Spring 5-17-2010

Exploring the Relationship between Middle School Children's Body Mass Index and the Home Food Environment within the Contextual Process of Food Choice

Joanna E. Holsten
University of Pennsylvania, joanna.holsten@gmail.com

Exploring the Relationship between Middle School Children's Body Mass Index and the Home Food Environment within the Contextual Process of Food Choice

Abstract

Rates of childhood obesity and comorbidities have been escalating steadily over the past three decades. Children's food environment may promote excessive consumption of energy-dense food. This concurrent mixed-methods dissertation examined the relationship between physical home food environment (availability and accessibility) and body mass index (BMI) of middle school children within the contextual process of their food choices. Sixty-five children from a U.S. public middle school were enrolled. BMI z-scores were calculated based on measured weight and height, and derived against national reference data for standardization. Food store receipt and purchase log data were collected as a measure of home food availability. Home food accessibility, dietary intake, and other BMI covariates were measured via questionnaires and recalls. Hierarchical multiple regression analyses were conducted (n=58 participants). Semi-structured interviews were conducted with a sub-sample of children (n=47 participants) to explore factors that affect their food choices in the home. A data-driven content analysis was performed. Quantitative and qualitative data were integrated in analysis by exploring the differences in qualitative data by overweight status and in the interpretation of the results. Home food availability and accessibility were not significantly associated with BMI z-scores. However, dietary intake of fruits, low-fat dairy, and sugar-sweetened beverages were correlated with their availability in the home. Qualitative data revealed that children's food choice in the home was a dynamic process involving three main interacting components – the child, parent, and food – embedded in the context of time. Overweight children emphasized weight concerns and nutritional aspects of foods, such as calories, in describing their food choices. Compared to healthy weight children, overweight children also expressed greater emotion in their preferences for and awareness of higher-energy foods in their homes. The inconsistency between the desire to lose weight and preferences for and awareness of higher-energy foods along with the significant associations between availability and intake support a focus on physical home environment within family-based obesity interventions. Future research should test the relationship between the home food environment, dietary intake, and BMI with larger cross-sectional or prospective studies and explore children's process of food choice in other settings.

Degree Type
Dissertation

Degree Name
Doctor of Philosophy (PhD)

Graduate Group
Nursing

First Advisor
Charlene W. Compher

EXPLORING THE RELATIONSHIP BETWEEN MIDDLE SCHOOL CHILDREN'S

BODY MASS INDEX AND THE HOME FOOD ENVIRONMENT WITHIN THE

CONTEXTUAL PROCESS OF FOOD CHOICE

Joanna E. Holsten

A DISSERTATION

in

Nursing

Presented to the Faculties of the University of Pennsylvania

in

Partial Fulfillment of the Requirements for the

Degree of Doctor of Philosophy

2010

Supervisor of Dissertation_____
                      Charlene W. Compher, PhD, RD, FADA, CNSC, LDN
                      Associate Professor of Nutrition Science

Graduate Group Chairperson _____
                      Lorraine J. Tulman, DNSc, RN, FAAN
                      Associate Professor of Nursing

Dissertation Committee

Janet A. Deatrick, PhD, FAAN, RN
Associate Professor of Nursing

Shiriki Kumanyika, PhD, MPH
Professor of Epidemiology

Jennifer Pinto-Martin, PhD, MPH
Viola MacInnes/ Independence Professor of Nursing

DEDICATION

To D. Scott Brown for providing enduring patience, vast support, and unflinching belief.

ABSTRACT

EXPLORING THE RELATIONSHIP BETWEEN MIDDLE SCHOOL CHILDREN'S

BODY MASS INDEX AND THE HOME FOOD ENVIRONMENT WITHIN THE

CONTEXTUAL PROCESS OF FOOD CHOICE

Joanna E. Holsten

Charlene W. Compher

Rates of childhood obesity and comorbidities have been escalating steadily over the past three decades. Children's food environment may promote excessive consumption of energy-dense food. This concurrent mixed-methods dissertation examined the relationship between physical home food environment (availability and accessibility) and body mass index (BMI) of middle school children within the contextual process of their food choices. Sixty-five children from a U.S. public middle school were enrolled. BMI z-scores were calculated based on measured weight and height, and derived against national reference data for standardization. Food store receipt and purchase log data were collected as a measure of home food availability. Home food accessibility, dietary intake, and other BMI covariates were measured via questionnaires and recalls. Hierarchical multiple regression analyses were conducted (n=58 participants). Semi-structured interviews were conducted with a sub-sample of children (n=47 participants) to explore factors that affect their food choices in the home. A data-driven content analysis was performed. Quantitative and qualitative data were integrated in analysis by exploring the differences in qualitative data by overweight status and in the interpretation of the results. Home food availability and accessibility were not significantly associated with BMI z-

scores. However, dietary intake of fruits, low-fat dairy, and sugar-sweetened beverages were correlated with their availability in the home. Qualitative data revealed that children's food choice in the home was a dynamic process involving three main interacting components – the child, parent, and food – embedded in the context of time. Overweight children emphasized weight concerns and nutritional aspects of foods, such as calories, in describing their food choices. Compared to healthy weight children, overweight children also expressed greater emotion in their preferences for and awareness of higher-energy foods in their homes. The inconsistency between the desire to lose weight and preferences for and awareness of higher-energy foods along with the significant associations between availability and intake support a focus on physical home environment within family-based obesity interventions. Future research should test the relationship between the home food environment, dietary intake, and BMI with larger cross-sectional or prospective studies and explore children's process of food choice in other settings.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Exploring the Relationship between Middle School Children's Body Mass Index and

the Home Food Environment within the Contextual Process of Food Choice

Introduction and Significance

Childhood obesity, defined as at or above the 95th body mass index (BMI)

percentile, affects 19% of children ages 6 to 19 years in the United States, a three fold

increase over almost three decades (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010).

Obesity in children is associated with physical, social, and mental health co-morbidities

such as type 2 diabetes mellitus, social stigma, and depression respectively (Institute of

Medicine, 2005). Due to the overwhelming prevalence and severe health consequences,

childhood obesity prevention and treatment quickly emerged as national health priorities.

Healthy People 2010 listed obesity as a leading health indicator and many of the co-

morbidities as crucial focus areas (U.S. Department of Health and Human Services,

2000).

At the individual level, obesity results when more energy is consumed than

expended over an extended period of time (U.S. Department of Health and Human

Services, 2009b). Dietary intake and physical activity are the primary behaviors

underlying this imbalance, however interventions targeting these behaviors at the

individual level have not had lasting impact (Summerbell et al., 2005). The Ecological

Model of Health Behavior captures a broad view of behavior and considers five primary

levels of influence: intrapersonal factors, interpersonal processes and primary groups,

organizational factors, community factors, and public policy (Sallis & Owens, 2002).

These levels interact, leading to reciprocal causation (McLeroy, Bibeau, Steckler, &

Glanz, 1988). Of these different levels of influence, environmental contributions to the

obesity epidemic and the interactions of environmental factors with individual behaviors represent some of the greatest gaps in the literature.

Widespread and profound societal changes during the last few decades have increased the availability of inexpensive, convenient, energy-dense food (Hill, Wyatt, Reed, & Peters, 2003). Between 1985 and 2000, food supply trends have indicated an increase in added sugars, fats, and grains, especially refined grains, compared to other food groups. Food cost trends have shown the opposite effect, with fruits and vegetables prices increasing the most and carbonated soft drinks increasing the least in retail price (Putnam, Allshouse, & Kantor, 2002). At the same time, many children are deviating from national nutrition recommendations. In recent studies, percentages of youth meeting the United States Department of Agriculture (USDA) recommendations ranged from approximately 30% for fruit, grain, meat, and dairy to 36% for vegetables. Sixteen percent of youth did not meet any recommendations, and only 1% met all recommendations (Munoz, Krebs-Smith, Ballard-Barbash, & Cleveland, 1997). These changes in the food environment and dietary patterns of children have coincided with the upward trajectory of obesity (Binkley, Eales, & Jekanowski, 2000). Many leading health organizations call for environmental solutions to stem the epidemic (Kumanyika, 2001; World Health Organization & Food and Agriculture Organization of the United Nations, 2003). However, limited research is available to describe the relationship between the food environment and obesity, particularly for children. This research study helps address this critical gap in obesity research.

The food environment involves sources of energy and other nutrients and the circumstances surrounding their procurement (Holsten, 2009). The food environment of

children spans numerous settings, including food stores, restaurants, homes, and schools. Of all these settings, the home environment plays a crucial role in children's food consumption habits. Although food consumed away-from-home is increasing, national data demonstrate that children consume two thirds of their food intake at home (Adair & Popkin, 2005; Guthrie, Lin, & Frazao, 2002; Neilsen, Siega-Riz, & Popkin, 2002). In addition, eating at home provided the greatest amount of energy from low-nutrient, energy-dense foods on a typical school day (Briefel, Wilson, & Gleason, 2009) and the majority of sugar-sweetened beverages are consumed in the home environment (Wang, Bleich, & Gortmaker, 2008). The home food environment is particularly complex due to the influence of other organizations, such as food stores and restaurants, and interpersonal influences of the family (Glanz, Sallis, Saelens, & Frank, 2005). The physical home food environment involves availability and accessibility of food in an individual's residence. Availability refers to the presence of foods in an environment. Accessibility refers to the placement, preparation, and maintenance of the foods that encourage consumption (Hearn et al., 1998).

The physical home food environment is a fundamental element of food choice; if food is not available and accessible to a child, the child cannot consume it. In addition, the home food environment provides a context of learning about food and nutrition (Birch & Davison, 2001). The physical home food environment is theorized to influence the BMI of children as follows: less availability of lower-energy foods predicts lower consumption and greater availability of higher-energy foods predict higher consumption leading toward excess energy intake and eventual obesity (Rosenkranz & Dzewaltowski, 2008). However, considering challenges in measuring dietary intake, including

systematic bias by BMI (Savage, Mitchell, Smiciklas-Wright, Symons Downs, & Birch, 2008), and the educational and contextual implications of the environment, it is important to study the direct relationship between the physical home food environment and BMI, beyond dietary intake.

Many cross-sectional studies have found direct associations between the availability and accessibility of foods in children's homes and the intake of those foods (Pearson, Biddle, & Gorely, 2009). However, only six studies investigated the relationship between the home food environment and weight status (Ard et al., 2007; Byrd-Bredbenner & Abbot, 2009; Downs et al., 2009; Gable & Lutz, 2000; Haines, Neumark-Sztainer, Wall, & Story, 2007; Humenikova & Gates, 2008). The appendix contains a table of evidence that summarizes these six studies. Five of the six studies did not find significant associations between the home food environment variables and weight status (Ard et al., 2007; Downs et al., 2009; Gable & Lutz, 2000; Haines et al., 2007; Humenikova & Gates, 2008). A single study found that greater availability of vegetables was significantly associated with lower BMI-for-age (Humenikova & Gates, 2008). Two studies found unexpected inverse relationships with greater availability of high-energy snack foods inversely associated with overweight in girls (Haines et al., 2007) and the nutrition adequacy ratios for energy and saturated fat available at home significantly lower in households with obese children (Byrd-Bredbenner & Abbot, 2009). These mixed results may be due to the limitations of self-reported or cross-sectional food environment measures and the lack of consideration to covariates for weight status. While a solid foundation of research has investigated the effect of the physical home food environment on dietary intake, more research is needed to clarify the relationship

between the home food environment and body mass index (BMI) using valid measures and designs.

In addition to quantitatively assessing the relationship between the physical home food environment and BMI, an investigation of the specific factors that influence this relationship is also needed. Many qualitative studies have explored parents' and children's perceptions of general factors that affect food choice, particularly for fruit and vegetable intake. Focus groups with youth in middle and/or high school found that many factors influence food choices including: taste, availability of foods at home, hunger, food cravings, health benefits, time and effort of food preparation and consumption, cost, advertising, parent support (modeling, cooking, buying, and serving foods), peer support/approval, body image, and mood (Cullen et al., 2003; McKinley et al., 2005; Molaison, Connell, Stuff, Yadrick, & Bogle, 2005; Neumark-Sztainer, Story, Perry, & Casey, 1999; Wind, Bobelijn, De Bourdeaudhuij, Klepp, & Brug, 2005). However, many of these studies employed a directed approach using established theories to guide the questions and analysis, which may have limited the findings to pre-specified concepts or pathways and discounted potentially important factors. In some of these studies, details of the analysis were not described raising questions about the credibility of the findings. No studies have directly explored factors that potentially influence the relationship between the physical home food environment and BMI with inductive methods. By qualitatively exploring child's perceptions of the home food environment and their food choices within the environment, the relationship can be better understood and potential solutions can be identified.

The mixed methods study helped fill these gaps by investigating the relationship

between the physical home food environment and BMI z-scores within the context

of food choices for middle school children. Quantitative data on the availability and

accessibility of foods in the home and qualitative data on factors that affect food choice

in the home were collected concurrently to explain the relationship between the home

food environment and BMI. The dependent variable was children's BMI z-scores. BMI

was selected as the outcome for weight status because it is a widely accepted and

validated unit of measurement correlated with body fat (Garrow & Webster, 1985; Mei et

al., 2002; U.S. Department of Health and Human Services, 2009a). BMI z-scores

standardized the observed BMIs by indicating how many standard deviations children

were above or below the age and sex specific population mean, which were derived

against the U.S. CDC 2000 reference data (Kuczmarski et al., 2000). This

standardization allows for cross-sectional classification of adiposity for children (Cole,

Faith, Pietrobelli, & Heo, 2005). The independent variables included home food

availability and accessibility. The availability of different food groups in the home

environment was quantifiably measured using four weeks of food store receipt data and

an accompanying food purchase log. These data provided an objective measure of

availability, which many other studies in the literature lacked. The accessibility of food

was measured using a self-report questionnaire. Dietary factors, physical activity,

pubertal status, demographic variables, and external food environment factors were also

measured as covariates of BMI. Theoretically the relationship between the physical

home food environment and BMI should involve dietary intake, but due to the limitations

in measurement of dietary variables (Savage et al., 2008) the direct relationship was

explored with dietary variables serving as covariates.

Qualitative methods were embedded in the study to describe the context of the phenomenon and assess the utility of the Ecological Model in directing research. Semi-structured interviews were conducted with a sub-sample of children to understand the potential factors that influence the relationship between the physical home food environment and BMI. Maximum variation sampling techniques were used to purposefully select a sample that represented a wide range of BMI z-scores and socio-demographic characteristics (Patton, 2002). Interviews elicited children's perspective on the physical food environment and how they make food choices within the home setting. A conventional content analysis was conducted to analyze the interview data. The process that emerged from the analysis helped to explain the relationship between the physical home food environment and BMI.

Quantitative and qualitative data were collected concurrently and integrated, both in analysis by exploring the differences in qualitative data by overweight status, and in the interpretation of the results, by contextually seating the quantitative findings in the process of children's food choice. The study deductively explored the direct relationship between the home food environment and BMI and inductively assessed children's food choices to contextualize the quantitative findings and assess the utility of the Ecological Model. Both quantitative and qualitative data were necessary to provide a comprehensive and complete understanding of the relationship between the home food environment and BMI in children.

Overall Objective and Aims

The main purpose of this mixed-methods study was to examine the relationship between physical home food environment and BMI of middle school children as seated

within the contextual process of their food choices. The research questions addressed in this study included: What is the relationship between availability and accessibility of "lower-energy" and "higher-energy" foods in the home and BMI for middle school children? Within the context of the home food environment, what other factors related to eating patterns help to explain BMI?

Specific Aim 1

The first specific aim was to quantitatively determine the direct relationship between the physical home food environment (availability and accessibility) and BMI z-scores of middle school children after controlling for non-dietary obesity risk profiles (cluster analysis of non-dietary covariates), dietary intake (average daily energy and fat intake), and external food environment factors (frequency of meals at school and restaurants).

Hypothesis 1. There is an inverse relationship between availability of "lower-energy" foods (i.e. fruits, vegetables, and low-fat dairy) and BMI z-scores after controlling for home food accessibility, non-dietary obesity risk profiles, dietary intake, and external food environment factors.

Hypothesis 2. There is a direct linear relationship between the availability of "higher-energy" foods (i.e. sweet snacks, savory snacks, and sugar-sweetened beverages) and BMI z-scores after controlling for home food accessibility, non-dietary obesity risk profiles, dietary intake, and external food environment factors.

Hypothesis 3. There is an inverse relationship between home accessibility of "lower-energy" foods and BMI z-scores after controlling for home food availability, non-dietary obesity risk profiles, dietary intake, and external food environment factors.

Specific Aim 2

The second specific aim used qualitative methods to describe factors that influence the relationship between the physical home food environment and BMI as perceived by middle school children.

Specific Aim 3

The third specific aim was to integrate the quantitative and qualitative findings to describe the relationship between the home food environment and BMI and to assess the utility of the Ecological Model in explaining this relationship and directing future research.

<div align="center">

Manuscript Overview

</div>

This dissertation is presented in a manuscript format with three separate papers prepared for publication that highlight discrete components of the research process: the food receipt and purchase log methodology, the qualitative description of children's food choice process in the home, and the mixed methods assessment of the relationship between the physical home food environment and BMI.

For this dissertation, a food receipt and purchase log protocol was developed to measure home food availability of "lower-energy" and "higher-energy" food groups to understand the relationship between their availability and BMI in children. The first manuscript describes and evaluates the receipt/log methodology for measuring home food availability. The receipt/log protocol, including data collection, entry, and systematic coding, is fully presented and then evaluated as an overall research process to determine both feasibility for participants and utility for researchers. Food receipt and log data are also examined for seasonal variation and compared with questionnaire responses to

further determine utility as a research tool. The discussion highlights how this protocol advanced the method compared to previous receipt/log protocols and other home food availability measurement methods. The first manuscript presents the methodological description and assessment needed to confidently assess the relationship between the physical home food environment and BMI in the final manuscript.

In this dissertation, the qualitative method inductively explored factors that affect children's food choices in the home in order to understand both children's perspective of the environmental contributions, like availability and accessibility, and the overarching context of food choice. This allows for a more thorough understanding of the relationship between the home food environment and BMI. The second manuscript describes the process of middle school children's food choice in the home, which emerged from a content analysis with grounded theory overtones of semi-structured interview data. The manuscript identifies all the contributing factors and their interactions that surfaced in the content analysis through the presentation of the model of children's food choice process. The manuscript details how children's food choices at home resulted from the interaction of the child, parent, food, and outside influences over time. The utility of the Ecological Model of Health Behavior is also assessed for its ability to conceptualize food choices and direct future research. Presenting the broader context of food choice in the home allows for contextual understanding of the information provided by the combined quantitative and qualitative data that are presented in the final manuscript.

With the methodological and contextual groundwork provided by the first two manuscripts, the final manuscript presents the mixed methods findings that address the

main objective of the dissertation – to examine the relationship between physical home food environment and BMI of middle school children as seated within the contextual process of their food choices. The final manuscript describes the home food environment variables, BMI, and covariates that were quantitatively measured and reports the findings from the regression analysis that tests the hypotheses. In addition, the integration of the quantitative and qualitative data is presented in comparing of the interview data between the overweight and healthy weight children. Lastly, the discussion further integrates the results and interprets them within the context of children's food choice process to explain the findings and suggest future directions for research.

The results from these three manuscripts are reviewed in a final conclusion that summarizes the contributions of each manuscript in furthering our understanding of the relationship between the physical home food environment and BMI of middle school children. Explanations for the findings that lie outside of the home food environment are postulated and a more lengthy discussion about the next steps for research is presented.

Measuring Home Food Availability:

Evaluation of Food Receipt and Food Purchase Log Collection Methodology

Joanna E. Holsten, MPH, MS, RN

University of Pennsylvania, School of Nursing

Dissertation

Chairperson: Charlene W. Compher, PhD, RD, FADA, CNSD, LDN

Committee Members: Janet A. Deatrick, PhD, FAAN, RN

Shiriki Kumanyika, PhD, MPH

Jennifer Pinto-Martin, PhD, MPH

Abstract

Objectives: 1) To describe a food receipt and purchase log protocol to measure home food availability; 2) To evaluate the data collection process, receipt seasonality, and utility of the receipt/log method compared to questionnaires. Methods: Home food availability was assessed using: food receipts, food purchase logs, and questionnaires. Sixty-five adolescents and parents were enrolled. Receipt/log data were collected over 30 days and coded into "lower-energy" and "higher-energy" food categories. Descriptive and bivariate analyses were performed. Results: Few families reported missing food receipts with more than three items (5%) and all food receipt items with two exceptions were identifiable. No significant seasonal variations were found. Questionnaire and receipt data were significantly correlated for all food categories with the exception of children's perceptions of dairy ($\rho=0.06$, $p=0.650$), and parent's perceptions of sweet snacks ($\rho=0.24$, $p=0.071$) and sugar-sweetened beverages ($\rho=0.21$, $p=0.118$). Conclusions: The receipt/log method offers a feasible data collection protocol and systematic data-coding scheme to improve measurement of home food availability.

Keywords: home food availability, receipt, food environment, obesity

Measuring Home Food Availability:

Evaluation of Food Receipt and Food Purchase Log Collection Methodology

Introduction

The home food environment plays a crucial role in children's diet and health.

Several studies have found that home availability of "lower-energy" and "higher-energy"

foods are related to intake (Pearson, Biddle, & Gorely, 2009), and intake of these foods

correlate with weight status or weight loss (Bradlee, Singer, Qureshi, & Moore, 2009;

Epstein, Paluch, Beecher, & Roemmich, 2008). Home food availability refers to the

presence of food items in an individual's residence. In previous research, home food

availability has been measured using three main methods: self-report questionnaires,

observed home inventories, and household food acquisition data. However, measuring

home food availability presents several challenges including variation over time and

between different individuals' perspectives. Documenting all food inputs that come into

the home offers a promising approach to measure home food availability using objective

data.

Two methods often combined to document household food acquisition are food

receipt collection and food purchase logs. Receipt collection involves participants

gathering itemized food receipts over a period of time. A food purchase log often

accompanies receipt collection to document food purchases without itemized receipts, or

clarify purchases on a receipt for non-household use, preventing under and

overestimation from receipts alone (Ransley et al., 2001). Although the combined

receipt/log method is a promising approach, protocols are still evolving. This paper aims

to: 1) describe a receipt/log protocol for measuring home food availability, 2) evaluate

the data collection process, receipt seasonality, and utility of the receipt/log method compared to questionnaires, and 3) highlight improvements from previous protocols and other methods.

Methods

A food store receipt and log protocol was developed to measure home food availability of "lower-energy" and "higher-energy" food groups to understand the relationship between their availability and body mass index (BMI) in children. Participants were recruited from one public middle school with a student body of 742 located in a Northeastern suburb of the United States. A convenience sample of 65 adolescents and parents was enrolled (8.8% enrollment rate).

