tr>
<td><strong>Family Meals per</strong></td>
<td>0.25</td>
<td>(-0.23, 0.72)</td>
<td>-0.12</td>
<td>(-0.48, 0.23)</td>
<td>2.91</td>
<td>(-1.18, 6.99)</td>
</tr>
<tr>
<td><strong>week (n=53)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Food Resources in</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>travel pattern (n=15)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convenience/Pharmacy</td>
<td>-0.01</td>
<td>(-0.06, 0.06)</td>
<td>0.01</td>
<td>(-0.05, 0.07)</td>
<td>0.15</td>
<td>(-0.25, 0.55)</td>
</tr>
<tr>
<td>Fast-food</td>
<td>0.002</td>
<td>(-0.02, 0.02)</td>
<td>0.002</td>
<td>(-0.02, 0.02)</td>
<td>0.03</td>
<td>(-0.12, 0.18)</td>
</tr>
<tr>
<td>Gas station</td>
<td>-0.01</td>
<td>(-0.10, 0.08)</td>
<td>0.005</td>
<td>(-0.08, 0.09)</td>
<td>0.04</td>
<td>(-0.56, 0.65)</td>
</tr>
<tr>
<td>Grocery/Supermarket</td>
<td>0.0003</td>
<td>(-0.06, 0.06)</td>
<td>-0.003</td>
<td>(-0.06, 0.06)</td>
<td>0.18</td>
<td>(-0.21, 0.57)</td>
</tr>
<tr>
<td>Other restaurant</td>
<td>0.0009</td>
<td>(-0.01, 0.01)</td>
<td>0.00006</td>
<td>(-0.01, 0.01)</td>
<td>0.03</td>
<td>(-0.04, 0.11)</td>
</tr>
<tr>
<td><strong>Food Store Selection</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grocery/Supermarket</td>
<td>0.23</td>
<td>(-1.55, 2.01)</td>
<td>-0.41</td>
<td>(-2.16, 1.34)</td>
<td>1.63</td>
<td>(-10.64, 13.90)</td>
</tr>
<tr>
<td>Fast-food</td>
<td>0.47</td>
<td>(-0.97, 1.91)</td>
<td>-0.63</td>
<td>(-2.04, 0.77)</td>
<td>-7.11</td>
<td>(-16.15, 1.92)</td>
</tr>
<tr>
<td>Gas station</td>
<td>-0.26</td>
<td>(-1.64, 1.11)</td>
<td>0.06</td>
<td>(-1.28, 1.41)</td>
<td>-0.36</td>
<td>(-9.71, 8.99)</td>
</tr>
</tbody>
</table>
Table 4.3 (continued)

<table>
<thead>
<tr>
<th></th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
</tr>
<tr>
<td><strong>Family Meals per week (n=53)</strong></td>
<td>-0.79</td>
</tr>
<tr>
<td><strong>Food Resources in travel pattern (n=15)</strong></td>
<td></td>
</tr>
<tr>
<td>Convenience/Pharmacy</td>
<td>-0.01</td>
</tr>
<tr>
<td>Fast-food</td>
<td>-0.004</td>
</tr>
<tr>
<td>Gas Station</td>
<td>-0.02</td>
</tr>
<tr>
<td>Grocery/Supermarket</td>
<td>-0.04</td>
</tr>
<tr>
<td>Other restaurant</td>
<td>-0.007</td>
</tr>
<tr>
<td><strong>Food Store Selection</strong></td>
<td></td>
</tr>
<tr>
<td>Grocery/Supermarket</td>
<td>-0.63</td>
</tr>
<tr>
<td>Fast-food</td>
<td>-1.69</td>
</tr>
<tr>
<td>Gas station</td>
<td>-0.55</td>
</tr>
</tbody>
</table>

*Linear regression controlling for age (no residency because all of the data are from KY)
Table 4.4 depicts fast food purchasing habits for parents and the association with diet for both parents and adolescents. For parents, having fast food for dinner approximately one time/week (per parental report) increased consumption of added sugars by 14.18 (95% CI: 2.52, 25.84) teaspoons and sugars from SSB by 15.73 (95% CI: 3.26, 28.19) teaspoons. Consuming fast food for dinner 1-2 times/month and 1-2 times/week was not found to be significantly associated with any changes in dietary intake. Several associations were found between fast food consumption on weekends with dietary intake of parents. Having fast food 1-2 times/month was associated with consuming 503.93 (95% CI: -968.03, -40.84) less milligrams of calcium, on average. Individuals who ate at a fast food establishment 1 time/week on the weeks consumed -5.27 (95% CI: -9.82, -0.73) less grams of fiber, 0.66 (95% CI: -1.26, -0.06) less grams of fiber, and 0.93 (95% CI: -1.74, -0.11) less servings of fruits and vegetables (not including French fries). Finally, parents who ate fast food 2-3 times/week or everyday (on the weekends) consumed, on average, 6.97 (95% CI: -12.22, -1.71) less grams of fiber, 702.03 (95% CI: -1264.88, -139.17) less milligrams of calcium, 11.56 (95% CI: 2.81, 20.32) more teaspoons of added sugars, 1.13 (95% CI: -2.07, -0.19) less servings of fruits and vegetables, and 13.51 (95% CI: 4.85, 22.17) more teaspoons of sugar from SSB.

Only one association was found between fast food purchasing habits and adolescent dietary intake. Parents who reported having fast food for dinner 1 time/week had adolescents who consumed 21.24 (95% CI: 4.98, 37.51) more grams of fiber.
Table 4.4: Fast-food purchasing habits for meals among parents and the association with diet among parents and adolescents

<table>
<thead>
<tr>
<th>Fast-food for dinner**</th>
<th>Fiber (g)</th>
<th>Calcium (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>1-2 times/month</td>
<td>1.35</td>
<td>(-5.27, 7.96)</td>
</tr>
<tr>
<td>1 time/week</td>
<td>-3.39</td>
<td>(-12.22, 5.44)</td>
</tr>
<tr>
<td>2-3 times/week</td>
<td>6.56</td>
<td>(-4.47, 17.59)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fast-food on weekends**</th>
<th>Fiber (g)</th>
<th>Calcium (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>1-2 times/month</td>
<td>-3.88</td>
<td>(-8.20, 0.44)</td>
</tr>
<tr>
<td>1 time/week</td>
<td>-5.27*</td>
<td>(-9.82, -0.73)</td>
</tr>
<tr>
<td>2-3 times/week or everyday</td>
<td>-6.97*</td>
<td>(-12.22, -1.71)</td>
</tr>
</tbody>
</table>

Table 4.4 (continued)

<table>
<thead>
<tr>
<th>Fast-food for dinner**</th>
<th>Added Sugars (tsp)</th>
<th>Whole Grain (oz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>1-2 times/month</td>
<td>-1.01</td>
<td>(-9.75, 7.72)</td>
</tr>
<tr>
<td>1 time/week</td>
<td>14.18*</td>
<td>(2.52, 25.84)</td>
</tr>
<tr>
<td>2-3 times/week</td>
<td>-1.38</td>
<td>(-15.94, 13.19)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fast-food on weekends**</th>
<th>Added Sugars (tsp)</th>
<th>Whole Grain (oz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>1-2 times/month</td>
<td>3.63</td>
<td>(-3.57, 10.84)</td>
</tr>
<tr>
<td>1 time/week</td>
<td>2.33</td>
<td>(-5.25, 9.92)</td>
</tr>
<tr>
<td>2-3 times/week or everyday</td>
<td>11.56*</td>
<td>(2.81, 20.32)</td>
</tr>
</tbody>
</table>
Table 4.4 (continued)