Data Collection

Families who consented to participate were given verbal instructions over the phone and sent a packet instructing them to begin collecting all receipts for food items that entered the home and recording items without a receipt (i.e. gift of banana bread) or items on a receipt not intended for the home (i.e. candy for a school party). Each family started receipt collection on different dates from September 2008 to April 2009. Enrollment was suspended so that no data collection occurred during the winter holiday period. The instruction packet included: a magnetic receipt envelope for the refrigerator, a food purchase log, and written instructions. Each family received two data collection reminder calls. During the second call, home visits were scheduled with families to occur after receipt/log collection.

At the home visit, trained study personnel reviewed the receipts and purchase log with the parent to clarify food item details (i.e. percent milk-fat). All parents were

questioned about possible missing receipts. If the family reported missing receipts, they were asked how many items would have been missing. Questionnaires were administered to the child and parent and the child's weight and height were measured. One questionnaire assessed how often items in each food group were present in the home with five ordinal response options ranging from 'hardly ever' (1) to 'always' (5). The reliability and validity of this questionnaire has not been documented, but it had been used in research with children and parents (Gable & Lutz, 2000).

Data Entry

One month of data were entered for each participant, starting two days after consent and continuing 30 days from the start date. All receipt data were scanned and imported into a spreadsheet using the NEAT Receipt software program (Version 3, NEAT Receipts, Philadelphia, PA). Additional items and item clarifications recorded on the food purchase logs were hand entered. Food items were considered single line items on receipts.

Data Coding

Although receipt and log data recorded all possible foods, the coding protocol selected only food items that met eligibility criteria for one of six groups: ***fruit, vegetables, low-fat dairy, sweet snacks, savory snacks, and sugar-sweetened beverages***. These six categories were selected since studies have found significant correlations between their availability in the home and children's intake (Pearson et al., 2009), and because intake of these foods is related to weight status outcomes (Bradlee et al., 2009; Epstein et al., 2008). Specific foods that were included or excluded from each category are shown in Table 1. The criteria and rationale are described below.

Fruits, vegetables, and low-fat dairy were considered "lower-energy" food groups that is, relatively high in micronutrients and low in kilocalories. In turn, greater intake of these "lower-energy" foods (relative to "higher-energy" foods) is associated with *lower* BMI (Bradlee et al., 2009; Epstein et al., 2008). The United States Department of Agriculture (USDA) food pyramid classifications of fruits, vegetables, and low-fat dairy items (U.S. Department of Agriculture, 2010) were the starting point for coding these foods. To systematically exclude high-energy versions of fruits, vegetables, and low-fat dairy items, an "energy-density" cutoff was applied. A food's energy density is "the amount of energy per unit weight" (i.e. kilcalories/100 grams) (World Cancer Research Fund / American Institute for Cancer Research, 2007, p. 324). Fruit, vegetable, or low-fat dairy items with greater than 100 kilocalories per 100 grams were eliminated from the "lower-energy" food groups, excluding strawberry jam, French fries, and cheese, respectively. An expert panel report recommended this approach to categorize foods that do or do not promote excess weight gain (World Cancer Research Fund / American Institute for Cancer Research, 2007).

Sweet snacks, savory snacks, and sugar-sweetened beverages were considered "higher-energy" foods that is, relatively low levels of micronutrients and high levels of kilocalories. Greater intake of these "higher-energy" foods is associated with *higher* BMI (Bradlee et al., 2009; Epstein et al., 2008). Snacks were defined as non-core foods not typically eaten as a main meal, but between or after meals, usually without utensils (Wansink, Payne, & Shimizu, 2009). Many of these foods are listed as sources of discretionary calories in the USDA food pyramid (U.S. Department of Agriculture, 2010). The same energy-density cutoff was applied to systematically exclude low-energy

versions of sweet and savory snacks (100 kilocalories/100 grams or less), such as gelatin desserts, from the snack food groups.

Sugar sweetened beverages included any non-dairy drink with greater than 10 calories per serving that were *not* 100% juice. Although most sugar-sweetened beverages were less than 100 kilocalories/100 grams due to their high water content, all sugar-sweetened beverages were excluded since they are not a part of the USDA recommended intake (U.S. Department of Agriculture, 2010) and are linked with adolescent obesity (Haines, Neumark-Sztainer, Wall, & Story, 2007).

Additional food product information needed for coding (i.e. beverage sugar content) was obtained from food company websites, or if unavailable, the USDA nutrition database. Energy-density information was obtained from the USDA Food and Nutrient Database for Dietary Studies (Version 3, Agricultural Research Service, Food Surveys Research Group, Beltsville, MD).

Data Analysis

The percentages of items in each category out of the total food items were calculated as the final home food availability variables. Descriptive analyses were conducted to describe the participant characteristics, receipt and log collection process, the percentage of items in each category, and the home food availability questionnaire responses. Means and variances were calculated for each continuous variable. Frequencies and percentages were calculated for categorical variables.

Using the non-parametric Mann-Whitney U Test, the percentages of items in the food categories and demographic variables were compared to see if there was a significant difference between the families that reported missing receipts and those that

did not. In order to identify any seasonal effect on the home food availability data,

the families that collected in the fall months (September to November) were compared to

those that collected in the winter months (January to March) using a Mann Whitney U

Test. Spearman correlations were conducted between the receipt and questionnaire data.

P-values less than 0.05 were considered statistically significant.

<center>**Evaluation**</center>

The receipt and log collection protocol was evaluated to determine feasibility for

participants and utility for researchers.

Process Evaluation

Of the 65 participants enrolled, 58 households both remained eligible (2

participants were ineligible at the home visit) and completed receipt/log collection and

home visits (92.3% response rate). Only five participants did not complete receipt

collection. The mean age of the children was 12.48 years (range 11.1-14.5 years) with

29% overweight ($\geq 85^{th}$ and $<95^{th}$ BMI percentile) and 10% obese ($\geq 95^{th}$ BMI percentile)

(U.S. Department of Health and Human Services, 2009). The majority of children were

non-Hispanic and white. The median annual income range was $75,000 to $99,000, and

60% identified a college degree or greater as the highest level of education attained by

either parent.

Over a period of 30 days, families collected an average of 9 ± 4.5 food store receipts

(range 2-21) with the majority from supermarkets. During data collection, 64% of

families used the food purchase log. Of the 37 families that used the log, 68% (n=25)

noted food purchased from a store without a receipt; 43% (n=16) noted food not intended

for household use; 27% (n=10) recorded food received as a gift; and 41% (n=15)

recorded food from restaurants. In reviewing the receipts with the parents, 35%

(n=20) recalled information that should have been recorded on the food purchase log.

Seventy-four percent of families (n=43) reported that they were not missing any

receipts. Fifteen families (26%) reported that they could potentially be missing a receipt,

but only three of these families reported that they were definitely missing a receipt from a

large shopping trip that included more than two items and could not recall them all. The

families (n=15) that stated that they might be missing receipts of any size had a

significantly higher percentage of sugar-sweetened beverages (p=0.013) and had

significantly lower parental education levels (p=0.017) than those with complete receipt

collection. In comparing families that reported that they were definitely missing at least

one receipt from a large shopping trip (n=3), and the rest of the sample, there were no

significant differences in the percentages of food items available. They also had

significantly lower parental education (p=0.004) and income levels (p=0.021).

In reviewing the data, only two receipts had unreadable items due to water

damage. Thirty-two items needed to be clarified with store managers. Only two items

could not be coded due to vague labeling (i.e. "manager special") and the parent's

inability to recall the item.

Seasonality Findings

Comparing families that collected receipts in the fall versus winter, there were no

significant differences in the percentages of food items available in different categories.

Although not significant, families that collected receipts during winter months had a

higher percentage of fruit purchases than those in that collected receipts in the fall

(10.12% vs. 7.14% respectively, p=0.06).

Correlation Between Receipt/Log and Questionnaire Data

In order to compare receipt/log and questionnaire data, alterations were made to the receipt/log food categories to match the questionnaire groupings, including combining the fruits and vegetables into one category and using all dairy items instead of just the low-fat items. Child and parent questionnaire responses were significantly correlated for all food groups ($\rho=0.27-0.55$) besides sugar-sweetened beverages. Child questionnaire responses and receipt/log data were significantly correlated for all food categories except dairy (Table 2). Parent questionnaire responses and receipt/log data were significantly correlated for fruits and vegetables, dairy, and savory snacks; however sweet snacks and sugar-sweetened beverages were not significantly associated (Table 2).

Discussion

In light of the method's description and analysis, following is a comparison of the receipt/log protocol with other receipt protocols and other methods used to measure home food availability.

Comparison with Other Receipt Protocols

Data collection differences include: receipt collection time frames, types of receipts collected, documentation of food item details, and missing receipts. While our protocol collected 30 days of receipts, other studies stipulated time periods that range from a single receipt (Martin, Howell, Duan, & Walters, 2006) to 10 weeks of data (Rankin et al., 1998). A single receipt does not capture daily or weekly variation in food availability, however as the timeframe extends, subject burden increases. Although beyond the scope of this analysis, re-analyzing the data with subsets of fewer days might provide useful insights for an appropriate data collection timeframe. Variation across

seasons is another concern, yet our seasonality analysis corroborates French and colleagues' (2009) lack of significant differences in purchases based on month of enrollment. However, the study did not collect data over the spring and summer months when fresh fruits and vegetables are highly available. The types of receipts collected by the participants also differ between protocols. Some studies collected all restaurant receipts, which provided a comprehensive understanding of food purchasing, but did not necessarily represent home food availability.

Protocols also differ in techniques to document purchases without receipts and record details about foods. Several studies trained participants to document additional details directly on the receipts (Rankin et al., 1998; Winett et al., 1997) or make detailed annotations of all purchases (French, Wall, Mitchell, Shimotsu, & Welsh, 2009) during the data collection period. These annotation techniques may produce more accurate results since information is recorded closer to the purchase occasion; although extensive annotation may decrease accuracy by increasing subject burden and awareness of healthful qualities of food (i.e. percent milk-fat) during the data collection period. While the post-collection review introduces recall and social desirability bias, it may reduce burden and reactivity by limiting the amount that participants need to consciously record during data collection. In addition, annotations recorded directly on the food receipts interfered with the scanning process used to input the receipt data.

Limiting missing data is an important element in establishing a data collection protocol. Seventy-four percent of parents reported not missing any receipts, which is higher compared to the 64% of parents in another study that felt all of their food purchases were captured by the protocol (French et al., 2009). Although some families

reported missing receipts, the purchasing levels were not significantly less for any of

the food categories; instead families that reported missing one or more receipts had

significantly higher percentages of sugar-sweetened beverages than families missing no

receipts, implying underestimation of their availability. Since these families had lower

education levels and incomes, researchers might find difficulty attaining complete data

collection in populations of different socio-demographic backgrounds.

The level of nutritional analysis and classification of food groups represent the

main differences in data coding. Other studies utilized nutritional databases (Rankin et

al., 1998; Ransley et al., 2001; Winett et al., 1997) to estimate energy, macronutrient, and

fiber in food purchases. While analyzing foods by nutrients may provide more precise

research outcomes, analyzing foods by categories produce results that can be applied

more readily to individual dietary decisions and allow investigation of the association

with intake of food groups. Many protocols lack a consistent strategy for determining

classification in particular food groups. This protocol employed "energy density"

cutoffs, which advances the method by creating a consistently applied rule in coding

decisions, specifically for obesity research.

Comparison with Other Measurement Methods

Self-report questionnaires are widely used to measure home food availability.

However, questionnaires theoretically measure the participants' *perception* of availability

since they are not grounded with objective data (except self-reported inventories).

Therefore, the associations between receipt and questionnaire data indicate that

perceptions are correlated with availability, however there are some exceptions. For

example, children's responses for dairy availability had no correlation with receipt data

(ρ=0.06) while both child and parent perceptions of all other food categories had much higher correlations (ρ=0.21-0.40), possibly indicating children's lower awareness of dairy availability. In addition, the lack of significant correlation for the parent's reported availability of sweets and sugar-sweetened beverages could indicate parents' social desirability bias, similar to other research findings (van Assema, Glanz, Martens, & Brug, 2007). While individuals can still withhold receipts, the social pressure may be lessened since it is not directly tied to an individual's response (French et al., 2009). Although since receipt/log data collection and food acquisition occur concurrently, participants may temporarily alter the pattern of food purchases due to the awareness that they are being observed. Unlike questionnaires, the issue of reactivity limits the receipt/log method. While there is no gold standard of home food availability measurement, the receipt/log method offers a grounding to objective data over time rather than potentially conflicting participant perceptions or a cross-sectional self-reported inventory.

Limitations

Since the participants were more highly educated, wealthier, and less overweight than the national average, the findings may not be generalizable to many populations. In addition, no data were collected in the spring and summer seasons, limiting a complete evaluation of seasonality. The study did not systematically assess participant's opinions about how the receipt/log collection reflected their usual purchasing, which would have been useful in further evaluating the technique. Lastly, the study did not collect take-out receipts, which is technically food that entered the home environment and should be accounted for in future research.

Implications

By providing a detailed description of data collection and coding, future studies can replicate the protocol and continue to refine it. The protocol appears highly feasible for families with children since few families reported missing receipts for large shopping trips, all items with the exception of two were identifiable following the protocol, and 92% of families initially enrolled completed receipt/log collection. In addition, the 30-day data collection protocol conceptually allowed for daily and weekly variations. The lack of significant variation between seasons adds support for this methodology as a stable measure of home food availability over fall and winter months. Compared to self-report questionnaires, the receipt/log method is grounded in objective data, reducing reliance on self-reported information that is subject to recall and social desirability bias and avoiding conflicting reports between individuals. Although, reactivity or the potential that participants change their food purchasing behaviors due to observation cannot be ruled out as a limitation of the method. Overall, the food receipt and purchase log method offers several advantages over other methods and advances the development of a feasible and systematic protocol to improve measurement of home food availability.

Acknowledgements

References

Bradlee, M. L., Singer, M. R., Qureshi, M. M., & Moore, L. L. (2009). Food group intake and central obesity among children and adolescents in the third National Health and Nutrition Examination Survey (NHANES III). *Public Health Nutrition,* 1-9.

Epstein, L. H., Paluch, R. A., Beecher, M. D., & Roemmich, J. N. (2008). Increasing healthy eating vs. reducing high energy-dense foods to treat pediatric obesity. *Obesity, 16*(2), 318-326.

French, S. A., Wall, M., Mitchell, N. R., Shimotsu, S. T., & Welsh, E. (2009). Annotated receipts capture household food purchases from a broad range of sources. *The International Journal of Behavioral Nutrition and Physical Activity, 6*(37).

Gable, S., & Lutz, S. (2000). Household, parent, and child contributions to childhood obesity. *Family Relations, 49*, 293-300.

Haines, J., Neumark-Sztainer, D., Wall, M., & Story, M. (2007). Personal, behavioral, and environmental risk and protective factors for adolescent overweight. *Obesity, 15*(11), 2748-2760.

Martin, S. L., Howell, T., Duan, Y., & Walters, M. (2006). The feasibility and utility of grocery receipt analyses for dietary assessment. *Nutrition Journal, 5*(10).

Pearson, N., Biddle, S. J., & Gorely, T. (2009). Family correlates of fruit and vegetable consumption in children and adolescents: A systematic review. *Public Health Nutrition, 12*(2), 267-283.

Rankin, J. W., Winett, R. A., Anderson, E. S., Bickley, P. G., Moore, J. F., Leahy, M., Harris, C. E., & Gerkin, R. E. (1998). Food purchase patterns at the supermarket and their relationship to family characteristics. *Journal of Nutrition Education, 30*(2), 81-88.

Ransley, J. K., Donnelly, J. K., Khara, T. N., Botham, H., Arnot, H., Greenwood, D. C., & Cade, J. E. (2001). The use of supermarket till receipts to determine the fat and energy intake in a UK population. *Public Health Nutrition, 4*(6), 1279-1286.

U.S. Department of Agriculture. (2010). *MyPyramid.* Retrieved April 1, 2010, from http://www.MyPyramid.gov

U.S. Department of Health and Human Services. (2009). *Healthy weight – it's not a diet, it's a lifestyle! About BMI for children and teens.* Retrieved April 1, 2010, from http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html

van Assema, P., Glanz, K., Martens, M., & Brug, J. (2007). Differences between parents' and adolescents' perceptions of family food rules and availability. *Journal of Nutrition Education & Behavior, 39*(2), 84-89.

Wansink, B., Payne, C. R., & Shimizu, M. (2009). "Is this a meal or snack?" Situational cues that drive perceptions. *Appetite, 54*(1), 214-216.

Winett, R. A., Anderson, E. S., Bickley, P. G., WalbergRankin, J., Moore, J. F., Leahy, M., Harris, C. E., & Gerkin, R. E. (1997). Nutrition for a lifetime system(c): A multimedia system for altering food supermarket shoppers' purchases to meet nutritional guidelines. *Computers in Human Behavior, 13*(3), 371-392.

World Cancer Research Fund / American Institute for Cancer Research. (2007).

*Food, nutrition, physical activity, and the prevention of cancer: A global perspectiv*e.

Washington DC: AICR.

Table 1

Food group category definitions and examples of items included or excluded by the

coding rules for each group

Category	Food Group Definition	Examples of INCLUDED Food and Drink Items	Examples of EXCLUDED Food and Drink Items
Fruit	Any fruit based item - fresh, canned, frozen, dried, whole, cut-up, pureed, or 100% juice	Apples, strawberries, peaches, 100% fruit juices	Fruit items with >100 kcal/100gram: avocados, jams, raisins
Vegetable	Any vegetable based item - raw, cooked, fresh, frozen, canned, dried, whole, cut-up, pureed, mashed varieties, legumes, or 100% juice	Peppers, broccoli, tomatoes, green peas, white potatoes, salsa	Vegetable items with >100 kcal/100gram: baked beans, potato salad, sweet potatoes
Low-fat dairy	Foods made from milk that retain their calcium content with ≤1% milk-fat. Foods made from milk with little to no calcium, such as cream cheese, cream, and butter, are not included. Milk-based desserts are considered sweet snacks.	Non-fat or 1% milk, yogurt, cottage cheese	Low-fat dairy items with >100 kcal/100gram: fat-free or low-fat cheese
Sweet snacks	High-energy food items consumed outside a meal with a sweet taste - baked goods, ready-to-make/ingredients, frozen treats, milk-based desserts, candy, sweet toppings.	Cookies, muffins, cake/brownie mixes, ice cream, frozen yogurt, jelly, chocolate sauce, chocolate chips, granola bars	Sweet snack items with ≤100 kcal/100gram: sorbet, Jell-O^{TM}, fat-free pudding
Savory snacks	High-energy food items consumed outside a meal with a savory or salty taste.	Potato chips, pretzels, beef jerky, crackers, fried vegetables, nuts	Savory snack items with ≤100 kcal/100gram: none
Sugar-sweetened beverages	Any non-dairy beverage with ≥10 calories per serving excluding 100% fruit juice	Soda, sports drinks, fruit punch	An energy-density cutoff was not applied to this group.

Table 2

Correlation between receipt/log data and child-reported and parent-reported questionnaire data for home food availability variables

Food Category	Receipt Data: Percentage of items in food group/ total food items Mean (Standard Deviation)	Child Questionnaire: How often are (food groups) in your home? Mean (SD)	Parent Questionnaire: How often are (food group items) in your home? Mean (SD)	Correlation: Child and Parent Questionnaire coefficient and p-value	Correlation: Child Questionnaire and Receipt data coefficient and p-value	Correlation: Parent Questionnaire and Receipt data coefficient and p-value
Fruit and Vegetable	20.42 (8.70)	4.12 (1.03)	4.22 (0.99)	0.42 p=0.001	0.40 p=0.002	0.34 p=0.010
All dairy	10.62 (6.05)	4.66 (0.54)	4.78 (0.53)	0.29 p=0.027	0.06 p=0.650	0.30 p=0.021
Sweet snacks	10.55 (10.18)	3.28 (1.07)	3.34 (1.13)	0.55 p<0.001	0.41 p=0.001	0.24 p=0.071
Salty snacks	5.58 (3.01)	3.29 (1.09)	3.36 (1.24)	0.27 p=0.042	0.40 p=0.002	0.34 p=0.009
Sugar-sweetened beverages	4.22 (2.92)	3.26 (1.40)	3.29 (1.51)	0.21 p=0.119	0.27 p=0.038	0.21 p=0.118

The Process of Children's Food Choice in the Home Environment:

A Qualitative Descriptive Study

Joanna E. Holsten, MPH, MS, RN

University of Pennsylvania, School of Nursing

Dissertation

Chairperson: Charlene W. Compher, PhD, RD, FADA, CNSD, LDN

Committee Members: Janet A. Deatrick, PhD, FAAN, RN

Shiriki Kumanyika, PhD, MPH

Jennifer Pinto-Martin, PhD, MPH

Abstract

A qualitative descriptive approach was used to inductively describe the process of middle school children's food choice in the home with particular attention to environmental contributions. Semi-structured interviews were conducted with a sub-sample of 11 to 14 year-old children. A data-driven content analysis with grounded theory overtones was performed. Children's food choice in the home emerged as a process that involved three main interacting components, the child, parent, and food, embedded in the context of time. The parent created food options through food purchasing and preparation and indirectly affected the child's food choices by setting rules, providing information, and modeling behaviors. Pertinent aspects of the food included its availability within the home, specified attributes, such as flavor and preparation, and cost. The child affected the parent's decisions through communicating food preferences. The child evaluated potential food options based on their hunger level, food preferences, time pressure and activity prioritization, food preparation effort and skills, and expected physical consequences of food in order to make their final food choices. Future research should continue to examine the process of food choice using multiple data collection techniques and sources, such as participant observation and parent interviews, across many behavior settings including school.

Keywords: food choice, children, obesity, overweight, body mass index, home, food environment, qualitative

The Process of Children's Food Choice in the Home Environment:

A Qualitative Descriptive Study

Introduction

Prevalence rates of childhood obesity have increased dramatically over three decades (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010) and children's dietary patterns are moving further from recommendations. Nationally, children's intake of nutrient-dense foods, such as fruits, vegetables and low-fat dairy has declined (Guenther, Dodd, Reedy, & Krebs-Smith, 2006; Neilsen, Siega-Riz, & Popkin, 2002), and intake of energy-dense foods low in nutrients, such as snacks and sugar-sweetened beverages, has increased (Neilsen et al., 2002; Wang, Bleich, & Gortmaker, 2008). These trends adversely affect children's health in communities across the United States. In order to understand dietary intake and improve children's diet and health, it is important to examine the circumstances surrounding children's food choices.