<table>
<thead>
<tr>
<th></th>
<th>Fruit/Veg minus FF</th>
<th>Sugar from SSB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fast-food for dinner</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>1-2 times/month</td>
<td>0.22 (-0.90, 1.33)</td>
<td>0.59 (-8.75, 9.92)</td>
</tr>
<tr>
<td>1 time/week</td>
<td>-0.75 (-2.23, 0.74)</td>
<td>15.73* (3.26, 28.19)</td>
</tr>
<tr>
<td>2-3 times/week</td>
<td>0.88 (-0.98, 2.74)</td>
<td>0.85 (-14.71, 16.42)</td>
</tr>
<tr>
<td><strong>Fast-food on weekends</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>1-2 times/month</td>
<td>-0.37 (-1.15, 0.41)</td>
<td>4.59 (-2.54, 11.71)</td>
</tr>
<tr>
<td>1 time/week</td>
<td>-0.93* (-1.74, -0.11)</td>
<td>3.00 (-4.49, 10.50)</td>
</tr>
<tr>
<td>2-3 times/week or everyday</td>
<td>-1.13* (-2.07, -0.19)</td>
<td>13.51* (4.85, 22.17)</td>
</tr>
</tbody>
</table>

*Indicates p-value <0.05

** Parent linear regression models controlled for age and residency.

***The linear regression model is to examine the association between the predictor and adolescent dietary outcomes, controlling for parents' age and residency.
As shown in Table 4.5, food store resources within the community and food store selections were not associated with any changes in the frequency of family meals.

Table 4.5: Neighborhood food resources and the association with family meals

<table>
<thead>
<tr>
<th>Food Resources</th>
<th>β</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convenience/Pharmacy</td>
<td>0.02</td>
<td>(-0.05, 0.09)</td>
</tr>
<tr>
<td>Fast-food</td>
<td>0.005</td>
<td>(-0.02, 0.03)</td>
</tr>
<tr>
<td>Gas Station</td>
<td>0.01</td>
<td>(-0.08, 0.12)</td>
</tr>
<tr>
<td>Grocery/Supermarket</td>
<td>0.01</td>
<td>(-0.06, 0.08)</td>
</tr>
<tr>
<td>Other restaurant</td>
<td>0.003</td>
<td>(-0.01, 0.02)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food Store Selection</th>
<th>β</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grocery/Supermarket</td>
<td>0.5</td>
<td>(-1.62, 2.61)</td>
</tr>
<tr>
<td>Fast-food</td>
<td>1.2</td>
<td>(-0.37, 2.78)</td>
</tr>
<tr>
<td>Gas station</td>
<td>-0.46</td>
<td>(-2.05, 1.13)</td>
</tr>
</tbody>
</table>

*Linear regression controlling for age, no residency because all of the data are from KY. Family meals outcome was treated as ordinal variable 0: 0 meals, 1: 1-2 meals, 2: 3-4 meals, 3: 5-6 meals, 4: 7 meals, 5: >7 meals.*
Table 4.6 reports the results for the association between the healthfulness of the store (NEMS-S score) with purchasing habits among parents. Higher NEMS-S score was only associated with increased purchases of fruit drinks (0.36 [95% CI: 0.01, 0.70]). F/V score was not found to be associated with purchasing habits of any food category. Greater junk food availability in store was associated with increased purchases of fried potatoes (0.28 [95% CI: 0.09, 0.47]), candy (0.19 [95% CI: 0.10, 0.29]), pastries (0.23 [95% CI: 0.04, 0.43]), and baked goods (0.26 [95% CI: 0.11, 0.40]). Fruit juice availability was associated with higher purchases of juice (0.14 [95% CI: 0.02, 0.27]). High snack availability was found to be linked to increased purchases of soda (0.21 [95% CI: 0.06, 0.37]), fried potatoes (0.40 [95% CI: 0.12, 0.68]), candy (0.27 [95% CI: 0.12, 0.42]), pastries (0.32 [95% CI: 0.04, 0.61]), and baked goods (0.30 [95% CI: 0.07, 0.52]). Candy availability was discovered to be associated with fried potatoes (0.38 [95% CI: 0.12, 0.64]) and pastries (0.29 [95% CI: 0.02, 0.56]). Finally, soda availability was found to be associated with higher purchases of other potatoes (0.21 [95% CI: 0.02, 0.40]) and pastries (0.33 [95% CI: 0.10, 0.55]).