Since the majority of children's intake occurs at home (Neilsen et al., 2002) and many fundamental dietary behaviors are established and reinforced in this setting (Birch & Davison, 2001), the home is a crucial environment to understand food choice. The home food environment is particularly complex to investigate due to the effect of other organizations (Glanz, Sallis, Saelens, & Frank, 2005), such as food stores, and interpersonal influences of the family. Current models of the home food environment consist of interactions between built, natural, socio-cultural, political, and economic domains (Rosenkranz & Dzewaltowski, 2008) broadly directed by an ecological perspective (McLeroy, Bibeau, Steckler, & Glanz, 1988), but do not demonstrate the

specific process of food choice in the home setting and delineate the role of potential

environmental factors from children's perspectives.

Many qualitative studies have explored factors that affect food choice. Focus

groups with children and adolescents found a large number of factors that influence food

choices including: taste, availability of foods at home, hunger, food cravings, health

benefits, time and effort of food preparation and consumption, cost, advertising, parent

support (modeling, cooking, buying, and serving foods), peer support/approval, body

image, and mood (Cullen et al., 2003; McKinley et al., 2005; Molaison, Connell, Stuff,

Yadrick, & Bogle, 2005; Neumark-Sztainer, Story, Perry, & Casey, 1999; Wind,

Bobelijn, De Bourdeaudhuij, Klepp, & Brug, 2005). However, these studies explored

factors that primarily affected fruit and vegetable intake and not the entirety of children's

diet. The studies were also heavily directed by established health behavior theories,

which may have limited the findings to pre-specified concepts or pathways and

discounted potentially important factors. In addition, many of the studies did not state the

type of qualitative analysis performed on the data, raising credibility concerns.

No studies have explored the factors that affect children's food choice specifically

in the home setting using a non-directed approach. This qualitative descriptive study

inductively describes the process of middle school children's food choice in the home

with particular attention to environmental contributions. The inductive data analysis was

then used to assess the utility of the Ecological Model of Health Behavior.

Understanding child's perceptions of the home food environment and their food choices

within the environment can help direct future research in identifying potential risk factors

for obesity and refining interventions for obesity prevention and treatment.

Methods

Approach

A qualitative descriptive approach (Sandelowski, 2000) was used to describe

factors that affect children's food choices within the home environment. Face-to-face,

semi-structured interviews were conducted with a large sub-sample of children involved

in a concurrent mixed methods study investigating the association between the home food

environment and body mass index (BMI) (Holsten, Compher, Deatrick, & Kumanyika,

2010). The qualitative descriptive approach was selected since it can provide rich

information regarding eating decisions that are grounded in environmental and cultural

contexts (Sullivan-Bolyai, Bova, & Harper, 2005). The study also had grounded theory

overtones in that the analysis emphasized the examination of social interactions, which

led to the description of food choices as an interacting process. The University of

Pennsylvania Institutional Review Board approved the study.

Setting

All participants were recruited from a public middle school with a student body of

approximately 742. The school population was more racial and ethnically diverse than

the state or zip code area of the school (U.S. Census Bureau, 2008). The school was

located in a suburb of a U.S. Northeastern city with nearby recreation opportunities and

ample supermarkets and restaurants. The interviews took place in private locations

within the participants' homes.

Sampling Methods

The overall study involved a convenience sample of students (n=58) who were

fluent in English, able and willing to provide assent, resided at least 24 days per month in

the household under study, above the 5th BMI percentile for age and sex, and lacked

current health conditions or medications that caused significant diet or weight changes.

From the overall study sample, a sub-sample of children was invited to be interviewed.

Only one child refused the interview and two children were excluded based on sampling

criteria after data collection resulting in 47 interviews for analysis. The nature of

qualitative descriptive research prevented the sample size from being determined in

advance. Due to the rapid enrollment process necessary for the concurrent quantitative

aim, researchers were unable to determine saturation in analysis before the majority of

interviews were conducted. As analysis progressed, thematic saturation occurred with

fewer interviews than were collected (n=29), but the remaining interviews confirmed the

findings.

Maximum variation techniques (Patton, 2002) were used to select the

interviewees for analysis to ensure that each informant was as different as possible along

the dimensions of race, ethnicity, household income, and BMI. BMI was selected as a

measure of weight status since it is a widely accepted and validated unit of measurement

correlated with body fat (Garrow & Webster, 1985; Mei et al., 2002; U.S. Department of

Health and Human Services, 2009). Interviews with all overweight and obese children

($\geq$85th BMI percentile), children of most races and ethnicities, and from the lowest and

highest levels of household income and maternal education were selected for coding

based on the heterogeneous sampling technique.

Participants

Of the 47 participants that were interviewed, the average age of the sample was

12.4 years (range 11.1 to 14.5 years) with over half of the children in the sixth grade and

an equal amount of boys and girls. The majority of parents had a college degree or greater (28 participants) and were in the $75,000 to $99,999 income bracket (18 participants). The majority of participants were identified by their parents as white (34 participants), followed by black (9 participants), one or more races (3 participants), and Asian (1 participant). Only three children were identified as Hispanic. Sixteen participants were considered overweight ($\geq$85th and <95th BMI percentile), and only two participants were considered obese ($\geq$95th BMI percentile) (U.S. Department of Health and Human Services, 2009) based on measured weight and height from the quantitative data of the overall study.

Semi-Structured Interview Guide

All qualitative interviews were conducted using a semi-structured interview guide. The interview guide was structured using the funneling technique, which started with a general question about eating on a typical day and then worked towards gaining detailed perceptions of influences on food choice in the home environment using a series of probes. Initial probing questions were open-ended, such as "Can you tell me more about that?" Additional probing questions asked about different types of influences including people at home, food storage, food preparation, and food availability. Neither the questions nor analysis were directed by theory, which is critical in exploring potential factors that lie outside the bounds of established theory and in verifying the utility of theories that guide current research. Lastly, a summary question asked the child if there was any other information that would be important in understanding their food choices. The interview guide evolved throughout the course of the study to explore developing

concepts, however each child was asked about the same main focus areas to ensure

dependability in the data (Graneheim & Lundman, 2004).

Data Collection

A home visit was conducted with each family. Written consent and assent were

obtained from the parent and child respectively. Rapport between the participants and the

interviewer (JEH) was established by engaging in conversation about the child's interests

or current events. The interview was conducted before any other data collection at the

home visit to limit the potential Hawthorne effect from answering the questionnaires and

measuring weight and height. The interview was conducted with the child for 20 to 40

minutes in a private room. All interviews were audio-recorded using a digital recorder.

The interview began with a brief explanation of the purpose of the interview. The

interview guide was followed with flexibility for the informant's pace, comfort, and

expression. Ample time and space were created for the child to openly discuss his or her

thoughts on each topic to ensure that the participant's voice guided the interview. Upon

completion of the interview, each participant was asked if he or she were interested in

future contact to review some of the findings. Field notes about the interaction including

physical gestures and details about the surroundings were transcribed immediately

following the home visit.

Data Analysis

All interviews were fully transcribed by a professional transcription company,

checked against the audio-recording by the interviewer (JEH), and imported into NVivo

(Version 8, QRS International, Victoria, Australia) for analysis. A data-driven,

conventional content analysis (Hsieh & Shannon, 2005), informed by interactionist

techniques, was conducted with the goal to understand the main factors of influence

on food choice in the home. After a thorough read of transcripts, open coding was then

conducted for the first 13 interviews. An initial coding scheme was derived by

highlighting meaning units that capture key concepts (Graneheim & Lundman, 2004).

Extensive memos were written, which synthesized and directed the analysis and served as

an audit trail by documenting analytic decisions. Interactionist techniques, such as

constant comparison, were used to challenge the code development and understand the

social interactions in the data (Strauss & Corbin, 1998) by inductively comparing data

across each stage of the analytic process (quotes, codes, categories, larger categories,

themes) to produce more abstract concepts (Charmaz, 2006). Diagrams and flow charts

were also used to explore the data and advance analysis. Once codes were defined, the

codebook was applied to additional interviews selected based on maximum variation

sampling techniques to ensure that each informant was as different as possible along the

dimensions of race, ethnicity, household income, and BMI. After codes were verified

with additional data, categories surfaced in level II coding by clustering codes together

depending on their differences, similarities, and related links. Depending on the

relationship between the clusters, some categories were further combined into larger

categories (Hsieh & Shannon, 2005). During this stage, a food choice 'process' emerged

from the list of factors as an overarching theme, highlighting the grounded theory

overtones in the analysis. Theoretical saturation was reached after coding 29 interviews

and the remaining data served to verify the findings. In addition, four previously

interviewed participants were called to review the results and determine if the findings

adequately depicted their experiences. An experienced qualitative nurse researcher

(JAD) oversaw the progressive evolution of the interview guide in response to the content analysis and served as an auditor for analysis examining and critiquing each analytic stage: open coding, codebook formation, and category and theme generation. In addition, professional peer debriefing occurred weekly in a structured collective format. Both the role of the auditor and professional peer debriefing served to assess, challenge, and foster alternative perspectives and techniques throughout data collection and analysis. Descriptive statistics were used to depict the socio-demographic characteristics and BMI categories of the sub-sample.

Results

Food choice is the process of selecting food to eat. Children's food choice in the home involved three main components (the child, parent, and food) interacting over time. The parent created viable food options through food purchasing and preparation. The parent influences the child's attitudes and beliefs by setting rules, providing information and guidance, and modeling behaviors. The children described that their parent's actions were affected by the integration of the family's food preferences, time pressure and activity prioritization, food preparation effort and skills, and financial and health concerns. The child influenced the parent's actions through communicating preferences. Outside factors including peers, media, food outlets, and schools, were perceived by participants as having a less direct role in affecting both the parent and child. Final food choices were made when the child evaluated potential food options using their internal conditions, including hunger level, food preferences, time pressure and activity prioritization, food preparation effort and skills, and expected physical consequences of

food. Figure 1 illustrates these components, interactions, and context. Each element

of the food choice process discovered through the content analysis is described below.

The Context of Time

All food choices occurred within the context of time (Figure 1). Children's

activities throughout the day, week, and year were highly structured and helped form a

clear pattern in food choices across all participants. Children described the daily

sequence of activities that led up to or characterized occasions when they ate food in a

predictable, mundane manner. One sixth grade girl, described how eating fit into her

daily routine:

> "If it is a school day I normally have my mom wake me up. I go get dressed and eat breakfast.
> It's usually some cereal… I go to school and then at lunch… I normally have a fruit cup with it, a
> Sipps juice box…[after lunch I] Do more schoolwork, come home. Then I'll do some homework
> and then eat dinner."

The routine eating times consisted of morning/breakfast, lunch, after-school, dinner, and

dessert/after-dinner snack. Lunch and dinner were uniformly reported by most children

with dedicated time set aside for the meal by the school or parent, respectively. Children

also discussed the effects of past or future eating occasions on the current food choices.

One participant described how her decision to eat after-school depended on her

lunchtime:

> "It depends on what schedule I'm on either, A, B, or C week. For example on A, we eat [lunch] at
> 11:15 and then on B we eat the latest lunch and then C, we eat kind of in the middle so it depends
> on what schedules, if I'm hungry or not, usually when it's the later lunch I really don't eat
> anything, I just wait until dinner."

In addition to defining eating times, the time of day was associated with certain food

choices, such as pancakes in the morning and ice cream after dinner. Different food choices were discussed based on the time of the week. Children described foods offered at school lunch and dinner varying over the week or foods prepared on specific days of the week. Almost every participant noted which day of the week the school routinely served pizza for lunch. The largest difference throughout the week occurred in comparing weekday and weekend time periods. Weekday periods contained more obligatory activities (i.e. bus pick-up and class schedule) and as a result children's eating patterns were more structured. On weekends, children described a decrease in required, structured activities allowing greater personal preference for activities and time expenditure for both children and parents, as described by this participant:

> "On the school day you have to get up by a certain time and you got to be off by a certain time and everything's just put into, like in little time frames. On the weekend you just do whatever really."

Weekends were also conceptualized as a time to relax, have fun, and enjoy energy-dense foods that children may not typically eat on a weekday. One participant described his weekend food choices:

> "I personally consider weekend[s] more of the party time for lunch and what I mean by party time is like maybe pizzas, hot dogs and hamburgers and maybe ribs sometimes."

Food choices were also affected by the time of year. Variations in outside temperature and seasonal food items made certain foods appealing at different times. In addition, the structure of activities varied over the year with less structure over the summer and holiday vacations compared to time in school.

The Child

Children described several internal factors that motivated their decisions to eat and the foods they selected including: hunger levels, food preferences, time pressure and

activity prioritization, food preparation effort and skills, and expected physical consequences of food. These internal factors were influenced by the parent and interacted with the food to develop food choices in the home as depicted in the model (Figure 1).

Hunger levels: Fill me up. While not a food insecure population, many children discuss feeling hungry or not feeling hungry as a reason for choosing to eat or not to eat respectively. Hunger was described as a temporary drive to eat and not an enduring state due to persistent lack of food access. Children described continuing to feel hungry as a reason for eating more food within a defined period, such as having a second helping at dinner. Feeling hungry also justified the desired amount of food and speed of preparation. If a child was very hungry, they tended to describe eating greater amounts of food, more substantial types of food, and/or foods that can be prepared quickly to appease their feeling of hunger. Even if they were not currently hungry at a specified mealtime, children made food choices to prevent feeling hungry in the future when they would be unable to eat. One participant describes needing more food for lunch:

> "If I just have like sandwich in my lunch, it won't be enough…to help fill my hunger 'cause sometimes we have all our classes and then lunch."

Different reasons for hunger were provided including high-energy activities and an extended time without eating due to the scheduling of other meals/activities. A common circumstance occurred when class schedules required that children eat an early lunch causing them to be very hungry after-school. Although once they arrived home, many children talked about how they would only eat enough to appease their hunger until dinner because their parents expected them to eat the evening meal. One girl explains her

after school food choice:

> "Because it's not big but it will hold me over until dinner, but I won't be too full for dinner."

During dinner, hunger overrode children's preference for certain foods. Children described eating foods that they thought were "just okay" or that they "don't like" because they were hungry and no other options were permitted or available.

> "All the vegetables, are sometimes I like them, but sometimes I'm just hungry so I will eat them anyway. Same with everything else. Sometimes I will eat them because I like them, and sometimes I will eat them just because I am hungry… Sometimes we have to because or we'll starve overnight. That is what my mom says."

Food preferences: Love, hate, like, don't like, whatever. Food preference was the most frequently described factor influencing food choice. Children indicated the level of favor for particular foods expressed through positive ("like"), negative ("don't like"), and neutral ("it's okay" or "whatever") phrases. Children also conveyed emotions toward food in expressing their preferences. Strong emotions were revealed in describing food preferences of both positive and negative favor. These emotions were conveyed with impassioned language ("I love," "I just hate," and "my favorite") and an enthusiastic tone or animated body language, such as describing how "disgusting" tomatoes are with a grimaced facial expression. Lower levels of emotion were conveyed with a mundane, casual tone and muted expressions such as: "I like", "I don't like", "it's okay", and "whatever". Both the favor of and emotions toward food were important to how preference interfaced with other factors that affect food choice and the ultimate decision made by the child. Low levels of emotion and neutral levels of favor indicated a greater flexibility in food choice allowing other factors to override, such as parent rules and requests, or effort in preparation. For example, one boy explained why he ate vegetables

despite his preference:

> "My parents always like me to have at least one thing of vegetables, so I usually have broccoli or green beans, sometimes cauliflower, but I don't really like cauliflower as much."

High levels of negative emotion, such as disgust or hate, led to flat refusal of the food items without flexibility. Children also described a desire or craving for a particular food which seemed to have both an emotional and temporal element to the degree of the preference. Some children labeled themselves as "picky," which this boy described as having limited preferences:

> "It is the only ones I like, [I am] sort of a picky eater…I don't really have many things I like."

The taste of the food had the greatest influence on preference. Children described their taste evaluation of a particular food as a reason to choose certain foods. Taste was an individual experience, therefore not an attribute of the food itself (i.e. "It tastes good to me"). Taste has a similar favorableness dimension as preference with positive and negative expressions. Taste juxtaposed other food attributes and desires, particularly healthfulness. Healthy foods were assumed and assessed as bad tasting and surprise was expressed when this is not the case. One boy illustrated this juxtaposition in describing his cereal selection:

> "It is not like normal sugary cereal, but it is not like a like healthy-tastes-like-nothing kind of cereal and it has taste to it and it is not the like the most, the worst cereal you could eat."

Most children were not able to explain their preferences beyond the attribute of the food that they liked or disliked. Food preferences were closely linked with certain food attributes, especially foods that were sweet, "junk," fried, salty, and fruit. One participant describe his preference for sweet foods as why he chooses to eat the snack in his lunch first:

"I guess that I just I like things that contain sugar because of the sweetness and the flavor, so I tend to go for those first just cause I want the sweetness."

Food preferences also varied based on food patterns over time. Children select food because they favor the familiarity of habits, some variation from the routine, and excitement in trying new foods. Children described certain foods or food practices as occurring in a habitual routine by referring to "what we always have" or what they were "used to" and conveyed an element of comfort in the routine. Children also referred to routine as negative or monotonous indicating a preference for more variety or change, as described by this participant:

"We always have…the brown sugar kind at our house, and I'm really starting to get sick of it."

Children described both ordinary variations in routine, such as elaborate weekend breakfasts, and rare variations in routine or special occasions, such as birthdays. Most variations typically involved less healthy food items as described by this boy:

"But we don't usually have ice cream…Because my mom knows that it's not very good for us, so she doesn't get it as often, unless we just have had a party the day before that, we have leftovers like that."

Children also described experiences of trying new foods. Sometimes these descriptions communicated a mix of hesitancy and curiosity reflecting the uneasy feeling of veering from the familiar and the excitement of discovery. After trying foods, children adopted or rejected them based on food preferences. When trying leads to adoption, children seem excited by the discovery. Self-described "picky" eaters expressed an aversion to new foods.

Time pressure and activity prioritization: I don't have time. Children's assessment of the time they have available to eat and how they prioritize activities in this

time was another factor that influenced their food choice. In addition to the overall

context, time was viewed as a resource that could be allotted to different activities.

Children described preferences for different activities and prioritized them, especially

when time was scarce. When time was limited by the structured activities (catching the

bus) and/or there were many highly preferred competing activities (sleeping, watching

TV, playing with friends), food preparation and eating were not prioritized as described

by this participant:

> "Usually in the morning I don't have enough time to eat so I just go to school. [In order to eat
> breakfast] I would have to wake up early and I wake up early enough right now. 'Cause I wake up
> at 6:30 to get up, turn my alarm clock off and get dressed, brush my teeth and then by the time I
> am done doing all that stuff, I gotta go to my bus stop."

Children identified quick and easy food preparation and consumption as reasons for food

choices when time was limited and/or eating was not prioritized. For example, this

participant described how she valued time with friends, which affect her food choice for

lunch on weekend afternoons:

> "I like to hang out with my friends and so I try to eat as quickly as I can to go back down with my
> friends so I think that's the quickest [a peanut butter and jelly sandwich] to get back down to my
> friends."

Lack of food preparation effort and skills: Grab and open. Children's level of

food preparation effort and skill affected their food choices. Children described not

wanting to prepare foods or wanting foods that are convenient and easy to make and eat,

which led them to select pre-prepared foods that they could "grab and open." One

participant described how her desired level of effort affects her food choice after school:

"Well, sometimes I don't feel like making it and sometimes I do and sometimes I want

Ramen noodles at that time. And sometimes I don't."

In addition, children talked about their lack of food preparation skills as a reason why

they do not make certain foods for themselves, however this factor was not frequently

discussed. Effort and skill level limited food options when the parent was not at home

and the child was responsible for picking and preparing food.

Expected physical consequence of food: Food helps and hurts. Children

described foods that physically helped them or made them feel bad as reasons in selecting

certain foods. Children described foods as helping them with energy to perform tasks

during the day and with the ability to relax at the end of the day. Children discussed

health or dental issues, particularly cavities and braces, that prevented them from or

eating certain food or required certain foods. Children also talked about the general

concern of wanting to eat healthy as a reason for selecting foods like fruits and

vegetables, as described by this participant:

"I pick some of the vegetables and fruits because I know they're good for me."

Children avoided foods that may cause them pain or sickness due a negative past

experienced, such as heartburn, or fear of a negative health outcome. Children also

described weight concerns or desired weight loss as playing a role in their food choices.

Both boys and girls shared concerns of being judged as big in size.

The Parent

All children discussed how their parent(s) affect their food choices. Mothers play

a much greater role than fathers, except in single father families. Children detailed

several conditions related to their parents that affected the parent's actions including: the

parent's presence in the home, time pressure and activity prioritization, incorporating family members' preferences, food preparation effort and skills, and financial and health concerns. These conditions underlie the parent's actions of food purchasing and preparation and communication of rules and requests, which affect both the child and food in the home as displayed in the model of food choice (Figure 1).

Parent presence: When mom's home. Children described their parents' presence or lack of presence in the home as a factor that influences their food choices. If the parent was not present, the parent could not play a role in food preparation or guide eating decisions, which necessitated greater autonomy in the child. Parents were frequently not present or involved during the breakfast and after-school time periods. Without the parent present, children fixed foods that they preferred and that required less effort and skill to prepare. One participant described his food choices when his mother was not home:

> "Dinner usually it depends if…she's gone I usually just have like a Hot Pocket or those microwavable Taquitos…Hot Pockets are good and they're really easy to make."

Time pressure and activity prioritization: Mom doesn't have time. Similar to how children had competing priorities that contended for their time, children also described that their parents experienced time pressure and prioritized activities, including food preparation for the family. When time was limited and other activities were prioritized above food preparation, such as a parent's work, families tended to eat food from restaurants or children compensated by making more food themselves. One girl described going to a restaurant when her mother did not have time to cook:

> "If my mom is working that night sometimes we go out because she doesn't have time to make dinner"

Parent effort and skill: If mom doesn't feel life cooking. Children discuss their parent's desired effort in food preparation as a factor that affects what foods they eat at home, especially for meals typically prepared by parents. Along with time pressure, the lack of parent's desire to cook was one of the most common reasons for going to a restaurant or ordering take-out. In discussing why he eats food from a convenience store for dinner, one boy stated:

> "Because sometimes my mom, she gets back from work and she doesn't feel like cooking so we get stuff."

Children also identified their parents' higher skill level in preparing foods as a reason why their parents usually prepare food instead of the children. Parents were typically described as good cooks and children praised their skills.

Family food preferences: Everybody likes it. Children described their parent's concern for everyone's food preferences as a factor that affects parent's actions including food purchasing and preparations and subsequently children's food choices. Family food preferences included those of siblings, parents, visitors, and the child. This concern for everyone's preferences led parents to ask others about their preferences as this participant described:

> "Well everybody likes them 'cause it wouldn't be fair if one person liked food and the other person would have to eat something else. So my mom usually asks us what we want."

Sometimes other family members' preferences diverged from the child's own food preferences leading to tension or accommodation with the parent or child preparing a separate option, as this girl discussed:

> "Sometimes me and my brother won't like the same things…if he wants something for dinner that I don't want, then I'll just make my own food like I'll just make soup for myself."

A few children described having people visit their homes, mainly on weekends, and parents prioritized visitors' preferences in selecting foods to prepare for everyone.

Financial concerns: Not enough money. Some children talked about monetary concerns of the parents affecting food purchasing. The problem of not having enough money interacted with food costs and limited food purchases, especially of non-essential food items desired by children. Only two children mentioned the significant lack of money as a major factor for their parents, but many children discussed parent's frugality related to non-essential foods. One boy described how his father's finances affect his food choices,

> "I just eat stuff like rice and beans because my dad doesn't really have a lot of money for like something special...But he just really doesn't have a lot of money and rice and beans and French fries and fish sticks are just really cheap and they're just really good."

Health concerns: Keeping the family healthy. Children talked about parent's health concerns or desire to diet as shifting the entire family's food consumption towards more healthy choices. Health concerns were linked with a specific diagnosis of a family member ("I have soda rarely since my dad found out he has diabetes.") or a general desire to improve the diet of the family ("she [mom] is trying to keep the whole family healthy and on the right track"). Parents' health concerns affected the parent's actions of food purchasing, preparation, rules, and requests, which indirectly affect children's food options and choices.

The Food

Food was another essential component in the process of children's food choices. Children described several aspects of food that impacted their final food choices

including: the attributes, the availability in the home, and the cost of foods. These

aspects of food interacted with parent's internal factors (i.e. health and financial

concerns) and parent's food preparation and purchasing actions. The food also affected

child's internal factors (i.e. food preferences) and final food choices (Figure 1).

Food attributes: Sweet, salty, hot, homemade. Children described different

properties of food. These attributes were crucial in both their decision to select, make,

and eat them and their parent's decision to buy, pick, and prepare them by interacting

with preferences and concerns. Frequent attributes that children used to describe foods or

meals included: sweet, salty, flavor, plain, boring, spicy, sugary, color, temperature,

texture, brand name, amount, transportability, healthy/junk, cooking method, preparation

complexity, homemade, and pre-prepared. These attributes were often explicitly

described as reasons for selecting the food to eat ("I picked donuts because they are

sweet"). Although other factors in the process make the particular food attribute

important in the food choice. For example, one participant describes the importance of

each food attribute in packing a lunch:

> "Because the sandwich usually doesn't need to stay cold or hot. The chips are just easy, you
> just take them out and throw them in a bag and then the fruit is just kind of like something
> sweet."

Most attributes influenced taste evaluations and informed food preferences. Other

attributes are more subjective and represent the child's interpretation of the food (i.e.

healthy/junk). Parents' communication of nutrition information influenced this

interpretation.

Food available at home: Whatever we have in there. Viable food options were defined by what is present or available in the setting and permissible for the child to eat. Children described the mere presence of foods in their home as a reason for their food choice. Some children stated that they eat whatever is available to them without further reason, "whatever is around the house, I guess." When asked about foods available in the home and prompted about specific food groups, most children reported that foods in all major groups were available. When asked about foods they wished to have available, sweet snacks were most frequently mentioned. Foods available at home varied over time. Children described running out of foods that are consumed rapidly and/or infrequently purchased. One participant described the availability of yogurt over time,

> "Usually there is yogurt but I eat it a lot, so a lot of times it disappears fast and until we go to the supermarket again."

Food not only had to be present, but also could not be reserved for other purposes or individuals. Children described leaving or saving foods for other members in their household or other purposes when making food choices. Some foods were present, but there was a limited supply and had a competing use making them not available for consumption, as this participant explained:

> "If we have more apples, then I'll just grab an apple so that there's more cookies for everybody else."

Food cost: Expensive or on sale. Children described foods as expensive, cheap, or "on sale." The cost of the foods was discussed as limiting factors to their parent's ability to purchase certain foods, particularly food items conceptualized as non-essential, but desired by the child. One participant describes how food cost affects food availability

in the home,

> "Well sometimes we go to the supermarket and there are foods that are more expensive like
>
> strawberries or grapes, that I like to eat but we just can't get them because they are way too
>
> expensive."

Children also discussed food cost as a factor that influenced their decision to buy school

lunch or bring lunch from home with some children describing buying as the less

expensive option and others described packing as the less expensive option.

Outside Influences

Children described several influences that were not always physically within the

home, but still asserted influence on their food choices at home including peers, media,

food outlets, schools, and other home settings (Figure 1). Overall, the participants

described these influences less frequently compared to other factors in the model.

Peer influence. Children discussed their peers affecting their food choices. The

most frequent and significant role peers played involved creating social pressure for

children to eat what everyone else eats, particularly in the school setting. One participant

described this influence:

> "Most of the time I just…go with the flow… Like you just do what everyone does."

Friends also played a minor role in providing access to food outside the home by buying

or sharing food with children at school and in other home settings. Friends encouraged

children to try new foods, which influenced preferences and requests in the child's own

home as described by this participant,

> "Right now we have a…box of kiwi because a really good friend of mine has me eating a lot of
>
> foods that I've never tried before, and we tried kiwi and it was really good, so I have that here."

Peers serve as companions in eating and making food, however this was far less of a significant role compared to the parent.

Media. Only two children mentioned learning about foods or health issues through media sources. In one instance, the child came to desire an energy-dense, sugary breakfast item by watching a commercial. Another child learned about the dangers of obesity and diabetes from a television show on MTV.

Food stores. Children described large chain supermarkets where their parents did most food shopping. Some children talked about going with their parents and requesting certain foods in this setting. Only three children talked about visiting convenience or corner stores independently after-school or on the weekends to purchase snacks.

Restaurants. Children talked about going out to eat at restaurants and their parents ordering take-out foods. Going out to eat on the weekends was more frequent than during the week, but was still not described as a typical practice. Children talked about going out to eat with enthusiasm and recounted the experiences readily even though they were infrequent. Children mentioned that if the location was close to the home, parents could get food from restaurants as take-out easily when they did not have time or effort to prepare dinner at home.

School. Children described eating school lunch and the school activities schedule affecting their hunger levels when they came home. Children expressed autonomy in selecting foods from the lunch and snack lines, however, the school provide parents the ability to limit food purchasing at school through electronic account restrictions. One participant describes how her parents limit her purchase of snacks at school,

"My account…will only let me get the lunch, so sometimes I am still hungry…At school,

you can put money into the account and then just type in your number instead of brining in

cash…I need to bring in a note if I want to get a snack cause they will have pretzels, chips, stuff

like that, you could get."

Actions

As depicted in the model (Figure 1), both parent and child actions play vital roles

in the process of children's food choice. Parents influence food choices of the child by

setting rules, requesting actions, providing information, and modeling behaviors. Parents

also influence the food in the home environment as the main agents of food purchasing

and preparation. These actions create food options in the home leading to interactions

between the child and food, and ultimately the child's food choice. Figure 2

demonstrates the interactions of the components and their conditions leading to ultimate

food choices of children over time.

Food purchasing: Parent buys. Children talked about their parents' purchase of

foods or unwillingness to purchase as a reason for their eating the food or having the food

in the home. While some children talked about food shopping with their parents or

having their parents take their preferences into account, most communicated a lack of

input regarding food-purchasing decisions. Children also described parent's financial

and health concerns informing food purchasing. In response to a question of how other

people affect food choices, one participant spoke to the parent's dominant influence by

buying food:

"The only people who affect what we eat at home is our parents because they're the ones who

spend the money to get the things at the grocery stores so they basically have the decision on

what comes into the house."

Parents also decided when the family would interface with the outside food outlets

by eating out at a restaurant or ordering take-out food.

    Food preparation: Parent picks and prepares. Children described their

parents' direct influence on their food choices through the parents' actions of picking out

and preparing food. Most children identified their parents as responsible for preparing

dinner and packing lunch. Parent effort, skills, and presence in the home affected food

preparation. A difference between picks and prepares or just prepares was identified in

the data. If the parent both selected and prepared the food, the influence of the child's

food preferences was not explicitly accounted for. If the parent just prepared food, it

allowed for the possibility that the child could have input on the selection. However,

many children communicated a lack of autonomy in meal preparation, as conveyed by

this participant in explaining what she eats for dinner,

> "So, whatever my mom makes that night, I guess…Whatever she makes. It depends on what she
> feels like making."

    Rules, guidance, and modeling: Parent allows, says, wants, does. Children

described how their parents indirectly affected their food choices through rules, provision

of information, and behavior modeling. Children described being "allowed," "not

allowed," or required to consume certain foods or drinks by their parents, as illustrated by

this participant's decision:

> "When I come home…we have dinner so I am not allowed to eat anything till 'cause I have to
> eat all my dinner."

A few children described parental threats of a consequence and/or use of a bribe or

reward to guide behavior. For example, a participant described how her mother

encouraged her with candy to clean her room. Some children described their parent's

requests or encouragement for the food they eat as guiding food choices, which was less punitive than being "allowed" or "not allowed." One participant described how his mother's encouragement guided his food choices,

> "My mom always, when I was little, she would want me to eat healthy things and be healthy so it was, it just kind of became a habit and then just when I get school lunches that's what I choose."

Children also identified parents as a source of nutrition information. Two children described modeling parent eating behaviors. One participant modeled the negative behavior of eating candies throughout the day from watching her father, and another child was motivated to eat well and exercise after his mother initiated a weight loss program for herself.

Reciprocal requests: Asking and picking. Parents both asked for children's opinions on food and children offered their requests. Sometimes parents ask for the child's preference to inform their decisions. Opinions were solicited by parents either as an open question or by providing a list of options. Some children talked about how they would ask for certain foods from their parents usually before or during food shopping or meal preparation. While the parent was clearly described by all children as the ultimate gatekeeper, this interaction demonstrates the reciprocity between the parent and children and the importance of the child's preferences in determining the food in the home and at meals.

Child's food choice: I pick, I make, I have, I don't eat. The food-purchasing and preparation actions of the parent ultimately created viable food options for the child. From the food options, the interaction between the child and food

determined the ultimate action of food choice in the home. Children talked about the

foods that they pick, make, have, and don't eat. Children described occasions in

which they independently selected or made their own food. More children described

preparing breakfast and snacks for themselves due to factors, such as lack of parental

presence, parent's time pressure, and ease of the preparation process. The foods

children described making for themselves typically required no preparation or simple

preparation due to minimal effort and skills and prioritization of other activities. Very

few children described preparing dinner. Older girls participated in more food

preparation, including making family meals, and expressed a greater sense of

autonomy than younger girls and boys of all ages. For example, one eighth grade girl

described making dinner for her family:

> "If I make it, we always have either Hamburger Helper, or mac and cheese."

Most often, children specified their ultimate food choice using the phrase "have" or eat.

For example, one participant stated,

> "I usually have a snack, like chips or sometimes I have an apple sometimes. And then I have
> dinner."

Children also spoke firmly about foods they "don't" or "won't" eat. This refusal of

certain foods not only communicated a strong, negative preference, but was also directly

linked with the action of not eating – if children don't like it, they typically don't eat it.

This refusal of certain foods was a powerful food choice action connoting autonomy.

With various factors influencing this final step, the actions of the child to pick, make,

have, or not eat ended the process of food choice.

Discussion

The findings described the process of children's food choices at home by identifying the overall context, main interacting components, and key actions. The context of time influences all components and actions. The main components of food choice are the child, parent, and food. The parent creates food options through food purchasing and preparation. The parent affects the child's attitudes and beliefs by setting rules, providing information and guidance, and modeling behaviors. The child affects the parent's decisions through communicating their preferences. Outside influences secondarily affected the child, parent, and food. Final food choices are made when the child evaluates viable options based on their hunger level, food preferences, time pressure and activity prioritization, food preparation effort and skills, and expected physical consequences of food. Children's perspective on the environmental contributions to their food choices involved food availability. Children identified the parent as the main gatekeeper of food availability, however children could influence what foods were in their home by requesting food on their own or when asked by their parent.

Two of the most influential factors described by the participants were food preferences and the role of the parent. Children's food preferences were the most frequently cited factor affecting food choice. These preferences were also communicated to the parent, further affecting food preparation and purchasing. The importance of taste, liking, or preference for foods surfaced in at least five other qualitative studies of older children (Baranowski et al., 1993; McKinley et al., 2005; Molaison et al., 2005; Neumark-Sztainer et al., 1999; Wind et al., 2005). However, previous studies did not

identify the emotional dimension that underpins preferences as being an important component in understanding food choices.

Children described the primary role their parents play as a gatekeeper to food in their homes. Other qualitative studies have also articulated the vital role of the parent in a child's food choices, however the level of control varied. A study of children 7 to 11 years old found that older children described parents acquiescing to most food desires, which contrasted starkly to the parents firmer stance with younger children (Warren, Parry, Lynch, & Murphy, 2008). Most other studies described interplay between children's preferences and parents gatekeeping, with the ultimate control lying in the parents' actions (Molaison et al., 2005; Neumark-Sztainer et al., 1999; Wind et al., 2005). Bassett and Began (2008) provide a thorough description of the co-construction of food choice between parents and children that reflect a similar interaction found in this study.

Early adolescence, 12 to 14 years old, is a time of increasing independence in which children make more of their own choices, but also requires continued support from parents (U.S. Department of Health and Human Services, 2005). This balance of independence and support is present in the findings. Participants clearly expressed their preferences and burgeoning role in food choice, but they also described that their parents still playing a major role in the process through purchasing and preparing foods. While children exert their growing autonomy, parents still have great influence in shaping children's food choices by making foods available and accessible in the home environment. This developmental stage requires a balance of autonomy and support in which the home food environment is an essential place of intervention.

Theoretical Comparisons

The factors that affect food choice can be mapped onto the Ecological Model of Health Behavior to assess the utility of the framework in explaining the overall process and directing further research. The factors that affect children's food choice can be placed across all levels of influence, including, intrapersonal, interpersonal, and community levels, and shape one another producing reciprocal causation of behaviors as the Ecological Model specifies (McLeroy et al., 1988). Intrapersonal factors involve individual characteristics such as psychobiological influences. The internal factors of the child (hunger level, food preferences, etc.) would be placed on this level. The interpersonal level involves processes that occur between people and within primary groups like the family. The parent, peers, and the interactions between the parent and child would comprise the factors that fit into this level of the ecological framework. The community level involves organizational, community, and public policy factors. This would involve food stores, restaurants, schools, and the media. Booth and colleagues also defined 'enablers of choice' as part of the Ecological Model, which are the enhancers or barriers to behavior (Booth et al., 2001). These would include time and food attributes, availability, and cost. While the Ecological Model allows for the placement of all the inductively determined factors that affect children's food choice and notes their reciprocal causation, it lacks specificity within and between levels, causing experts to encourage the incorporation of other models (Sallis & Owens, 2002). The model of children's food choice process in the home helps to articulate the actions and interactions within and between the different levels of influence. Approaching childhood obesity research with adaptations of the Ecological Model assures that the all levels of

influence are accounted for, but additional inductive research is needed to articulate

the intricacies of food choice in specific settings and populations.

Strengths

While previous studies have explored children's perspectives of factors that affect

food choice, none have used an inductive approach to articulate the food choice process

separately from pre-formed theoretical assertions. Several of the studies list the factors or

rank them by importance, however no study describes the process whereby the factors

interact and produce food choice from the children's perspectives. The inductive data-

driven approach of this study fostered a level of detail to emerge from the participant's

voices. In addition, the private interviews allowed for independent responses and greater

depth of each individual child's process to become known compared to focus groups

commonly employed in many other studies.

Limitations

The limitations of the study included sampling issues and inherent methodological

issues. The study involved only two children over the 95th BMI percentile for age and

sex limiting the variation of the participants and the breadth of data collection. The

sample was also more highly educated, wealthier, and less overweight than the national

average. In addition, more control-oriented parents may have signed up for the overall

study, possibly affecting how the parent was described in the data. While a characteristic

of the method and not a limitation of the study, findings are not transferable to dissimilar

populations. Children in different communities, such as those experiencing food

insecurity or in dense urban areas with different distributions of food outlets, like corner

stores, may identify or emphasize different factors that affect food choices. In addition,

the factors enumerated in this process were those perceived and explicitly expressed

by the child. Certain factors may contribute to food choice, but were not perceived or

expressed by the child, such as advertising or lack of food availability on a community

level. Lastly, the level of abstraction was also limited by the qualitative descriptive

approach, although interactionist techniques aided in the abstraction of the interactions

between categories and allowed the process to emerge from the analysis.

Implications for Research

Future research should describe children's food choices in dissimilar populations

and utilize additional data collection methods to triangulate the factors that affect food

choices. Other data collection methods and sources, such as participant observation and

interviews with parents, would help describe factors that children do not directly perceive

and provide a more complete model of food choice.

In terms of intervention, the findings from this study support a family-based

approach to obesity prevention and treatment for children and adolescents. Most obesity

prevention approaches have been school-based and involved the family in a limited

capacity, such as provision of educational materials (Doak, Visscher, Renders, & Seidell,

2006). Studies on home-based strategies and extensive preventative behavioral

interventions with both parents and children have been recently published, but need

further testing (Fulkerson et al., 2010; Olvera et al., 2010). Family-based obesity

treatment approaches, which have typically involved cognitive-behavioral programs with

both the child and parent, are more established (Dalton & Kitzmann, 2008; Young,

Northern, Lister, Drummond, & O'Brien, 2007). Several of the interventions address

factors identified in this study, particularly for the parent, such as encouraging parents to

make healthy foods available at home and provide healthy food choice

encouragement to their children. Inductive research on parent's perspectives of the

factors that affect children's food choice would help identify any missing or undervalued

elements to improve the interventions. While some obesity interventions have a

cognitive-behavioral approach, they may not adequately address all of the internal factors

of the child and their respective interactions that derive food choices.

In understanding the dynamic process of children's food choices, practical loci for

intervention emerge. For example, on weekday mornings, kids typically want to sleep as

late as possible without missing the bus. This time pressure, combined with a taste

preference for sweet foods, a low desire to make foods, and a lack of parental presence

leads children to select pre-packaged, higher-energy foods, like breakfast pastries, or to

skip breakfast altogether. Since research has demonstrated a link between these breakfast

behaviors and weight status (Timlin, Pereira, Story, & Neumark-Sztainer, 2008),

brainstorming ways to address this scenario, such as encouraging children to wake up

earlier or encouraging parents to provide a transportable, lower-energy breakfast option,

might be a simple and effective idea to impact obesity. Another common scenario ripe

for intervention involved food choices after school. Children typically arrive home from

school feeling very hungry and lack the desired effort to prepare foods because of

competing activities like homework or playing with friends. Since the parent was not

usually present at this time, kids frequently selected higher-energy snacks that were

available, convenient, and tasted good to them, such as cookies, granola bars, and chips.

Working with children to find healthier snacks that they enjoy, such as low-fat yogurts

and fruit, and working with parents to encourage these choices and make them more

available in the home would be another practical contribution to family-based

obesity programs. Interventions should consider all the coalescing factors and identify

common scenarios for intervention to have a lasting impact on dietary behaviors. The

inductive descriptions of setting-specific food choice processes provide a more nuanced

understanding of behavior, which can help improve interventions to address dietary

behaviors and weight status outcomes.

Acknowledgements

References

Baranowski, T., Domel, S., Gould, R., Baranowski, J., Leonard, S., Treiber, F., & Mullis, R. (1993). Increasing fruit and vegetable consumption among 4th and 5th grade students - results from focus groups using reciprocal determinism. *Journal of Nutrition Education, 25*(3), 114-120.

Bassett, R. C.,Gwen E., & Beagan, B. L. (2008). Autonomy and control: The co-construction of adolescent food choice. *Appetite, 5*0(2-3), 325-332,

Birch, L. L., & Davison, K. K. (2001). Family environmental factors influencing the developing behavioral controls of food intake and childhood overweight. *Pediatric Clinics of North America, 48*(4), 893-907.

Booth, S. L., Sallis, J. F., Ritenbaugh, C., Hill, J. O., Birch, L. L., Frank, L. D., Glanz, K., Himmelgreen, D. A., Mudd, M., Popkin, B. M., Rickard, K. A., St Jeor, S., & Hays, N. P. (2001). Environmental and societal factors affect food choice and physical activity: Rationale, influences, and leverage points. *Nutrition Reviews, 59*(3 Pt 2), S21-39; discussion S57-65.

Charmaz, K. (2006). Coding in grounded theory practice. *Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis* (pp. 42-71). London: SAGE Publications.

Cullen, K. W., Baranowski, T., Owens, E., Marsh, T., Rittenberry, L., & de Moor, C. (2003). Availability, accessibility, and preferences for fruit, 100% fruit juice, and vegetables influence children's dietary behavior. *Health Education & Behavior, 30*(5), 615-626.

Dalton, W. T.,3rd, & Kitzmann, K. M. (2008). Broadening parental involvement in family-based interventions for pediatric overweight: Implications from family systems and child health. *Family & Community Health, 3*1(4), 259-268.

Doak, C. M., Visscher, T. L., Renders, C. M., & Seidell, J. C. (2006). The prevention of overweight and obesity in children and adolescents: A review of interventions and programmes. *Obesity Reviews,* 7(1), 111-136.

Fulkerson, J. A., Rydell, S., Kubik, M. Y., Lytle, L., Boutelle, K., Story, M., Neumark-Sztainer, D., Dudovitz, B., & Garwick, A. (2010). Healthy home offerings via the mealtime environment (HOME): Feasibility, acceptability, and outcomes of a pilot study. *Obesity, 18 Suppl* 1, S69-74.

Garrow, J. S., & Webster, J. (1985). Quetelet's index (W/H2) as a measure of fatness. *International Journal of Obesity,* 9(2), 147-153.

Glanz, K., Sallis, J. F., Saelens, B. E., & Frank, L. D. (2005). Healthy nutrition environments: Concepts and measures. *American Journal of Health Promotion, 19*(5), 330-3, ii.

Graneheim, U. H., & Lundman, B. (2004). Qualitative content analysis in nursing research: Concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today, 2*4(2), 105-112.

Guenther, P. M., Dodd, K. W., Reedy, J., & Krebs-Smith, S. M. (2006). Most Americans eat much less than recommended amounts of fruits and vegetables. *Journal of the American Dietetic Association, 10*6(9), 1371-1379.

Holsten, J. E., Compher, C. W., Deatrick, J., & Kumanyika, S. (2010).