Multiple linear regression analyses were also conducted to determine predicted nutrient intake based upon NEMS-S score, F/V score, and in-store availability, while controlling for gender and age (Table 6). A greater availability of fruits and vegetables within stores was found to be associated with 0.03 (95% CI: -0.05, -0.01) less teaspoons of sugar intake. Increased predicted sugar intake was found with greater availability of junk food (0.03 [95% CI: 0.003, 0.06]), candy (0.05 [95% CI: 0.02, 0.09]), and soda (0.05 [95% CI: 0.02, 0.08]). NEMS-S score, F/V score, and in-store availability was not found to be associated with BMI.
Table 4.6: NEMS-S Score, F/V Score, and store availability and the association with food store purchases.

<table>
<thead>
<tr>
<th></th>
<th>Soda</th>
<th>Juice</th>
<th>Fruit Drink</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEMS-S Score</td>
<td>0.12 (-0.28, 0.47)</td>
<td>0.09 (-0.28, 0.47)</td>
<td>0.36 (0.01, 0.70)*</td>
</tr>
<tr>
<td>F/V Score</td>
<td>-0.04 (-0.19, 0.11)</td>
<td>-0.06 (-0.23, 0.10)</td>
<td>-0.03 (-0.18, 0.17)</td>
</tr>
<tr>
<td>F/V Availability</td>
<td>-0.11 (-0.20, -0.02)*</td>
<td>0.01 (-0.09, 0.11)</td>
<td>-0.04 (-0.16, 0.07)</td>
</tr>
<tr>
<td>Junk Food Availability</td>
<td>0.08 (-0.04, 0.20)</td>
<td>-0.02 (-0.14, 0.11)</td>
<td>0.03 (-0.11, -0.17)</td>
</tr>
<tr>
<td>Fruit Juice Availability</td>
<td>-0.08 (-0.21, 0.05)</td>
<td>0.14 (0.02, 0.27)*</td>
<td>0.11 (-0.04, 0.26)</td>
</tr>
<tr>
<td>Snack Availability</td>
<td>0.21 (0.06, 0.37)*</td>
<td>-0.09 (-0.27, 0.09)</td>
<td>0.02 (-0.18, 0.23)</td>
</tr>
<tr>
<td>Candy Availability</td>
<td>0.11 (-0.05, 0.27)</td>
<td>0.06 (-0.10, 0.23)</td>
<td>0.09 (-0.10, 0.28)</td>
</tr>
<tr>
<td>Pop Availability</td>
<td>0.24 (0.13, 0.35)</td>
<td>-0.04 (-0.19, 0.11)</td>
<td>0.10 (-0.06, 0.27)</td>
</tr>
</tbody>
</table>

Table 4.6 (continued)