Understanding the relationship between children's body mass index and home food

environment within the context of food choice: A concurrent mixed methods study.

Unpublished manuscript, University of Pennsylvania, Philadelphia, PA

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis.

*Qualitative Health Research, 1*5(9), 1277-1288.

McKinley, M. C., Lowis, C., Robson, P. J., Wallace, J. M., Morrissey, M., Moran, A., &

Livingstone, M. B. (2005). It's good to talk: Children's views on food and nutrition.

*European Journal of Clinical Nutrition, 5*9(4), 542-551.

McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective

on health promotion programs. *Health Education Quarterly, 1*5(4), 351-377.

Mei, Z., Grummer-Strawn, L. M., Pietrobelli, A., Goulding, A., Goran, M. I., & Dietz,

W. H. (2002). Validity of body mass index compared with other body-composition

screening indexes for the assessment of body fatness in children and adolescents. *The

American Journal of Clinical Nutrition, 7*5(6), 978-985.

Molaison, E. F., Connell, C. L., Stuff, J. E., Yadrick, M. K., & Bogle, M. (2005).

Influences on fruit and vegetable consumption by low-income black American

adolescents. *Journal of Nutrition Education & Behavior, 3*7(5), 246-251.

Neilsen, S., Siega-Riz, A., & Popkin, B. (2002). Trends in energy intake in U.S. between

1977 and 1996: Similar shifts seen across age groups. *Obesity Research, 1*0(5), 370-

378.

Neumark-Sztainer, D., Story, M., Perry, C., & Casey, M. A. (1999). Factors influencing food choices of adolescents: Findings from focus-group discussions with adolescents. *Journal of the American Dietetic Association, 9*9(8), 929-937.

Ogden, C. L., Carroll, M. D., Curtin, L. R., Lamb, M. M., & Flegal, K. M. (2010). Prevalence of high body mass index in U.S. children and adolescents, 2007-2008. *The Journal of the American Medical Association, 30*3(3), 242-249.

Olvera, N., Bush, J. A., Sharma, S. V., Knox, B. B., Scherer, R. L., & Butte, N. F. (2010). BOUNCE: A community-based mother-daughter healthy lifestyle intervention for low-income Latino families. *Obesity, 18 Suppl* 1, S102-4.

Patton, M. (2002). Purposeful sampling. In M. Patton (Ed.), *Qualitative Research and Evaluation Method*s. Thousand Oaks, CA: Sage Publishers.

Rosenkranz, R. R., & Dzewaltowski, D. A. (2008). Model of the home food environment pertaining to childhood obesity. *Nutrition Reviews, 6*6(3), 123-140.

Sallis, J. F., & Owens, N. (2002). Ecological models of health behavior. In K. Glanz, B. K. Rimer & F. M. Lewis (Eds.), *Health Behavior and Health Educatio*n (3rd ed., pp. 462-484). San Francisco: Jossey-Bass.

Sandelowski, M. (2000). Whatever happened to qualitative description*? Research in Nursing & Health, 2*3(4), 334-340.

Strauss, A., & Corbin, J. (1998). *Basics of Qualitative Researc*h. Thousand Oaks, CA: Sage Publications.

Sullivan-Bolyai, S., Bova, C., & Harper, D. (2005). Developing and refining interventions in persons with health disparities: The use of qualitative description. *Nursing Outlook, 5*3(3), 127-133.

Timlin, M. T., Pereira, M. A., Story, M., & Neumark-Sztainer, D. (2008). Breakfast eating and weight change in a 5-year prospective analysis of adolescents: Project EAT (Eating Among Teens). *Pediatrics, 12*1(3), e638-45.

U.S. Census Bureau. (2008). *American FactFinder*. Retrieved August 1, 2008, from www.factfinder.census.gov

U.S. Department of Health and Human Services. (2005). *Child development: Early adolescence*. Retrieved March 21, 2010, from http://www.cdc.gov/ncbddd/child/earlyadolescence.htm

U.S. Department of Health and Human Services. (2009). *Healthy weight – it's not a diet, it's a lifestyle!, About BMI for children and teens*. Retrieved April 1, 2010, from http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_b mi.html

Wang, Y. C., Bleich, S. N., & Gortmaker, S. L. (2008). Increasing caloric contribution from sugar-sweetened beverages and 100% fruit juices among U.S. children and adolescents, 1988-2004. *Pediatrics, 12*1(6), e1604-14.

Warren, E., Parry, O., Lynch, R., & Murphy, S. (2008). 'If I don't like it then I can choose what I want': Welsh school children's accounts of preference for and control over food choice. *Health Promotion International, 2*3(2), 144-151.

Wind, M., Bobelijn, K., De Bourdeaudhuij, I., Klepp, K. I., & Brug, J. (2005). A qualitative exploration of determinants of fruit and vegetable intake among 10- and 11-year-old schoolchildren in the low countries. *Annals of Nutrition & Metabolism, 4*9(4), 228-235.

Young, K. M., Northern, J. J., Lister, K. M., Drummond, J. A., & O'Brien, W. H.

(2007). A meta-analysis of family-behavioral weight-loss treatments for children.

*Clinical Psychology Review, 2*7(2), 240-249.

THE PROCESS OF CHILDREN'S FOOD CHOICES AT HOME
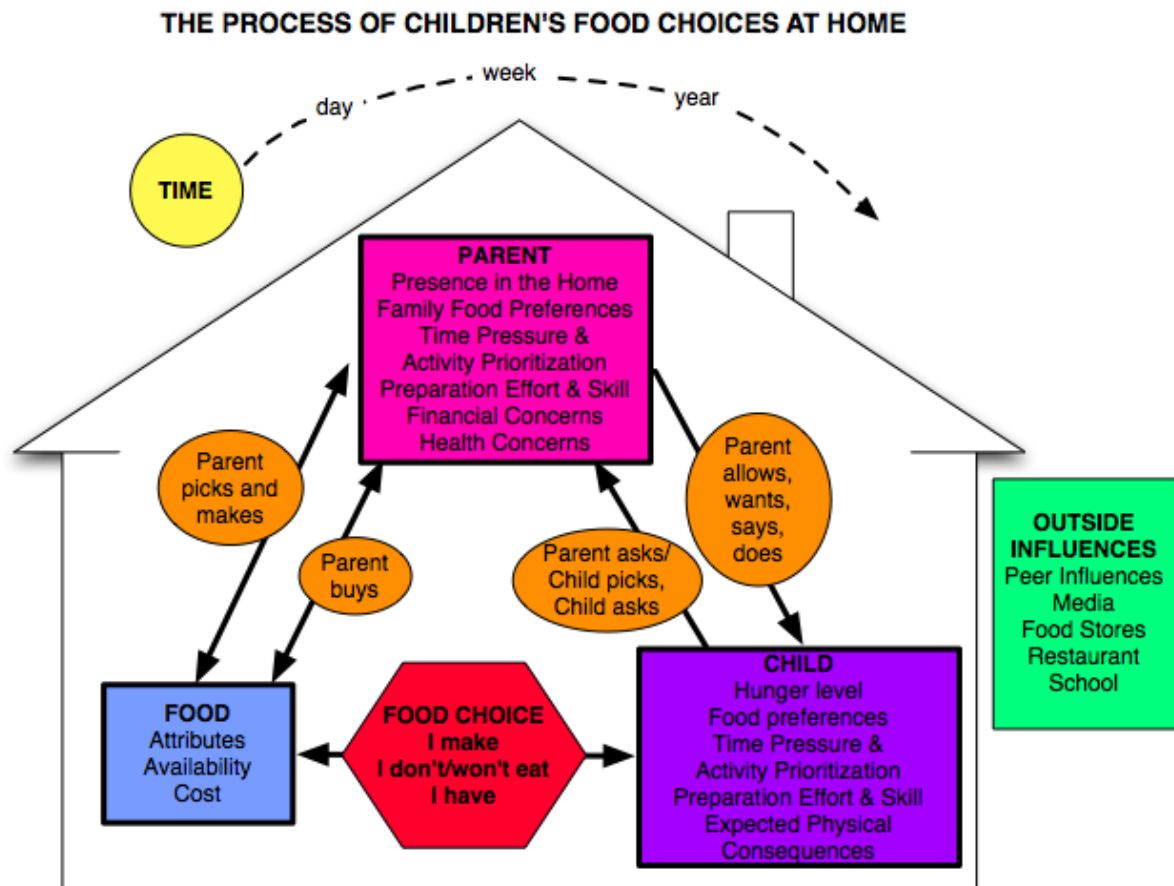
Figure 1. A model depicting the process of children's food choices in the home setting.
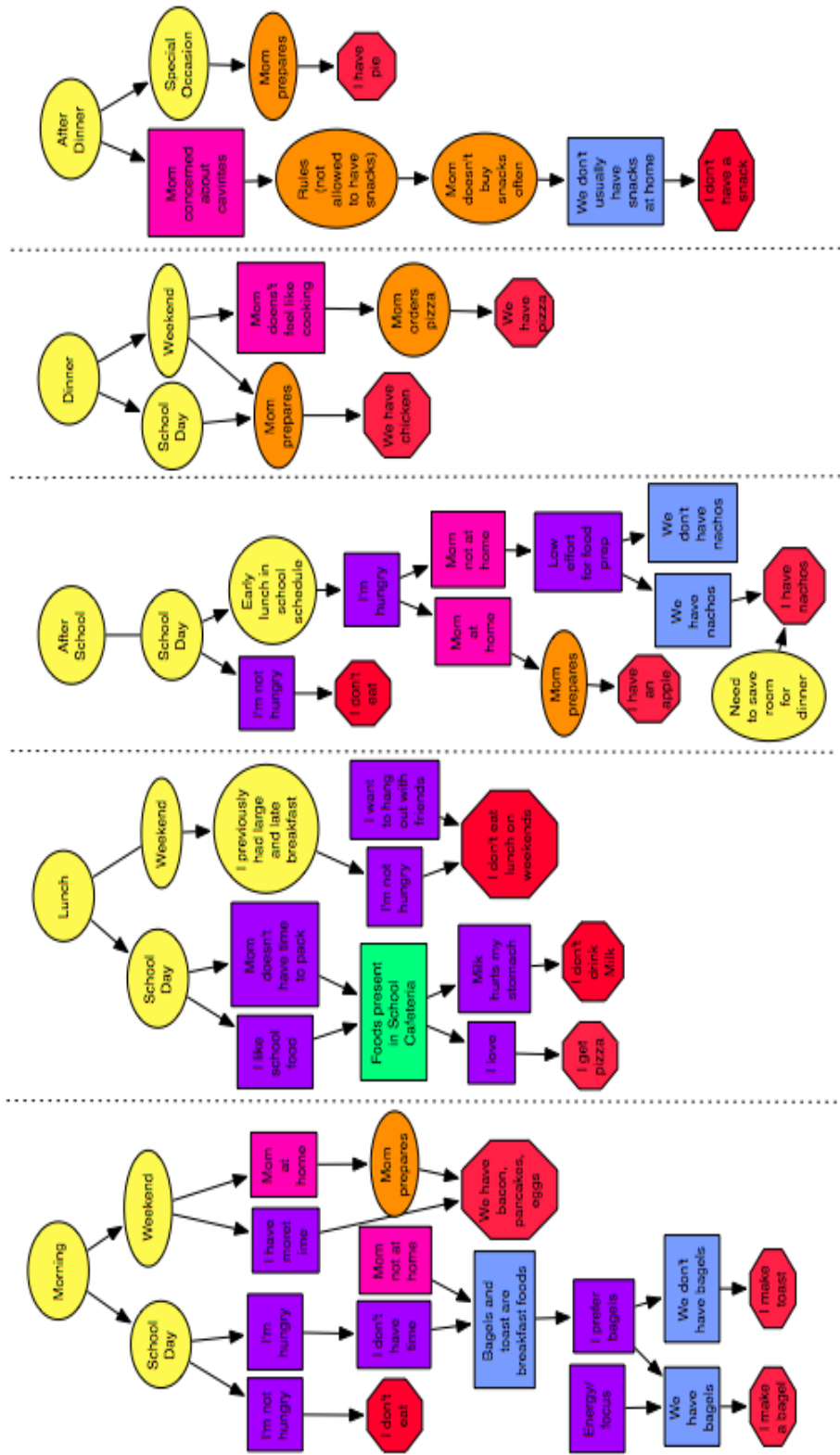
Figure 2. A flow diagram depicting a child's food choices throughout a typical week.

Understanding the Relationship Between Children's Body Mass Index and Home Food

Environment within the Context of Food Choice: A Concurrent Mixed Methods Study

Joanna E. Holsten, MPH, MS, RN

University of Pennsylvania, School of Nursing

Dissertation

Chairperson: Charlene W. Compher, PhD, RD, FADA, CNSD, LDN

Committee Members: Janet A. Deatrick, PhD, FAAN, RN

Shiriki Kumanyika, PhD, MPH

Jennifer Pinto-Martin, PhD, MPH

Abstract

This concurrent mixed-methods study examined the relationship between children's physical home food environment and BMI as seated within the contextual process of food choice. Home food availability and accessibility were not significantly associated with BMI z-scores after controlling for covariates. However, dietary intake of fruits, low-fat dairy, and sugar-sweetened beverages were correlated with their availability in the home. Qualitative data revealed that overweight children emphasized weight concerns and nutritional aspects of foods, such as calories and portion sizes, in describing their food choices. They also expressed greater emotion in their preferences for and awareness of higher-energy foods in their homes compared to their healthy weight counterparts. The inconsistency between the desire to lose weight and preferences for and awareness of higher-energy foods along with the associations between availability and intake support a focus on the physical home environment in obesity interventions. Future research should test the relationship between the home food environment, dietary intake, and BMI with larger cross-sectional or prospective studies and explore children's process of food choice in other settings.

Keywords: home food environment, children, obesity, overweight, body mass index, food choice

Understanding the Relationship Between Children's Body Mass Index and Home

Food Environment within the Context of Food Choice: A Concurrent Mixed Methods

Study

Introduction

Childhood obesity affects 19% of children 6 to 19 years old, representing a three-fold increase over almost three decades (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Dietary intake and physical activity are the primary behaviors underlying the energy imbalance that causes excess weight gain, however interventions targeting these behaviors at the individual level have not had lasting impact (Summerbell et al., 2005). The Ecological Model of Health Behavior emphasizes the need to examine several levels of influence on behavior from the individual to public policy and interactions between all levels (McLeroy, Bibeau, Steckler, & Glanz, 1988). Of these influences, one of the greatest gaps in the literature involves the investigation of environmental contributions to the obesity epidemic and the interactions of environmental factors with individual behaviors. Over the last few decades the availability of inexpensive, convenient, energy-dense food has increased (Putnam, Allshouse, & Kantor, 2002); and the percentage of youth meeting the United States Department of Agriculture (USDA) dietary recommendations has decreased (Munoz, Krebs-Smith, Ballard-Barbash, & Cleveland, 1997). These changes have coincided with the escalation of obesity (Binkley, Eales, & Jekanowski, 2000).

The food environment involves sources of energy and other nutrients and the circumstances surrounding their procurement (Holsten, 2009). While the food environment of children spans numerous settings, children consume two thirds of food at

home (Neilsen, Siega-Riz, & Popkin, 2002) highlighting the crucial role of the home food environment. The physical home food environment involves availability and accessibility of food in an individual's residence. Availability refers to the presence of foods, and accessibility refers to the placement, preparation, and maintenance of foods that encourage consumption (Hearn et al., 1998). The physical home food environment is a fundamental element of food choice and should subsequently affect body mass index (BMI). However, considering challenges in measuring dietary intake, such as systematic bias by BMI (Savage, Mitchell, Smiciklas-Wright, Symons Downs, & Birch, 2008), and the educational and contextual implications of the environment, it is important to understand the direct relationship between the physical home food environment and BMI, beyond dietary intake.

Many cross-sectional studies have found direct associations between children's dietary intake and home food availability and accessibility (Pearson, Biddle, & Gorely, 2009); however, few studies have examined the relationship between the home food environment and BMI (Ard et al., 2007; Byrd-Bredbenner & Abbot, 2009; Downs et al., 2009; Gable & Lutz, 2000; Haines, Neumark-Sztainer, Wall, & Story, 2007; Humenikova & Gates, 2008). One study found that greater availability of vegetables was associated with lower BMI-for-age (Humenikova & Gates, 2008). Two studies found some unexpected results with greater availability of high-energy snack foods inversely associated with overweight in girls (Haines, Neumark-Sztainer, Wall, & Story, 2007) and lower nutrition adequacy ratios for kilocalories and saturated fat (lower amounts) available in households with an obese child (Byrd-Bredbenner & Abbot, 2009). These studies used limited self-report or cross-sectional measures of the food environment and

did not account for many BMI covariates indicating the need for research to clarify

this relationship using valid measures and designs.

In addition, describing the context of children's food choices at home is critical in

identifying other factors that help explain the relationship between the home food

environment and BMI. A qualitative analysis of interviews with middle school children

described the process of children's food choice in the home as involving three main

components: the child, parent, and food. The parent created food options through food

purchasing and preparation and affected the child's attitudes and beliefs by setting rules,

providing information and guidance, and modeling behaviors. The child affected the

parent's decisions through communicating food preferences. Pertinent aspects of the

food included its cost, attributes, such as flavor and preparation, and availability within

the home. Final food choices were made when the child evaluated viable food options

based on his/her hunger level, food preferences, time pressure and activity prioritization,

food preparation effort and skills, and expected physical consequences of food (Holsten,

Deatrick, Compher, & Kumanyika, 2010). By comparing these factors by weight status,

potential differences may help explain the relationship between the home food

environment and BMI. In addition, interpreting the quantitative findings within the

context of food choice can lead to a nuanced understanding of the relationship and

potentially help direct future research and refine interventions.

This concurrent mixed-methods study examined the relationship between physical

home food environment and BMI of middle school children as seated within the

contextual process of their food choices. The first specific aim was to quantitatively

determine the direct relationship between home food availability, accessibility, and BMI

z-scores after controlling for covariates. Theoretically the relationship between the physical home food environment and BMI should involve dietary intake, but due to the limitations in measurement of dietary variables (Savage et al., 2008) the direct relationship was explored with dietary variables serving as covariates. Figure 1 depicts the conceptual model of the quantitatively measured variables. We hypothesized that the availability and accessibility of "lower-energy" foods would be associated with lower BMI z-scores and availability in "higher-energy" foods would be correlated with higher BMI z-scores after controlling for covariates of body mass index. The second specific aim was to qualitatively describe factors that influence the relationship between the home food environment and BMI as perceived by middle school children.

Methods

Design

A concurrent mixed method study was conducted with children and parents in their homes. Using a cross-sectional approach, food receipts were collected over one month and body measurements, recalls, and questionnaires were administered in order to quantitatively assess the relationship between the independent variables, home food availability and accessibility, and the dependent variable, children's BMI z-scores. A qualitative descriptive approach was employed by conducting semi-structured interviews to understand the factors that affect children's food choices in the home. The methods were integrated in analysis by comparing qualitative data by overweight status based on the measured BMI. Integration also occurred in the interpretation of the findings to provide a comprehensive understanding of the relationship between the home food environment and weight status.

Study Sample

A convenience sample was recruited from a public middle school with a student body of 742 located in a U.S. Northeast suburb. Families were invited to participate if the child was 10 to 14 year-old and resided in one household for at least 24 days per month, the child and parent were fluent in the English language and had access to a telephone, the consenting parent was responsible for food purchasing, and the child was above the 5th BMI percentile and lacked any health conditions or medications that cause significant changes in their weight or diet.

A purposeful sample (n=47) was selected from the overall sample to participate in the semi-structured interview using maximum variation techniques (Patton, 2002) to identify participants with a wide range of BMI z-scores and socio-demographic characteristics. Thematic saturation occurred after analyzing 29 interviews with the remainder of the interviews serving to verify the findings. The University of Pennsylvania Institutional Review Board (IRB) approved the study.

Measures

Food environment. Itemized food receipts and a food purchase log were used to measure home food availability. The family collected all food receipts for a 30-day period. In addition, a food purchase log was collected to document food that entered the home without a receipt, (i.e. gift of food), and foods on itemized receipts not intended for household consumption (i.e. food for a school party). Both the receipt and log data were used to calculate the percent of "lower-energy" foods (fruit, vegetables, and low-fat dairy products) and "higher-energy" foods (sweet snacks, savory snacks, and sugar-sweetened

beverages) from total food purchases. These categories were selected since studies have found significant correlations between their availability and intake (Pearson et al., 2009) and intake of these foods have been correlated with weight status or weight loss (Bradlee, Singer, Qureshi, & Moore, 2009; Epstein, Paluch, Beecher, & Roemmich, 2008). Details regarding data collection, entry, and systematic coding are described in a separate manuscript (Holsten, Compher, & Kumanyika, 2010).

Home food accessibility was measured using a modified version of the Hearn/Cullen 5-A-Day questionnaire (Cullen et al., 2001; Hearn et al., 1998), which asked about preparation and storage of fruits and vegetables at home in the past week. Questions were added about general food preparation styles. The questionnaire was scored with higher scores indicating greater accessibility of fruits and vegetables and healthier food preparation techniques. Another self-report questionnaire was used to determine the frequency of meals obtained from school or restaurants, which served as covariates representing participation in food environments outside the home. The questionnaire asked about the child's usual food consumption and purchasing patterns, separated by times of the day and week.

Body measurements. Three measurements of weight and height were taken at the home visit using a calibrated digital scale and portable stadiometer. The measurements were averaged and BMIs were calculated with the equation: BMI = [weight (kg) / height (m^2)]. BMI z-scores and percentiles were derived against the U.S. CDC 2000 reference data (Kuczmarski et al., 2000) to standardize BMIs by age and sex. The continuous BMI z-scores served as the quantitative outcome variable. Overweight

classification ($\geq$85th BMI percentile) was used to compare the qualitative data (U.S. Department of Health and Human Services, 2009).

Potential covariates. Average daily energy intake, fat intake, and number of servings consumed from each food group were assessed using three 24-hour dietary recalls. Dietary recalls were collected with the multiple pass approach facilitated by the Nutrition Data System for Research (University of Minnesota, Minneapolis, MN). Average daily moderate and vigorous physical activity levels were measured using three Previous Day Physical Activity Recalls (PDPAR). The PDPAR is a self-report measure of children's specific activities and their relative intensities (Weston, Petosa, & Pate, 1997). Both dietary and activity recalls were conducted over the phone by trained research nutritionists with two recalls that reflected a weekday and one recall that reflected a weekend day. Puberty status was measured using the Pubertal Development Scale, a self-report instrument designed to measure development on five indices of pubertal growth in non-clinical settings (Carskadon & Acebo, 1993). Demographic information, the child's usual sleep duration, and weight and height of both parents were also collected with questionnaires. Parental BMIs were calculated with the same equation stated above.