<table>
<thead>
<tr>
<th></th>
<th>Fruit</th>
<th>Fried Potato</th>
<th>Other Potato</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEMS-S Score</td>
<td>0.14 (-0.28, 0.56)</td>
<td>-0.01 (-0.69, 0.71)</td>
<td>0.40 (-0.11, 0.90)</td>
</tr>
<tr>
<td>F/V Score</td>
<td>0.15 (-0.02, 0.33)</td>
<td>-0.17 (-0.47, 0.13)</td>
<td>0.05 (-0.19, 0.29)</td>
</tr>
<tr>
<td>F/V Availability</td>
<td>0.03 (-0.08, 0.14)</td>
<td>-0.06 (-0.24, 0.12)</td>
<td>-0.06 (-0.20, 0.07)</td>
</tr>
<tr>
<td>Junk Food Availability</td>
<td>-0.03 (-0.17, 0.10)</td>
<td>0.28 (0.09, 0.47)*</td>
<td>-0.12 (-0.28, 0.05)</td>
</tr>
<tr>
<td>Fruit Juice Availability</td>
<td>-0.08 (-0.22, 0.06)</td>
<td>0.20 (-0.03, 0.43)</td>
<td>-0.11 (-0.29, 0.07)</td>
</tr>
<tr>
<td>Snack Availability</td>
<td>-0.01 (-0.21, 0.18)</td>
<td>0.40 (0.12, 0.68)*</td>
<td>0.06 (-0.19, 0.30)</td>
</tr>
<tr>
<td>Candy Availability</td>
<td>0.08 (-0.10, 0.26)</td>
<td>0.38 (0.12, 0.64)*</td>
<td>0.06 (-0.17, 0.29)</td>
</tr>
<tr>
<td>Pop Availability</td>
<td>0.01 (-0.16, 0.17)</td>
<td>0.06 (-0.21, 0.33)</td>
<td>0.21 (0.02, 0.40)*</td>
</tr>
</tbody>
</table>

Table 4.6 (continued)

<table>
<thead>
<tr>
<th></th>
<th>Grains</th>
<th>Vegetables</th>
<th>Candy</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEMS-S Score</td>
<td>-0.06 (-0.55, 0.43)</td>
<td>-0.04 (-0.43, 0.35)</td>
<td>0.23 (-0.13, 0.58)</td>
</tr>
<tr>
<td>F/V Score</td>
<td>0.01 (-0.21, 0.23)</td>
<td>0.13 (-0.04, 0.29)</td>
<td>0.01 (-0.16, 0.17)</td>
</tr>
<tr>
<td>F/V Availability</td>
<td>0.14 (0.00, 0.28)</td>
<td>0.07 (-0.05, 0.18)</td>
<td>-0.02 (-0.13, 0.08)</td>
</tr>
<tr>
<td>Junk Food Availability</td>
<td>-0.08 (-0.26, 0.11)</td>
<td>-0.04 (-0.18, 0.11)</td>
<td>0.19 (0.10, 0.29)*</td>
</tr>
<tr>
<td>Fruit Juice Availability</td>
<td>-0.02 (-0.22, 0.19)</td>
<td>-0.02 (-0.18, 0.14)</td>
<td>0.01 (-0.13, 0.15)</td>
</tr>
<tr>
<td>Snack Availability</td>
<td>-0.07 (-0.34, 0.20)</td>
<td>-0.09 (-0.30, 0.11)</td>
<td>0.27 (0.12, 0.42)*</td>
</tr>
<tr>
<td>Candy Availability</td>
<td>-0.03 (-0.28, 0.23)</td>
<td>-0.05 (-0.24, 0.15)</td>
<td>0.18 (0.02, 0.34)*</td>
</tr>
<tr>
<td>Pop Availability</td>
<td>-0.16 (-0.37, 0.06)</td>
<td>-0.10 (-0.27, 0.07)</td>
<td>0.02 (-0.13, 0.18)</td>
</tr>
<tr>
<td>Table 4.6 (continued)</td>
<td>Pastry</td>
<td>Baked Goods</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------------------</td>
<td>----------------------------</td>
<td></td>
</tr>
<tr>
<td>NEMS-S Score</td>
<td>0.53 (0.00, 1.05)</td>
<td>-0.01 (-0.48, 0.46)</td>
<td></td>
</tr>
<tr>
<td>F/V Score</td>
<td>0.02 (-0.24, 0.28)</td>
<td>0.12 (-0.08, 0.32)</td>
<td></td>
</tr>
<tr>
<td>F/V Availability</td>
<td>-0.12 (-0.29, 0.05)</td>
<td>-0.11 (-0.25, 0.03)</td>
<td></td>
</tr>
<tr>
<td>Junk Food Availability</td>
<td>0.23 (0.04, 0.43)*</td>
<td>0.26 (-0.11, 0.40)*</td>
<td></td>
</tr>
<tr>
<td>Fruit Juice Availability</td>
<td>-0.15 (-0.38, 0.08)</td>
<td>-0.17 (-0.36, 0.01)</td>
<td></td>
</tr>
<tr>
<td>Snack Availability</td>
<td>0.32 (0.04, 0.61)*</td>
<td>0.30 (0.07, 0.52)*</td>
<td></td>
</tr>
<tr>
<td>Candy Availability</td>
<td>0.29 (0.02, 0.56)*</td>
<td>0.23 (0.00, 0.45)</td>
<td></td>
</tr>
<tr>
<td>Pop Availability</td>
<td>0.33 (0.10, 0.55)*</td>
<td>0.16 (-0.04, 0.37)</td>
<td></td>
</tr>
</tbody>
</table>
Chapter Five: Discussion

The results of this study suggest that the local food environment plays an influential role on parental food purchases, what is procured for the home and, ultimately, consumed by adolescents. While some research suggests that a greater availability of healthful foods (i.e. fruits and vegetables) may promote purchase and intake of such items (Glanz & Yaroch, 2004), the current study suggests that other approaches may also improve dietary intake.

The sample of this study was relatively homogeneous, with 100% of participants identified as Caucasian and nearly all having a body mass index classified as normal. Male participants were found to consume significantly more fiber, calcium, whole grains, and fruits & vegetables compared to their female counterparts. When looking at meals consumed during the week, the majority of both male and female participants reported eating family meals seven or more times per week and the bulk of primary caregivers reported preparing seven or more meals per week. In addition, the vast majority of both male and family participants reported assisting with grocery shopping one time or less in the week during the study (88.9% of males and 68.4% of females).

Neither food resources within the family’s travel pattern nor store selection was found to be associated with any significant changes in nutrient intake among adolescents. Of particular interest, results show that fast food establishment availability within travel patterns were not found to significantly influence nutrient intake. This contradicts a large study by Powell et al. that studied over 4,600 adolescents age 12 to 19 years. Researchers found that frequenting fast food outlets was linked to higher intakes of total daily energy, regular soda, total fat, saturated fat, sugar, and protein as well as being associated with
overall poor diet quality (Powell & Nguyen, 2013). Further research has shown that adolescents and parents who live in towns with access to fast-food establishments are more likely to eat at such stores compared to individuals who do not have access (Longacre et al., 2012). Although other studies that looked at adult diets have not found associations between local food environments, fast food intake, and diet quality (Mejia et al., 2015). However, it should be noted that Mejia et al. looked specifically at fast food establishment within walking distance from place of residence. Richardson et al. analyzed data from over 13,000 young adults and found that fast food availability did not directly translate into higher consumption, consistent with results of this study (Richardson, Boone-Heinonen, Popkin, Gordon-Larsen, 2011). The presence of grocery stores/supermarkets within the local food environment, in addition to shopping at these stores, also failed to observe any significant effect on adolescent dietary intake. While supermarkets are typically considered “better” stores due to a greater availability of healthier alternatives to traditional foods and a variety fresh produce, the present study suggests that having access to and choosing to shop at supermarkets does not enhance dietary quality. These results are supported by Cummins et al. who found that opening a new supermarket in a local “food desert” increased perceived accessibility of food but did not improve fruit and vegetable intake (Cummins, Flint, & Matthews, 2014). However, other studies have found accessibility and availability of supermarkets to be associated with increased diet quality (Lamichhane et al., 2012). Differing results compared to the current study may be the result of a small sample size or of focusing on a rural Kentucky community.
Furthermore, food store availability and selection were not found to be associated with changes in the amount of family meals prepared each week, meaning the presence of restaurants and fast food outlets did not decrease the amount of family meals consumed each week. Overall, these results indicate that the food store in which primary caregivers choose to conduct their food shopping does not significantly impact the diet quality of their adolescent.