Factors that affect food choice. Qualitative interviews were conducted with a semi-structured guide. The guide used a funneling technique to start with a general question about eating on a typical day, and worked towards gaining detailed perceptions of influences on food choice in the home environment, including availability and accessibility. Further details regarding the interview guide and procedure are reported elsewhere (Holsten, Deatrick, Compher, & Kumanyika 2010).

Study Procedures

Data collection occurred in three phases: food receipt/log collection, dietary and activity recall telephone interviews, and a home visit (Figure 2). After screening and consent/assent, the family received oral and written instructions for collecting food store receipts and log information. Within 30 days of enrollment, three 24-hour dietary recalls and PDPARs were conducted over the phone by trained research nutritionists from the Children's Hospital of Philadelphia. Each family received two reminder calls about collecting food receipts and filling out the food purchase logs. Home visits with the families occurred after receipt/log data collection. If the child was selected and agreed to participate in an interview, the interview was conducted with the child in a private location while parents filled out their questionnaires. After the interview, the child independently filled out questionnaires and the receipts and food purchase log were reviewed with the parent to check for completion. The child's body weight and height were measured at the end of the visit.

Data Analysis

Receipt/log data were coded into the six food groups: fruit, vegetables, low-fat dairy, sweet snacks, savory snacks, and sugar-sweetened beverages, according to a systematic coding rubric (Holsten, Compher, & Kumanyika, 2010). The percentage of items in each food group out of total food purchases was calculated to account for household size. The dietary recalls were analyzed using the Nutrition Data System for Research (University of Minnesota, Minneapolis, MN). Dietary recalls below the second

percentile and above the 98th percentile were excluded to adjust for under- and over-

reporting. The PDPARs were analyzed by determining the metabolic equivalent task

value (1 MET=1 kilocalorie · kilogram-1 · hour-1 [kcal · kg-1 · h-1]) for each activity in

the PDPAR and summing the number of 30-minute segments at or above a MET level of

three. Descriptive analyses were conducted to characterize the distributions of and

associations between all variables. Bivariate comparisons were conducted between the

dependent variable, independent variables, and covariates including Pearson (normally

distributed) or Spearman rank (non-normally distributed) correlations. The quantitative

analysis was performed using SPSS (Version 17, IBM, Chicago, IL).

Cluster analysis was used to identify groups of children with similar patterns of the

non-dietary covariates listed in Table 1. The criterion variable was the children's BMI z-

scores. Clusters were determined through an iterative process using Ward's Method

(Aldenderfer & Blashfield, 1984). Univariate comparisons were then conducted to see

which variables distinguished the clusters and less significant variables (p>0.15) were

removed. The process was repeated until meaningful clusters emerged and only variables

with p-values less than 0.05 were maintained. Once these clusters were formed, each

child's cluster status formed an ordinal variable for regression analysis labeled 'non-

dietary obesity risk profile.'

The first specific aim was accomplished using hierarchical multiple regression

analyses to test whether the independent variables, home food availability and

accessibility, predicted the dependent variable, BMI z-scores, while controlling for the

effects of the covariates (Figure 1). The first set included all the covariates: non-dietary

obesity risk profiles, energy intake, fat intake, school meals per week, and restaurant

meals per week. The second set included the six home food availability variables. The third set included the home food accessibility scores. The hierarchical regression was repeated without energy and fat intake in the first set to check for over-adjustment of the model potentially due to the inclusion of the two dietary intake variables. In an exploratory analysis, home food environment variables and intake variables were compared by weight status using Student's T-tests or Mann Whitney U-Tests.

Using Sample Power (Version 2.0, IBM, Chicago, IL), sample size calculations were performed in function of the first specific aim under the assumption that statistical analysis would consist of multiple linear regression. The regression model requiring the largest sample included three sets of variables. Estimated effect sizes for each variable in the planned analysis were based on correlations of comparable variables in the literature (Bere, Glomnes, te Velde, & Klepp, 2008; Daniels, Khoury, & Morrison, 1997; Hanson & Chen, 2007; Ward et al., 1997) and a pilot study testing similar questionnaires in the target population (Holsten & Compher, 2009). The effect sizes for variables in each set were averaged for the sample size calculation (Table 1). Assuming an alpha of 0.05 and 80% power, the study would require 58 subjects to detect a 0.61 increase in the coefficient of determination (R^2).

A conventional content analysis (Hsieh & Shannon, 2005) was employed to identify factors that affect food choice within the home food environment. Interactionist techniques (Strauss & Corbin, 1998), such as constant comparison, were also used to inductively compare data across each stage of the analytic process (quotes, codes, categories, larger categories, themes) and produce more abstract concepts (Charmaz, 2006). Further details about the content analysis are described elsewhere (Holsten,

Deatrick, Compher, & Kumanyika, 2010). Quantitative and qualitative data were

collected concurrently and integrated both in analysis by exploring the differences in

qualitative data by overweight status ($\geq 85^{th}$ vs. $<85^{th}$ BMI percentile) and in the

interpretation of the results by contextually seating the quantitative findings in the

process of food choice. The visual technique of word clouds (Feinberg, 2009) was used

to compare occurrences of words in the overweight and healthy weight children's

interview responses about home food availability with larger word size indicating greater

response frequency.

Results

The quantitative findings are reported first including descriptions of the main

variables and bivariate relationships followed by the multivariate relationship between

the home food environment and BMI to address the first specific aim. Next, the

qualitative food choice factors that differ by overweight status are described addressing

the second specific aim.

Description of the Main Quantitative Variables and Bivariate Relationships

Participant and household characteristics. Out of 742 children in the middle

school, 65 participants were enrolled (8.8% enrollment rate). Fifty-eight households

remained eligible (2 participants were ineligible at the home visit) and completed

receipt/log collection, recalls, and home visits (92.3% response rate). The mean age of

the children was 12.48 years old (range 11.1 to 14.5 years) with over half of the sample in

the sixth grade (55%) and female (53%). The average BMI z-score was 0.71 with 40% of

children above the 85th BMI percentile and 10% above the 95th BMI percentile for age

and sex. The majority of children were non-Hispanic and white. Of the parents that

participated, 88% were mothers, and 78% of the households included two

caregivers. The median annual household income range was $75,000 to $99,000, and

60% identified a college degree or greater as the highest level of education attained by

either parent. Higher parental education levels (ρ= -0.213, p=0.108) were weakly

inversely correlated with BMI z-scores. None of the socio-demographic variables were

significantly correlated with BMI z-scores (Table 2).

Non-dietary covariates. On average, the participants slept 8.61 hours per night.

Greater sleep duration was weakly correlated with lower BMI z-scores, but the

correlation was not significant (ρ= -0.207, p=0.119). Almost half of the sample was in

mid-puberty. The average BMI for mothers was 26.48$\pm$5.77 kg/m^2 with 24% considered

overweight (BMI$\geq$ 25 kg/m^2 and <30 kg/m^2) and 26% obese (BMI$\geq$30 kg/m^2).

Regarding physical activity, children spent an average of two 30-minute segments in

moderate activity and less than one segment in vigorous activity per day. None of these

covariates were significantly correlated with BMI z-scores (Table 1). In addition, when

the non-dietary covariates were entered into a cluster analysis, a two-cluster solution was

derived based only on maternal BMI, and there was not a significant difference in

children's BMI z-scores between clusters (p=0.573).

Dietary intake. Children consumed an average of 1,781 kilocalories and 68

grams of fat per day with lower averages for girls (1662 kilocalories, 64 grams)

compared to boys (1941 kilocalories, 72 grams). Energy intake was weakly correlated

with BMI z-scores, and only trended toward significance (r= 0.231, p=0.081), while fat

intake was not correlated. Children consumed 1.47, 1.49, and 0.65 servings of fruits,

vegetables, and low-fat dairy per day, respectively. Fruit intake was significantly related

to total energy intake (ρ= 0.347, p=0.003), however when 100% fruit juice was excluded from the fruit group, the correlation was lower and no longer significant (ρ=0.236; p=0.075). Sweet and savory snacks were consumed at 1.18 and 0.85 servings per day, respectively. Sweet and savory snack intake was significantly correlated with both energy (sweet ρ= 0.416, p=0.001, savory ρ= 0.402, p=0.002) and fat intake (sweet ρ= 0.398, p=0.002, savory ρ= 0.397, p=0.002). Children consumed an average of one serving of sugar-sweetened beverages per day, which was weakly correlated with energy intake (ρ= 0.232, p=0.079). No significant relationships were identified between dietary intake variables and BMI z-scores (Table 3).

Intake or purchase of food from restaurants, food stores, and school. The participants ate food from restaurants an average of one time per week. The frequency of restaurant food intake was not associated with BMI z-scores. According to food purchase data, families visited food stores an average of nine times per month. The most highly frequented type of food store was a chain supermarket, representing 71% of total receipts. On average, families visited all other types of food stores less than once a month.

Children bought an average of four meals at school per week including breakfast and/or lunch. Only 16% of the sample ate school breakfast at least once a week and these children averaged 3.11 days per week. Eighty-one percent of children bought school lunch at least once a week and on average these children purchased lunch 4.38 times per week. Separate from school meals, 33% of children bought additional food at school from places like the school store. Participation in school meals or other school food purchasing practices was not correlated with BMI z-scores or dietary intake variables.

Physical home food environment: availability and accessibility. The

majority of all children had breakfast and dinner in the home with 41% of children also

taking lunch from home at least once a week. Of the six food categories, vegetables had

the highest mean availability (13% of food items) followed by sweet snacks (11%), fruit

(8%), savory snacks (6%), low-fat dairy (6%), and sugar-sweetened beverages (4%). The

average home food accessibility score was 5.33 for the children's responses and 7.72 for

the parents' responses on a scale from -15 to 15 with higher scores indicating greater

accessibility of fruits and vegetables and healthier food preparation techniques. None of

the home availability or accessibility variables were significantly correlated with energy

or fat intake. Fruit, low-fat dairy, and sugar-sweetened beverage availability and intake

of foods in each respective category were significantly associated, with greater home

availability correlated with greater intake (Table 4). Sweet snack (ρ= 0.199, p=0.135)

and vegetable (ρ= 0.222, p=0.094) availability and intake were weakly correlated, but the

associations were not significant. None of the home availability and accessibility

variables were bivariately correlated with BMI z-scores.

Multivariate Relationship between the Physical Home Food Environment and BMI

The hierarchical regression model is presented in Table 5. The covariates of BMI

(non-dietary obesity risk profiles, energy and fat intake, school meals per week, and

restaurant meals per week) were force entered in step one and the model was not

significant (R=0.257, R^2=0.066, Adjusted R^2=-0.025, DF=56, $F_{(5, 58)}$=0.722, p=0.610),

indicating no relationship between the set of covariates and BMI z-scores. In step two,

the home food availability variables were entered and produced another non-significant

model (R=0.363, R^2=0.132, Adjusted R^2=-0.080, DF=56, $F_{(11, 58)}$=0.622, p=0.800),

indicating no relationship. The final step included the home food accessibility

variable, which was also entered, and again resulted in a non-significant model that did

not explain much of the variance (R=0.365, R^2=0.133, Adjusted R^2=-0.104, DF=56,

F(12, 58)=0.562, p=0.860) and no coefficients were significant (Table 5). Since the

cluster status was not correlated with BMI, all non-dietary covariates with a bivariate

correlation p-value less than 0.15 (parental education) were placed into the first set of the

regression instead of the non-dietary obesity risk profile, but the model fit was not

improved (R=0.406, Adjusted R^2=-0.035, DF=57, F=0.825, p=0.616). When the same

hierarchical multiple regression analysis was performed without energy and fat intake,

the model remained non-significant (R=0.292, R^2=0.086, Adjusted R^2=-0.113, DF=56,

F(10, 58)=0.430, p=0.924). In comparing home food availability and accessibility

variables by weight status as a dichotomous outcome, obese children (n=6) had more

vegetables available (including starchy vegetables and excluding fried vegetables) in their

homes compared to non-obese children (p=0.012), but no other variables were

significant.

**Qualitative Factors that Affect Children's Food Choice in the Home by Overweight
Status**

The overall process of food choice did not differ by weight status, however

overweight children diverged from their healthy weight counterparts in four key ways

(Figure 3). These differences may mediate the relationship between the home food

environment and BMI.

Food preferences: Emotions towards food. Overweight children expressed

more frequent and stronger emotions toward food, both positive and negative.

Overweight participants described loving, hating, craving, and being disgusted by foods throughout the interviews. The highly favored foods were usually sweet, energy-dense food items, and the disfavored foods are most often vegetables, foods served at school, or atypical foods. One overweight child expressed his feelings about a particular vegetable, "I just hate them. I just hate them. I'm glad they're not in the house. I mean, I just don't like them being in the house."

Expected physical consequences of food: Weight concerns. Almost all overweight children described weight concerns or desired weight loss as playing a role in their food choices. Both boys and girls shared concerns of being judged as big in size and conveyed this concern with a sense of embarrassment. An overweight participant expresses her struggle with food choice and body size: "I kind of try to watch a little bit. It doesn't work though for like guys at school, like we…maybe I should not eat this because I don't want to keep on getting bigger because I want to be tiny like the other girls, but it doesn't work."

Home food availability and attributes. Overweight children also discussed calories, fat, and sugar content in foods more often than healthy weight children. In responding to a question about foods she wished were available at home, one participant stated, "I wish there was more chocolate, like candy, but then again I don't because I don't want to put on a lot, a lot of weight because I know they're really fattening. Sometimes I wish we didn't have soda…Cause like I know soda is really fattening."

Overweight children also had a greater awareness of higher-energy food availability compared to healthy weight children. Figures 4 and 5 depict occurrences of words in the healthy and overweight weight children's unprompted responses listing

foods in their homes. Both groups named vegetables, chicken, milk and bread, however overweight children stated more sweet and savory snacks and described these higher-energy foods with more detail (i.e. ice cream, cookies, candy instead of just sweets). The conflict between the desire to lose weight and preferences for and awareness of higher-energy foods was apparent, potentially supporting inventions that address availability of food in the home to help with these conflicting desires.

Discussion

The main objective of this mixed methods study was to examine the relationship between the physical home food environment and BMI within the context of children's food choices. We hypothesized that the availability and accessibility of "lower-energy" foods would be associated with lower BMI z-scores and availability in "higher-energy" foods would be correlated with higher BMI z-scores. These hypotheses were not supported. By further examining the associations with intake and integrating the quantitative and qualitative data, a more nuanced understanding of the relationship between the home food environment and BMI can be offered and directions for future research proposed.

Both our quantitative and qualitative findings depict homes containing a complex compilation of foods and factors that influence food choice, rather than a dichotomous environment with overtly obesity-protecting or promoting circumstances. Each family has a different physical home food environment and each child chooses foods differently in that environment. Households typically had a combination of lower- and higher-energy foods, which could mutually counteract their effects on BMI. In addition, many other factors affected children's food choices. While the children clearly communicated

that availability, preparation, and convenience of the foods in their homes were important, these were only three factors of many in their food choice process and ultimately weight status.

Overweight children had greater emotional food preferences and greater awareness of snack foods in their home compared to their healthy weight counterparts, possibly implying that they may seek out higher-energy foods despite low availability or accessibility at home, or obtain them from other environments such as at school. Obese children had significantly more vegetables in their home, but most children disliked vegetables; therefore children may consume certain foods at the same level despite appropriate availability. In addition to the physical home food environment and factors that affect food choices at home, key sources of variation may occur in dietary intake outside of the home, which could help explain the lack of association with BMI (Guthrie, Lin, & Frazao, 2002). Children with higher BMIs could have also underreported their dietary intake (Savage et al., 2008), specifically intake of food groups with low social approval such as snacks (Moore, Tapper, Moore, & Murphy, 2008), which would create a systematic bias and impair analysis of the relationship between availability and intake, and dietary variables and BMI. Some parents of overweight children described their children's previous experience in nutrition or weight loss programs, which may help to explain overweight children's increased level of awareness of nutrition aspects of food and weight concerns in the qualitative data and potential underreporting of dietary intake.

Home availability and intake were significantly associated for certain food categories (fruit, low-fat dairy, and sugar sweetened beverages), but not for others (vegetables, sweet snacks, and savory snacks) implying that availability does not affect

the intake of all foods in the same way. Other factors that affect food choice in the home, such as preparation skills, food rules set by parents, and level of preference (Holsten, Deatrick, Compher, & Kumanyika, 2010), can help to explain this divergence. For example, low-fat dairy items like yogurts could be easy to eat, favored by children, and lack rules governing their intake, such that when they are available, children would eat more low-fat dairy. Other food groups may require greater effort in preparation, have different rules governing their intake, or be disliked such that even if they *are* available in the home they will not be consumed. Even though sweet and savory snacks were available in the home, intake of these higher-energy foods was not significantly associated with their availability. Thus, home availability alone may not be sufficient to link the foods with a child's BMI.

While many studies found associations between availability and intake of various food categories, some results supported the correlations in this study (Larson, Story, Wall, & Neumark-Sztainer, 2006; Neumark-Sztainer, Wall, Perry, & Story, 2003), while others found correlations for different food categories (Gable & Lutz, 2000; Martens, van Assema, & Brug, 2005). Neumark-Sztainer and colleagues found that home availability of both fruits and vegetables was moderately correlated with fruit and vegetable intake (Neumark-Sztainer et al., 2003). Gable and Lutz (2000) found that greater availability of sweets was directly correlated with high-sugar and high-fat food intake and availability of junk foods were correlated with junk food intake, but no association was found for fruits and vegetables. The differing associations between availability and intake for different food categories in our study and the literature indicate a complex interaction of factors around food choices in the home.

Both the bivariate and regression analyses examining home food availability, accessibility, and BMI z-scores confirm non-significant results of other studies that explored the relationship between the home food environment and weight status (Ard et al., 2007; Byrd-Bredbenner & Abbot, 2009; Downs et al., 2009; Gable & Lutz, 2000; Haines et al., 2007). In addition, our finding that obese children had significantly more vegetables in their home compared to non-obese children contradicts the one study that found an association between greater vegetable availability and lower BMI-for age (Humenikova & Gates, 2008). Interpreting these findings and those found in other studies does not depict a clear trend, however they help identify the need to understand the relationship between diet, environment, and weight status under the assumption that foods in distinct categories may be modeled differently based on many factors that affect children's food choices.

Strengths and Limitations

The study had many beneficial components in its design and methods to examine the objective. The mixed method design was crucial in understanding the nuanced relationship by concurrently testing quantitative hypotheses and qualitatively describing the contextual process of food choice and differences by weight status. In addition, home food availability was measured with 30-days of receipt/log data, which allowed for potential variability over time and a more objective source of data than the self-report measures used in many other studies.

The study's limitations should also be considered in interpreting the findings. The convenience sample of children and parents from one school was less obese and more educated and wealthy than the national average, which limited the generalizability

of the findings. The small sample size also limited stratified analyses by sex or age. Another limitation was the cross-sectional design, which cannot determine temporal directionality of the association. The inability to determine temporal associations is a problem in that the behaviors and environmental conditions measured at one-point in time may not have been the historical patterns that led to the child's BMI. Lastly, the study did not have sufficient power to test the potential mediation of dietary intake indicating an opportunity for future research.

Implications

The findings from this study call for a comprehensive approach to prevent and treat childhood obesity, which address multiple levels of influence that interact with one another as described by the Ecological Model of Health Behavior (McLeroy et al., 1988). In interviews, overweight children emphasized nutritional aspects of foods, such as calories and portion sizes, and weight concerns in describing what they ate and why they selected certain foods to eat. Conversely, they also expressed greater emotion in their food preferences for and awareness of high-energy foods in their homes. These issues imply that they are sensitized to nutrition information and the impact of food choices on body size, but possibly are unable to make behavior changes. Intervening on a cognitive-behavioral level would help to identify and problem solve these issues on the intrapersonal level.

Our findings also support addressing environment barriers. Home availability of fruit, low-fat dairy, and sugar sweetened beverages was associated with intake of the corresponding food groups, which are key behaviors found to be associated with obesity in children, and supports a focus on the physical home environment in interventions.

Practical solutions such as substituting lower-energy beverages, like flavored waters, for sugar-sweetened beverages at home may be useful. Even if the caloric contribution is not sufficient to determine BMI, sugar-sweetened beverages were clearly an important source of discretionary energy that can be targeted for reduction (Haines et al., 2007; Ludwig, Peterson, & Gortmaker, 2001). Since the role of the parent was crucial in both influencing the child's attitudes and beliefs and as the primary gatekeeper for the home food environment, addressing these interpersonal dynamics would be valuable (Holsten, Deatrick, Compher, & Kumanyika, 2010). These findings validate the family-based approach to obesity prevention and treatment, which involve a cognitive-behavioral approach, environmental strategies, and inclusion of the parent (Fulkerson et al., 2010; Olvera et al., 2010; Young, Northern, Lister, Drummond, & O'Brien, 2007). However, greater emphasis may need to be placed on the foods in the home and children's emotions toward and awareness of those foods particularly as children transition into adolescence. In early adolescence, children exert their growing independence particularly through food preferences, but parents still have great influence in shaping children's food choices by making foods available and accessible in the home environment. This developmental stage requires a balance of autonomy and support in which the home food environment is an essential locus of obesity prevention and treatment.

Future research should examine the emotional significance of food for overweight children, test the relationship between the home food environment, intake, and BMI with larger cross-sectional and/or prospective studies, and explore children's process of food choice in other settings. Emotions toward food may cause overweight kids to eat unhealthy foods in greater amounts and override other factors that should limit food

intake. While several studies have described the role of food preferences (Baranowski et al., 1993; McKinley et al., 2005; Molaison, Connell, Stuff, Yadrick, & Bogle, 2005; Neumark-Sztainer, Story, Perry, & Casey, 1999; Wind, Bobelijn, De Bourdeaudhuij, Klepp, & Brug, 2005), the specific dimension of emotion was not explored thoroughly. In addition, developing obesity occurs over time and the design and sensitivity of this cross-sectional study may not have been sufficient to demonstrate the small difference in energy intake or food availability that may accrue over time to cause excess weight gain. Larger cross-sectional studies with more power should reexamine this objective to see if a smaller effect is significant, in addition to mapping out the relationship between environmental variables, dietary intake, and body mass index to determine how they interact. Prospective study designs to test the relationship between these variables would also be valuable to establish a temporal association. Lastly, non-directed qualitative research should examine the process of food choice in other settings to more effectively direct research toward risk factors and multilevel interventions.

References

Aldenderfer, M. S., & Blashfield, R. K. (1984). *Cluster Analysis*. Newbury Park: Sage Publications.

Ard, J. D., Fitzpatrick, S., Desmond, R. A., Sutton, B. S., Pisu, M., Allison, D. B., Franklin, F., & Baskin, M. L. (2007). The impact of cost on the availability of fruits and vegetables in the homes of schoolchildren in Birmingham, Alabama. *American Journal of Public Health, 97*(2), 367-372.

Baranowski, T., Domel, S., Gould, R., Baranowski, J., Leonard, S., Treiber, F., & Mullis, R. (1993). Increasing fruit and vegetable consumption among 4th and 5th grade students - results from focus groups using reciprocal determinism. *Journal of Nutrition Education, 25*(3), 114-120.

Bere, E., Glomnes, E. S., te Velde, S. J., & Klepp, K. I. (2008). Determinants of adolescents' soft drink consumption. *Public Health Nutrition, 11*(1), 49-56.

Binkley, J. K., Eales, J., & Jekanowski, M. (2000). The relation between dietary change and rising U.S. obesity. *International Journal of Obesity and Related Metabolic Disorders, 24*(8), 1032-1039.

Bradlee, M. L., Singer, M. R., Qureshi, M. M., & Moore, L. L. (2009). Food group intake and central obesity among children and adolescents in the third National Health and Nutrition Examination Survey (NHANES III). *Public Health Nutrition*, 1-9.

Byrd-Bredbenner, C., & Abbot, J. M. (2009). Differences in food supplies of U.S. households with and without overweight individuals. *Appetite, 52*(2), 479-484.

Carskadon, M. A., & Acebo, C. (1993). A self-administered rating scale for pubertal development. *The Journal of Adolescent Health, 14*(3), 190-195.

Charmaz, K. (2006). Coding in grounded theory practice. *Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis* (pp. 42-71). London: SAGE Publications.

Cullen, K. W., Baranowski, T., Rittenberry, L., Cosart, C., Hebert, D., & de Moor, C. (2001). Child-reported family and peer influences on fruit, juice and vegetable consumption: Reliability and validity of measures. *Health Education Research, 1*6(2), 187-200.

Daniels, S. R., Khoury, P. R., & Morrison, J. A. (1997). The utility of body mass index as a measure of body fatness in children and adolescents: Differences by race and gender. *Pediatrics, 9*9(6), 804-807.

Downs, S. M., Arnold, A., Marshall, D., McCargar, L. J., Raine, K. D., & Willows, N. D. (2009). Associations among the food environment, diet quality and weight status in Cree children in Québec. *Public Health Nutrition, 1*2(9), 1504-1511.

Epstein, L. H., Paluch, R. A., Beecher, M. D., & Roemmich, J. N. (2008). Increasing healthy eating vs. reducing high energy-dense foods to treat pediatric obesity. *Obesity, 1*6(2), 318-326.

Feinberg, J. (2009). *Wordle*. Retrieved November 2, 2009, from http://www.wordle.net/create

Fulkerson, J. A., Rydell, S., Kubik, M. Y., Lytle, L., Boutelle, K., Story, M., Neumark-Sztainer, D., Dudovitz, B., & Garwick, A. (2010). Healthy home offerings via the mealtime environment (HOME): Feasibility, acceptability, and outcomes of a pilot study. *Obesity, 18 Suppl* 1, S69-74.

Gable, S., & Lutz, S. (2000). Household, parent, and child contributions to childhood obesity. *Family Relations, 4*9, 293-300.

Guthrie, J. F., Lin, B. H., & Frazao, E. (2002). Role of food prepared away from home in the American diet, 1977-78 versus 1994-96: Changes and consequences. *Journal of Nutrition Education & Behavior, 3*4(3), 140-150.

Haines, J., Neumark-Sztainer, D., Wall, M., & Story, M. (2007). Personal, behavioral, and environmental risk and protective factors for adolescent overweight. *Obesity, 1*5(11), 2748-2760.

Hanson, M. D., & Chen, E. (2007). Socioeconomic status, race, and body mass index: The mediating role of physical activity and sedentary behaviors during adolescence. *Journal of Pediatric Psychology, 3*2(3), 250-259.

Hearn, Baranowski, T., Baranowski, J., Doyle, C., Smith, M., Lin, L. S., & Resnicow, K. (1998). Environmental influences on dietary behavior among children: Availability and accessibility of fruits and vegetables enable consumption. *Journal of Health Education, 2*9(1), 26-32.

Holsten, J. E., Compher, C. W., & Kumanyika, S. (2010). Measuring home food availability: Evaluation of food receipt and log collection methodology. Unpublished manuscript, University of Pennsylvania, Philadelphia, PA

Holsten, J. E., Deatrick, J., Compher, C. W., & Kumanyika, S. (2010). The process of children's food choice in the home environment: A qualitative descriptive study. Unpublished manuscript, University of Pennsylvania, Philadelphia, PA

Holsten, J. E., & Compher, C. W. (2009). The food environment and body mass index in sixth grade children: A pilot study. Unpublished manuscript, University of Pennsylvania, Philadelphia, PA

Holsten, J. E. (2009). Obesity and the community food environment: A systematic review. *Public Health Nutrition, 1*2(3), 397-405.

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research, 1*5(9), 1277-1288.

Humenikova, L., & Gates, G. E. (2008). Social and physical environmental factors and child overweight in a sample of American and Czech school-aged children: A pilot study. *Journal of Nutrition Education and Behavior, 4*0(4), 251-257.

Kuczmarski, R. J., Ogden, C. L., Grummer-Strawn, L. M., Flegal, K. M., Guo, S. S., Wei, R., Mei, Z., Curtin, L. R., Roche, A. F., & Johnson, C. L. (2000). *CDC growth charts: United States*. Hyattsville, MS: National Center for Health Statistics.

Larson, N. I., Story, M., Wall, M., & Neumark-Sztainer, D. (2006). Calcium and dairy intakes of adolescents are associated with their home environment, taste preferences, personal health beliefs, and meal patterns. *Journal of the American Dietetic Association, 10*6(11), 1816-1824.

Ludwig, D. S., Peterson, K. E., & Gortmaker, S. L. (2001). Relation between consumption of sugar-sweetened drinks and childhood obesity: A prospective, observational analysis. *Lancet, 35*7(9255), 505-508.

Martens, M. K., van Assema, P., & Brug, J. (2005). Why do adolescents eat what they eat? Personal and social environmental predictors of fruit, snack and breakfast consumption among 12-14-year-old Dutch students. *Public Health Nutrition,* 8(8), 1258-1265.

McKinley, M. C., Lowis, C., Robson, P. J., Wallace, J. M., Morrissey, M., Moran, A., & Livingstone, M. B. (2005). It's good to talk: Children's views on food and nutrition. *European Journal of Clinical Nutrition, 5*9(4), 542-551.

McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 1*5(4), 351-377.

Molaison, E. F., Connell, C. L., Stuff, J. E., Yadrick, M. K., & Bogle, M. (2005). Influences on fruit and vegetable consumption by low-income black American adolescents. *Journal of Nutrition Education & Behavior, 3*7(5), 246-251.

Moore, G. F., Tapper, K., Moore, L., & Murphy, S. (2008). Cognitive, behavioral, and social factors are associated with bias in dietary questionnaire self-reports by schoolchildren aged 9 to 11 years. *Journal of the American Dietetic Association, 10*8(11), 1865-1873.

Munoz, K. A., Krebs-Smith, S. M., Ballard-Barbash, R., & Cleveland, L. E. (1997). Food intakes of U.S. children and adolescents compared with recommendations. *Pediatrics, 10*0(3 Pt 1), 323-329.

Neilsen, S., Siega-Riz, A., & Popkin, B. (2002). Trends in energy intake in U.S. between 1977 and 1996: Similar shifts seen across age groups. *Obesity Research, 1*0(5), 370-378.

Neumark-Sztainer, D., Story, M., Perry, C., & Casey, M. A. (1999). Factors influencing food choices of adolescents: Findings from focus-group discussions with adolescents. *Journal of the American Dietetic Association, 9*9(8), 929-937.

Neumark-Sztainer, D., Wall, M., Perry, C., & Story, M. (2003). Correlates of fruit and vegetable intake among adolescents. Findings from Project EAT. *Preventive Medicine, 3*7(3), 198-208.

Ogden, C. L., Carroll, M. D., Curtin, L. R., Lamb, M. M., & Flegal, K. M. (2010). Prevalence of high body mass index in U.S. children and adolescents, 2007-2008. *The Journal of the American Medical Association, 30*3(3), 242-249.

Olvera, N., Bush, J. A., Sharma, S. V., Knox, B. B., Scherer, R. L., & Butte, N. F. (2010). BOUNCE: A community-based mother-daughter healthy lifestyle intervention for low-income Latino families. *Obesity, 18 Suppl* 1, S102-4.

Patton, M. (2002). Purposeful sampling. In M. Patton (Ed.), *Qualitative Research and Evaluation Method*s. Thousand Oaks, CA: Sage Publishers.

Pearson, N., Biddle, S. J., & Gorely, T. (2009). Family correlates of fruit and vegetable consumption in children and adolescents: A systematic review. *Public Health Nutrition, 1*2(2), 267-283.

Putnam, J., Allshouse, J., & Kantor, L. (2002). U.S. per capita food supply trends: More calories, refined carbohydrates and fats. *FoodReview, 2*5(3), 2-15.

Savage, J. S., Mitchell, D. C., Smiciklas-Wright, H., Symons Downs, D., & Birch, L. L. (2008). Plausible reports of energy intake may predict body mass index in pre-adolescent girls. *Journal of the American Dietetic Association, 10*8(1), 131-135.

Strauss, A., & Corbin, J. (1998). *Basics of Qualitative Research*. Thousand Oaks, CA: Sage Publications.

Summerbell, C. D., Waters, E., Edmunds, L. D., Kelly, S., Brown, T., & Campbell, K. J. (2005). Interventions for preventing obesity in children. *Cochrane Database of Systematic Reviews (Online), 3*, CD001871.

U.S. Department of Health and Human Services. (2009). *Healthy weight – it's not a diet, it's a lifestyle!, About BMI for children and teens*. Retrieved April 1, 2010, from http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html

Ward, D. S., Trost, S. G., Felton, G., Saunders, R., Parsons, M. A., Dowda, M., & Pate, R. R. (1997). Physical activity and physical fitness in African-American girls with and without obesity. *Obesity Research, 5*(6), 572-577.

Weston, A. T., Petosa, R., & Pate, R. R. (1997). Validation of an instrument for measurement of physical activity in youth. *Medicine and Science in Sports and Exercise, 29*(1), 138-143.

Wind, M., Bobelijn, K., De Bourdeaudhuij, I., Klepp, K. I., & Brug, J. (2005). A qualitative exploration of determinants of fruit and vegetable intake among 10- and 11-year-old schoolchildren in the low countries. *Annals of Nutrition & Metabolism, 49*(4), 228-235.

Young, K. M., Northern, J. J., Lister, K. M., Drummond, J. A., & O'Brien, W. H. (2007). A meta-analysis of family-behavioral weight-loss treatments for children. *Clinical Psychology Review, 27*(2), 240-249.

Table 1

Effect size estimates and corresponding variable and regression sets utilized in the sample

size calculation.

Variables	Correlation with weight status	Effect Size	Reference Source
Covariates			
Non-dietary Obesity Risk Profile (averaged as one variable)			
Physical activity	-0.19	0.04	Ward et al., 1997
Pubertal status	0.49	0.24	Daniels et al., 1997
Maternal BMI	.23	0.05	Holsten & Compher, 2009
Socioeconomic status	-0.26	0.07	Hanson & Chen, 2007
Ethnicity/race	0.30	0.09	Hanson et al., 2007
Child's sex	-0.32	0.10	Holsten & Compher, 2009
Sleep duration	-0.49	0.24	Holsten & Compher, 2009
Dietary Factors			
Energy Intake	0.37	0.14	Holsten & Compher, 2009
Fat Intake	0.32	0.10	Holsten & Compher, 2009
Other Environmental Factors			
School meals per week	0.21	0.04	Holsten & Compher, 2009
Restaurant meals per week	0.30	0.09	Holsten & Compher, 2009
Average Covariate Effect Size (SET 1)			**0.11**
Independent Variables			
Availability			
Fruit	-0.34	0.12	Holsten & Compher, 2009
Vegetable	-0.34	0.12	Holsten & Compher, 2009
Dairy	-0.13	0.02	Holsten & Compher, 2009
Sweet snacks	0.44	0.19	Holsten & Compher, 2009
Salty snacks	0.32	0.10	Holsten & Compher, 2009
Sugar-sweetened beverages	0.62	0.38	Bere et al., 2007
Average Availability Effect Size (SET 2)			**0.16**
Accessibility	-0.58	**0.34**	Holsten & Compher, 2009
Accessibility (SET 3)			**0.34**

Table 2

Descriptive statistics of non-dietary variables and bivariate correlations with BMI.

	Non-dietary variables	**Descriptive Statistics**	**Correlation BMI z-scores coefficients (p-values)**
	Body Mass Index	Z-scores Mean 0.71 SD 0.77 95% CI (0.51, 0.91)	
Socio-demographics	Age	Mean 12.48 SD 0.95 95% CI (12.24, 12.74)	ρ= -0.106 (0.427)
	Sex	53% Females (31) 47% Males (27)	ρ= -0.166 (0.212) Eta=0.209
	Ethnicity	9% Hispanic (5) 91% Non-Hispanic (53)	ρ= 0.024 (0.859) Eta=0.014
	Race	14% Black (8) 76% White (44) 2% Asian (1) 9% More than one race (5)	ρ= 0.156 (0.244) Eta=0.180
	Household Income	3% 25,000-34,999 (2) 17% 35,000-49,999 (10) 17% 50,000-74,999 (10) 39% 75,000-99,999 (22) 19% 100,000-149,999 (11) 3% 150,000-199,999 (2) 2% >200,000 (1)	ρ= -0.105 (0.431)
	Highest level of parent education	1.7% Less than high school (1) 22.4% High school graduate (13) 15.5% Some college (9) 60.3% College or higher (35)	ρ= -0.213 (0.108)
Covariates	Sleep Duration	Mean 8.61 SD 1.47 95% CI (8.21, 9.00)	ρ= -0.207 (0.119)
	Maternal BMI	Mean 26.48 SD 5.77 95% CI (24.95, 28.01)	ρ= -0.008 (0.954)
	PDS Stage	2% Pre-pubertal (1) 12% Early puberty (7) 48% Mid puberty (28) 28% Late puberty (16) 3% Post-pubertal (2)	ρ= 0.052 (0.707)
Physical Activity	Moderate PA	Mean 2.01 SD 1.46 95% CI (1.62, 2.39)	ρ= -0.060 (0.657)
	Vigorous PA	Mean 0.98 $\pm$ 1.08 95% CI (0.69, 1.26)	ρ= -0.034 (0.802)
	Moderate and Vigorous PA	Mean 2.38 SD 0.77 95% CI (2.54, 3.42)	r= -0.078 (0.562)

Table 3

Descriptive Statistics of dietary variables and bivariate correlations with BMI z-scores

and intake variables.

Dietary Variables (average daily intake)	Descriptive Statistics	BMI z-scores	Energy Intake	Fat Intake
Kilocalories	Mean 1780.81 SD 408.14 95% CI (1672.52, 1889.11)	r= 0.231 (0.081)		
Fat	Mean 67.70 SD 18.82 95% CI (62.66, 72.74)	ρ= 0.113 (0.400)	ρ= **0.873**** **(0.001)**	
Fruit (including 100% juice)	Mean 1.47 SD 1.54 95% CI (1.06, 1.87)	ρ= 0.108 (0.421)	ρ= **0.347**** **(0.008)**	ρ= 0.165 (0.215)
Fruit (not including 100% juice)	Mean 0.62 SD 0.76 95% CI (0.42, 0.82)	ρ= 0.135 (0.314)	ρ= 0.236 (0.075)	ρ= 0.092 (0.494)
Vegetables	Mean 1.47 SD 1.16 95% CI (1.17, 1.78)	ρ= 0.146 (0.273)	ρ= 0.215 (0.105)	ρ= -0.200 (0.132)
Low-fat dairy	Mean 0.65 SD 0.93 95% CI (0.41, 0.89)	ρ= -0.005 (0.973)	ρ= -0.13 (0.921)	ρ= -0.030 (0.822)
Sweet snacks	Mean 1.18 SD 0.90 95% CI (0.90, 1.45)	ρ= 0.054 (0.685)	ρ= **0.416**** **(0.001)**	ρ= **0.398**** **(0.002)**
Savory snacks	Mean 0.85 SD 0.83 95% CI (0.63, 1.07)	ρ= 0.061 (0.647)	ρ= **0.402**** **(0.002)**	ρ= **0.397**** **(0.002)**
Sugar sweetened beverages	Mean 1.00 SD 0.99 95% CI (0.74, 1.26)	ρ= -0.018 (0.895)	ρ= 0.232 (0.079)	ρ= 0.170 (0.202)

** p-value <0.01
* p-value <0.05

Table 4

Descriptive Statistics of home food environment variables and bivariate correlations with

BMI z-scores and intake variables.

Food Environment Variables	Descriptive Statistics	BMI z-scores	Energy Intake	Fat Intake	Food Group Intake
Fruit (including 100% juice) Availability	Mean 7.80 SD 4.73 Median 7.37 95% CI (6.56, 9.05)	ρ= 0.188 (0.157)	ρ= -0.071 (0.596)	ρ= -0.150 (0.261)	ρ= **0.283 (0.032)***
Fruit (not including 100% juice) Availability	Mean 5.98 SD 4.30 Median 4.84 95% CI (4.85, 7.11)	ρ= 0.142 (0.287)	ρ= 0.030 (0.822)	ρ= -0.074 (0.582)	ρ= **0.344 (0.008)****
Vegetable Availability	Mean 12.62 SD 6.42 Median 12.40 95% CI (10.93, 14.30)	*r* = 0.192 (0.148)	*r* = 0.116 (0.385)	ρ= 0.115 (0.388)	ρ= 0.222 (0.094)
Low-fat dairy Availability	Mean 4.66 SD 5.33 Median 2.66 95% CI (3.26, 6.06)	ρ= -0.141 (0.292)	ρ= -0.200 (0.133)	ρ= -0.197 (0.139)	ρ= **0.420 (0.001)****
Sweet snack Availability	Mean 10.55 SD 10.18 Median 7.35 95% CI (7.87, 13.23)	ρ= -0.085 (0.527)	ρ= -0.110 (0.409)	ρ= -0.09 (0.414)	ρ= 0.199 (0.135)
Savory snack Availability	Mean 5.58 SD 3.01 Median 4.86 95% CI (4.79, 6.38)	ρ= -0.040 (0.767)	ρ= -0.029 (0.832)	ρ= -0.070 (0.601)	ρ= 0.173 (0.193)
Sugar-sweetened beverage Availability	Mean 4.22 SD 2.92 Median 4.33 95% CI (3.46, 4.99)	ρ= 0.043 (0.751)	ρ= -0.015 (0.913)	ρ= 0.002 (0.988)	ρ= **0.504 (0.001)****
Child Home Accessibility	Mean 5.33 SD 3.96 Median 6.00 95% CI (4.28, 6.38)	*r* = 0.006 (0.967)	*r* = -0.109 (0.413)	ρ= 0.000 (0.999)	
Parent Home Accessibility	Mean 7.72 SD 3.43 Median 8.00 95% CI (6.81, 8.63)	ρ= 0.187 (0.161)	ρ= -0.075 (0.575)	ρ= -0.058 (0.663)	

SD=Standard Deviation, CI=Confidence Interval
** p-value <0.01
* p-value <0.05

Table 5

Hierarchical Linear Regression for Body Mass Index Z-Scores for Middle School Children (n=58).

Regression Variable		Step 1 β	SE	β*	t	p	Step 2 β	SE	β*	t	p	Step 3 β	SE	β*	t	p
Covariates	Constant	-0.032	0.611		-0.052	0.959	-0.640	0.850		-0.753	0.456	-0.682	0.882		-0.773	0.443
	Non-dietary risk profile	-0.101	0.239	-0.058	-0.424	0.674	-0.186	0.266	-0.107	-0.698	0.489	-0.185	0.269	-0.106	-0.668	0.495
	Energy (kcal)	0.001	0.001	0.355	1.218	0.229	0.001	0.001	0.281	0.880	0.384	0.001	0.001	0.293	0.894	0.376
	Total Fat (g)	-0.006	0.012	-0.136	-0.467	0.643	-0.003	0.013	-0.067	-0.204	0.839	-0.003	0.014	-0.079	-0.236	0.815
	School meals/wk	0.023	0.041	0.080	0.561	0.577	0.045	0.048	0.158	0.948	0.348	0.047	0.049	0.162	0.954	0.345
	Restaurant meals/wk	-0.001	0.097	-0.002	-0.015	0.988	-0.032	0.102	-0.046	-0.308	0.759	-0.031	0.104	-0.045	-0.236	0.767
Availability	Fruit						3.000	2.800	0.185	1.071	0.290	2.879	2.887	0.178	0.997	0.324
	Vegetable						2.376	1.898	0.198	1.252	0.217	2.367	1.919	0.197	1.233	0.224
	Low-fat Dairy						0.061	2.187	0.004	0.028	0.978	-0.075	2.302	-0.005	-0.033	0.974
	Sweet Snack						0.761	1.100	0.101	0.691	0.493	0.710	1.138	0.094	0.624	0.536
	Savory Snack						0.804	3.778	0.032	0.213	0.832	0.929	3.864	0.037	0.240	0.811
	Sugar Sweetened Beverage						2.115	4.240	0.080	0.499	0.620	2.295	4.369	0.087	0.525	0.602
	Accessibility Score											0.007	0.033	0.036	0.213	0.832
	R			0.257					0.066					-0.25		
	R²			0.363					0.132					-0.80		
	Adjusted R²			0.365					0.133					-0.104		

*Standardized Beta, SE = Standard Error
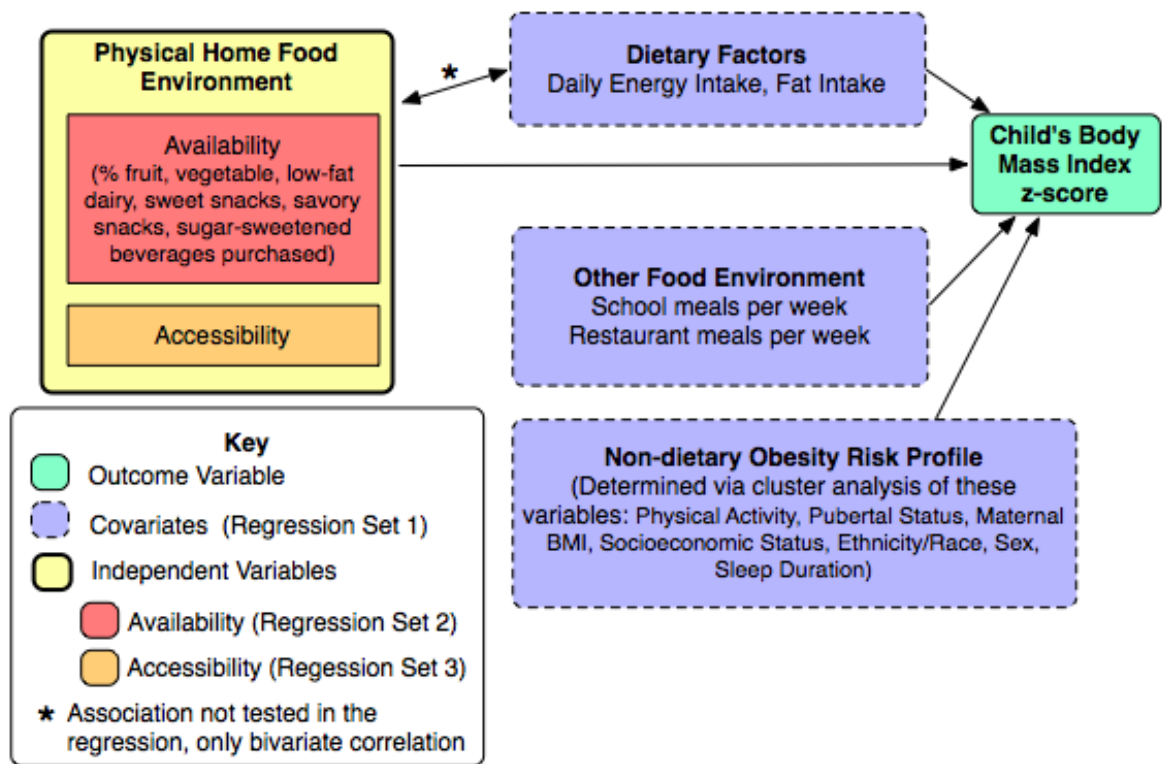
Figure 1. Conceptual Model of the Quantitative Variables. The study examined the effect of the home food environment variables (availability and accessibility) on the outcome of body mass index z-scores controlling for dietary factors, other food environments, and non-dietary obesity risk profiles. The key identifies the variables and relationships that were tested in each regression set and with bivariate correlations.