Food outlets were assessed by calculating a NEMS-S score and a Fruit and Vegetable (F/V) sub-score. Other than buying more fruit drinks, NEM-S score was not found to be associated with purchasing habits of the primary caregiver. In conjunction, F/V score showed no association with purchases of any food category. As stated previously, supermarkets/grocery stores are often considered “healthier” due to the wider range of products available for sale. However, this study suggests that the overall variety, cost, and quality of typically food items within local food environment stores does not impact parental purchases and, therefore, does not affect adolescents’ home availability.

Therefore, it may be necessary to look at the availability of specific groups of foods within stores as opposed to a store’s overall inventory. In this study, when parents purchased unhealthy foods (i.e. snacks, junk food, candy, and pop), they also chose to purchase related unwholesome foods (i.e. baked goods, pastries, fried potatoes, soda). This implies a direct relationship among purchasing habits. When a store’s availability of unhealthful foods is high, parents may be more likely to purchase other food or drink associated with such items. For example, when the primary caregiver buys chips, they may also decide to buy soda as these foods are often consumed together (i.e. impulse buying). These findings propose that a greater availability of specific unhealthy food
items directly translates into a higher presence of such foods within the home. As such, the availability of unwholesome foods in the local food environment may indirectly impact adolescent dietary intake. Analysis of self-reported intake data confirms this observation.

A greater availability of junk food, candy, and soda in community stores was linked to an increase in predicted sugar consumption compared to a decrease in sugar intake when fruits and vegetable availability was high. Not surprisingly, a higher quantity of soda availability in stores was associated with a higher consumption of sugar from sugar-sweetened beverages.

Overall, a higher presence of unhealthy food items within the community food environment appears to directly translate into a greater availability of energy-dense food items available for adolescent consumption in the home. Due to this potential relationship, reducing the availability of unhealthy food items in stores may be just as, if not more important, than increasing the accessibility of healthy foods in the local food environment. Policy makers need to recognize the complex relationship between availability and purchasing behaviors and how both influence home availability of healthy and unhealthy food items.

To date, no known studies have focused on how interventions developed specifically to decrease access to unhealthy food influence adolescent intake. However, some studies have focused on how availability of such foods predicts intake. A study by de Vet et al. examined how access to unhealthy foods predisposed adolescents in four European countries to higher intakes of snacks, sweets, and sugar-sweetened beverages (de Vet et al., 2013).
Overall, there appear to be multiple inter-related influences at work that shape dietary quality among adolescents in rural populations. The majority of recent studies have worked to develop interventions focused on increasing access to healthy foods, specifically fruits and vegetables. In addition to promoting the accessibility of nutritious foods, researchers should now examine if decreasing the availability of unhealthy foods in the community food environment helps to improve adolescent diet quality. Policies aimed at regulating the availability of such foods may prove to be beneficial in rural communities where access to fresh, healthy food may be limited.

**Limitations**

There are several limitations to this study. First, the small, homogenous sample size limits the generalizability to all adolescents across rural America. Additionally, adolescents were only sampled from two counties in rural Kentucky. Dietary intake was self-reported and social desirability bias may cause results to be skewed. The tool used to measure dietary intake was brief and may not adequately capture the nature the adolescent’s typical diet. Finally, this survey only collected data over a one-week period, which again may not show the full scope of the adolescents’ diets. It would be of interest to conduct a similar study with a greater number of participants, across a wider geographic region, and for a longer period of time. These limitations must be kept in mind when interpreting and applying these results to community practice.
References


Berge et al. (2014). Youth dietary intake and weight status: Healthful neighborhood food environments enhance the protective role of supportive family home environments. *Health Place, 26*, 69-77.


Cummins S, Flint E, & Matthews SA. (2014). New neighborhood grocery store increased awareness of food access but did not alter dietary habits or obesity. *Health Affairs, 33*(2), 283-291.


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