Figure 2. Study Flow Diagram. A flowchart of the main data collection phases including recruitment, enrollment, and data collection.

THE PROCESS OF CHILDREN'S FOOD CHOICES AT HOME
with indications of factors that differed by weight status

TIME

day ... week ... year

OUTSIDE INFLUENCES
Peer Influences
Media
Food Stores
Restaurant
School

PARENT
Presence in the Home
Family Food Preferences
Time Pressure &
Activity Prioritization
Preparation Effort & Skill
Financial Concerns
Health Concerns

CHILD
Hunger level
Food preferences
Time Pressure &
Activity Prioritization
Preparation Effort & Skill
Expected Physical Consequences

FOOD CHOICE
I make
I don't/won't eat
I have

FOOD
Attributes
Availability
Cost

Parent allows, wants, says, does

Parent asks/ Child picks, Child asks

Parent buys

Parent picks and makes

Food Preferences Overweight children expressed stronger emotions in conveying preferences.

Expected Physical Consequences Overweight children expressed concerns about body size and weight gain.

Food Attributes Overweight children described nutritional aspects of foods including calories, fat, and portion sizes.

Food Availability Overweight children expressed greater awareness of higher-energy foods in the home.

Figure 3. The Process of Children's Food Choices at Home. This model depicts the overall process of children's food choice with indications and explanations of the factors with differences by weight status.

Figure 4. Healthy Weight Children's Unprompted Responses for Food Available at

Home. A word cloud visually representing occurrences of words in unprompted

responses for foods available in their homes reported by children with healthy BMI

percentiles (<85th BMI percentile). Larger word size represents more frequent responses.

Figure 5. Overweight Children's Unprompted Responses for Food Available at Home.

A word cloud visually representing occurrences of words in unprompted responses for

foods available in their homes reported by children with BMI percentiles considered

overweight or obese ($\geq 85^{th}$ BMI percentile). Larger word size represents more frequent

responses.

Conclusion

These three manuscripts build an integrated understanding of the relationship between the physical home food environment and BMI of middle school children. The first manuscript detailed the food receipt and purchase log method of measuring home food availability. Through a process evaluation, the methodology proved feasible. Few families reported large receipts missing, all food items except two were identifiable, and 92% of families initially enrolled completed receipt/log collection. In addition, there were no significant differences between families that reported missing large receipts or between families that collected receipts in fall and winter seasons. The receipt/log method produced objective data for further analysis, and offered several improvements on the method to measure home food availability.

The second manuscript described the process of middle school children's food choice in the home. The food choice process involved three main components: the child, parent, and food. The parent created food options through food purchasing and preparation, and affected the child's attitudes and beliefs by setting rules, providing information and guidance, and modeling behaviors. Children described that their parent's actions were affected by the integration of the family's food preferences, time pressure and activity prioritization, food preparation effort and skills, and financial and health concerns. The child affected the parent's decisions through communicating food preferences. Pertinent aspects of the food included its availability within the home, food attributes, such as flavor and preparation, and food cost. Food availability was largely created by parent's actions of food purchasing and preparation and was indirectly influenced by children's preferences. Final food choices were made when the child

evaluated viable food options based on his or her hunger level, food preferences, time pressure and activity prioritization, food preparation effort and skill, and expected physical consequences of food.

The third manuscript integrated the quantitative and qualitative data to explain the relationship between the physical home food environment and BMI. Based on hierarchical regression models, home food availability and accessibility were not significantly associated with BMI z-scores after controlling for covariates. However, dietary intake of fruits, low-fat dairy, and sugar-sweetened beverages were bivariately correlated with their availability in the home. Qualitative data revealed that the fundamental process of food choice did not differ by weight status, however overweight children diverged from their normal weight counterparts in four key ways. Overweight children emphasized weight concerns and nutritional aspects of foods, such as calories and portion sizes, in describing their food choices. They also expressed greater emotion in their preferences for and awareness of high-energy foods in their homes. The inconsistency between the desire to lose weight and preferences for and awareness of higher-energy foods along with the associations between availability and intake support a focus on the physical home food environment in obesity interventions. Overall, the findings from these manuscripts converge to convey a complex interaction of several factors that occur in the home influencing food choice, food availability, overall intake, and weight status.

The conclusions offer loci for obesity prevention and treatment in addition to directing future research. Practical suggestions for intervention include helping parents address the home availability of foods, especially fruit, low-fat dairy, and sugar-

sweetened beverages, to make changes that agree with children's food preferences. Addressing common scenarios in which multiple factors converge to make healthy choices difficult including weekday breakfast and after-school snacks might be a productive place to start. In addition to providing practical loci for intervention, the findings direct future research to consider several potential routes including: 1) the inductive investigation of multiple perspectives on children's food choices across several behavioral settings, 2) the continued refinement of the food receipt and purchase log methodology to measure food availability and development of more reliable methods to measure food accessibility, and 3) the examination of the relationship between environment variables, dietary intake, and weight status in studies with more analytic power.

The process of food choice was inductively derived from children's perspectives. While producing valuable information, the food choice model does not include factors that may influence their behavior, but are not perceived by the children. By investigating perspectives from other sources and using supplementary data collection methods, data can be triangulated and new information discovered to improve the model of food choice. Since children perceived the parent as a major factor in their food choices, eliciting their perspective through interviews would greatly benefit the model and inform family-based interventions. In addition to interviewing parents, participant observation would be an additional method to discover latent factors not perceived or reported by family members. Observing children and their food choices would also provide in-depth insight into how interventions could be best incorporated in middle school children's family life. Behavior settings beyond the home, including schools, restaurants, food stores, or after-

school programs, should also be explored qualitatively to identify what factors affect the food choice process in various environments. Inductive data that specifies the detailed interaction between multiple levels of influence on children's food choices are needed to identify potential risk factors and guide interventions.

Future research should also continue to refine the food receipt and purchase log methodology to measure home food availability. The method was presented and evaluated against other protocols in this dissertation, but the different protocols should be quantitatively compared to develop a unified protocol that minimizes bias and burden in data collection, entry, and coding. Further evaluation of this method should test seasonal variation in the spring and summer months and collect restaurant receipts for take-out food, which should be considered as part of home food availability since it enters the home environment. In measuring home food accessibility, more objective methods should be designed and tested, such as inventories of how foods are prepared, stored, and served collected at multiple time points over the phone. With continued momentum behind food environment research, further investment in more objective and feasible measures is needed.

While there was no significant relationship between the physical home food environment and BMI, the promising associations between availability and intake and the overweight children's greater awareness of higher-energy foods at home direct us to continue researching the relationship. The quantitative relationship between the physical home food environment, dietary intake, and BMI should be explored with larger studies that have the power to examine several interrelationships. With the identification of additional factors from inductive research on children's food choice, studies should

utilize path analysis or structural equation modeling to understand the strength and directionality of the relationship between different factors. In addition, prospective study designs should be employed to investigate the temporal relationship between environmental variables and weight status in children. Obesity develops over time and cross sectional studies do not sufficiently capture the behavioral patterns that occur across many years and that are responsible for the excess weight gain. Prospective study designs using objective measures of the food environment would help elucidate the longitudinal impact of the environment.

In addition, future studies should also investigate food choices in settings outside the home to understand children's full food environment. This study attempted to account for behaviors in the restaurant and school settings by measuring school meal participation and away from home meals. These variables were not significantly correlated with BMI z-scores, however they were not the central focus of the study. Additional variables should be accounted for including types of restaurants visited and choices in these different environments because more variation could be present in these settings compared to the home and some studies have found greater consumption of energy density of foods (Briefel et al., 2009) and overall energy outside the home (Guthrie et al., 2002).

Despite many areas left to explore in future research, this study's findings support current efforts to address obesity prevention and treatment including family-based programs and larger scale public health approaches targeting entire communities or schools, especially those addressing food availability. We know the problem is *not* simply that overweight or obese children are living in unhealthy environments, with few

vegetables, fruits, and low-fat diary and many snacks and sodas, and other children are not. The 'obesogenic' environment may be ubiquitous placing strain on most individuals and families, and overweight children are left with fewer defenses against overeating (Kessler, 2009). Helping children and their parents cope with this strain by intervening on multiple levels of influence from individual food preferences to food costs in grocery stores will impact the home food environment and children's food choices.

References

Adair, L. S., & Popkin, B. M. (2005). Are child eating patterns being transformed globally? *Obesity Research, 13*(7), 1281-1299.

Ard, J. D., Fitzpatrick, S., Desmond, R. A., Sutton, B. S., Pisu, M., Allison, D. B., Franklin, F., & Baskin, M. L. (2007). The impact of cost on the availability of fruits and vegetables in the homes of schoolchildren in Birmingham, Alabama. *American Journal of Public Health, 97*(2), 367-372.

Binkley, J. K., Eales, J., & Jekanowski, M. (2000). The relation between dietary change and rising U.S. obesity. *International Journal of Obesity and Related Metabolic Disorders, 24*(8), 1032-1039.

Birch, L. L., & Davison, K. K. (2001). Family environmental factors influencing the developing behavioral controls of food intake and childhood overweight. *Pediatric Clinics of North America, 48*(4), 893-907.

Briefel, R. R., Wilson, A., & Gleason, P. M. (2009). Consumption of low-nutrient, energy-dense foods and beverages at school, home, and other locations among school lunch participants and nonparticipants. *Journal of the American Dietetic Association, 109*(2 Suppl), S79-90.

Byrd-Bredbenner, C., & Abbot, J. M. (2009). Differences in food supplies of U.S. households with and without overweight individuals. *Appetite, 52*(2), 479-484.

Cole, T. J., Faith, M. S., Pietrobelli, A., & Heo, M. (2005). What is the best measure of adiposity change in growing children: BMI, BMI %, BMI z-score or BMI centile*? European Journal of Clinical Nutrition, 5*9(3), 419-425.

Cullen, K. W., Baranowski, T., Owens, E., Marsh, T., Rittenberry, L., & de Moor, C. (2003). Availability, accessibility, and preferences for fruit, 100% fruit juice, and vegetables influence children's dietary behavior. *Health Education & Behavior, 30*(5), 615-626.

Downs, S. M., Arnold, A., Marshall, D., McCargar, L. J., Raine, K. D., & Willows, N. D. (2009). Associations among the food environment, diet quality and weight status in Cree children in Québec. *Public Health Nutrition, 12*(9), 1504-1511.

Gable, S., & Lutz, S. (2000). Household, parent, and child contributions to childhood obesity. *Family Relations, 49*, 293-300.

Garrow, J. S., & Webster, J. (1985). Quetelet's index (W/H2) as a measure of fatness. *International Journal of Obesity,* 9(2), 147-153.

Glanz, K., Sallis, J. F., Saelens, B. E., & Frank, L. D. (2005). Healthy nutrition environments: Concepts and measures. *American Journal of Health Promotion, 19*(5), 330-333, ii.

Guthrie, J. F., Lin, B. H., & Frazao, E. (2002). Role of food prepared away from home in the American diet, 1977-78 versus 1994-96: Changes and consequences. *Journal of Nutrition Education & Behavior, 34*(3), 140-150.

Haines, J., Neumark-Sztainer, D., Wall, M., & Story, M. (2007). Personal, behavioral, and environmental risk and protective factors for adolescent overweight. *Obesity, 15*(11), 2748-2760.

Hearn, Baranowski, T., Baranowski, J., Doyle, C., Smith, M., Lin, L. S., & Resnicow, K. (1998). Environmental influences on dietary behavior among children: Availability and accessibility of fruits and vegetables enable consumption. *Journal of Health Education, 2*9(1), 26-32.

Hill, J. O., Wyatt, H. R., Reed, G. W., & Peters, J. C. (2003). Obesity and the environment: Where do we go from here? *Science, 299*(5608), 853-855.

Holsten, J. E. (2009). Obesity and the community food environment: A systematic review. *Public Health Nutrition, 1*2(3), 397-405.

Humenikova, L., & Gates, G. E. (2008). Social and physical environmental factors and child overweight in a sample of American and Czech school-aged children: A pilot study. *Journal of Nutrition Education and Behavior, 4*0(4), 251-257.

Institute of Medicine. (2005). *Preventing Childhood Obesity: Health in the Balanc*e. Washington, DC: National Academies Press.

Kessler, D. (2009). *The End of Overeating. Taking Control of the Insatiable American Appetit*e. New York, NY: Rodale.

Kuczmarski, R. J., Ogden, C. L., Grummer-Strawn, L. M., Flegal, K. M., Guo, S. S., Wei, R., Mei, Z., Curtin, L. R., Roche, A. F., & Johnson, C. L. (2000). *CDC growth charts: United States*. Hyattsville, MS: National Center for Health Statistics.

Kumanyika, S. K. (2001). Minisymposium on obesity: Overview and some strategic considerations. *Annual Review of Public Health, 2*2, 293-308.

McKinley, M. C., Lowis, C., Robson, P. J., Wallace, J. M., Morrissey, M., Moran, A., & Livingstone, M. B. (2005). It's good to talk: Children's views on food and nutrition. *European Journal of Clinical Nutrition, 5*9(4), 542-551.

McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 1*5(4), 351-377.

Mei, Z., Grummer-Strawn, L. M., Pietrobelli, A., Goulding, A., Goran, M. I., & Dietz, W. H. (2002). Validity of body mass index compared with other body-composition screening indexes for the assessment of body fatness in children and adolescents. *The American Journal of Clinical Nutrition, 75*(6), 978-985.

Molaison, E. F., Connell, C. L., Stuff, J. E., Yadrick, M. K., & Bogle, M. (2005). Influences on fruit and vegetable consumption by low-income black American adolescents. *Journal of Nutrition Education & Behavior, 3*7(5), 246-251.

Munoz, K. A., Krebs-Smith, S. M., Ballard-Barbash, R., & Cleveland, L. E. (1997). Food intakes of U.S. children and adolescents compared with recommendations. *Pediatrics, 10*0(3 Pt 1), 323-329.

Neilsen, S., Siega-Riz, A., & Popkin, B. (2002). Trends in energy intake in U.S. between 1977 and 1996: Similar shifts seen across age groups. *Obesity Research, 1*0(5), 370-378.

Neumark-Sztainer, D., Story, M., Perry, C., & Casey, M. A. (1999). Factors influencing food choices of adolescents: Findings from focus-group discussions with adolescents. *Journal of the American Dietetic Association, 9*9(8), 929-937.

Ogden, C. L., Carroll, M. D., Curtin, L. R., Lamb, M. M., & Flegal, K. M. (2010). Prevalence of high body mass index in U.S. children and adolescents, 2007-2008. *The Journal of the American Medical Association, 30*3(3), 242-249.

Patton, M. (2002). Purposeful sampling. In M. Patton (Ed.), *Qualitative Research and Evaluation Method*s. Thousand Oaks, CA: Sage Publishers

Pearson, N., Biddle, S. J., & Gorely, T. (2009). Family correlates of fruit and vegetable consumption in children and adolescents: A systematic review. *Public Health Nutrition, 1*2(2), 267-283.

Putnam, J., Allshouse, J., & Kantor, L. (2002). U.S. per capita food supply trends: More calories, refined carbohydrates and fats. *FoodReview, 2*5(3), 2-15.

Rosenkranz, R. R., & Dzewaltowski, D. A. (2008). Model of the home food environment pertaining to childhood obesity. *Nutrition Reviews, 6*6(3), 123-140.

Sallis, J. F., & Owens, N. (2002). Ecological models of health behavior. In K. Glanz, B. K. Rimer & F. M. Lewis (Eds.), *Health Behavior and Health Educatio*n (3rd ed., pp. 462-484). San Francisco: Jossey-Bass.

Savage, J. S., Mitchell, D. C., Smiciklas-Wright, H., Symons Downs, D., & Birch, L. L. (2008). Plausible reports of energy intake may predict body mass index in pre-adolescent girls. *Journal of the American Dietetic Association, 10*8(1), 131-135.

Summerbell, C. D., Waters, E., Edmunds, L. D., Kelly, S., Brown, T., & Campbell, K. J. (2005). Interventions for preventing obesity in children. *Cochrane Database of Systematic Reviews (Online), (3*)(3), CD001871.

U.S. Department of Health and Human Services. (2000). *Healthy people 2010: Understanding and Improving Health*. Washington, DC: U.S. Government Printing Office.

U.S. Department of Health and Human Services. (2009a). *Healthy weight – it's not a diet, it's a lifestyle!, Body mass index*. Retrieved April 1, 2010, from http://www.cdc.gov/healthyweight/assessing/bmi/index.html

U.S. Department of Health and Human Services. (2009b). *Overweight and obesity, contributing factors.* Retrieved April 1, 2010, from

http://www.cdc.gov/obesity/childhood/causes.html

Wang, Y. C., Bleich, S. N., & Gortmaker, S. L. (2008). Increasing caloric contribution from sugar-sweetened beverages and 100% fruit juices among U.S. children and adolescents, 1988-2004. *Pediatrics, 12*1(6), e1604-14.

Wind, M., Bobelijn, K., De Bourdeaudhuij, I., Klepp, K. I., & Brug, J. (2005). A qualitative exploration of determinants of fruit and vegetable intake among 10- and 11-year-old schoolchildren in the low countries. *Annals of Nutrition & Metabolism, 4*9(4), 228-235.

World Health Organization, & Food and Agriculture Organization of the United Nations. (2003). *Diet, nutrition and the prevention of chronic disease*s (WHO Technical Report Series No. 916). Geneva: World Health Organization.

Appendix

Table of evidence summarizing studies that examined the relationship between the physical home food environment and weight status.

First Author Year	• Design • Weight-related Objective(s)	Sample	Physical Food Environment • Specific variables • Measurement	Weight Status • Variables • Measure	Physical Home Food Environment and Weight Status Findings
Gable 2000	• Cross-sectional • To compare the household demographics, food availability, parenting beliefs and attitudes, and child food intake and activities of obese and non-obese children.	• 6-10 yrs-olds • Recruited from an annual health fair • Midwest, U.S. • n=65	• Home availability of 5 food groups including: fruits/vegetables, breads, meats, dairy, snacks, sweets • Parent-reported questionnaire (5 availability items)	• Obese vs. non-obese • Measured weight and height	• Logistic regression: No significant difference was found in home food availability between obese and non-obese children. (Odds ratios ranged from 0.52 for fruit and vegetable availability and 1.58 for sweets availability).
Ard 2007	• Cross-sectional • To examine if fruit and vegetable item cost and consumers' race, income, gender, and child and parent BMI, predicts fruit and vegetable availability in the home.	• 8-10 yrs-olds • Recruited from 33 schools for the Hi5+ intervention • Southeast, U.S. • n=1,355	• Home availability of 3 food groups including: 100% fruit juice items, fruits, and vegetables • Parent-reported questionnaire (34 availability items)	• Body mass index (BMI) (continuous variable) • Measured weight and height	• Multivariate discrete choice modeling: The body mass index of the child was not a significant predictor of fruit and vegetable availability in the home (data not provided).

	Design/Purpose	Sample	Independent Variable/Measure	Dependent Variable/Measure	Results
Haines 2007	• Longitudinal • To examine personal, behavioral, and environmental risk and protective factors for overweight in male and female adolescents.	• 12-20 yrs-old (Time 1 mean age 12.8/15.8 yrs Time 2 mean age 17.2 /20.4 yrs) • Recruited from 31 schools for Project EAT • Midwest, U.S. • n=2,516	• Home availability/ accessibility of healthful foods (fruits, vegetables, fruit juice, milk) and high-caloric snack foods (junk foods, potato chips/salty snacks, chocolate/candy, soda) • Child-reported questionnaire (8 availability items)	• Overweight incidence and prevalence (Time 2) • Child-reported weight and height (Time 1 and 2) and/or measured weight and height (Time 1)	• Multiple logistic regression: For girls, home availability of high-caloric snack food at Time 1 and increases in this variable from Time 1 to Time 2 were **negatively** associated with Time 2 overweight (Odds ratio 0.89, Confidence Interval 0.83, 0.95), but the relationship was not significant when examining only incidence cases. Home availability of healthy foods was not associated with girls' Time 2 overweight or incidence of overweight. For boys, home availability of high caloric snack food and healthy foods at Time 1 were not associated with Time 2 overweight or incidence of overweight.
Downs 2008	• Cross-sectional • To examine the association children's dietary intake, weight status, and home food environment.	• 4th-6th grade students (ages not provided) • Recruited from 2 schools for the Active Kids Project • Subarctic Canada • n=201	• Home availability/ accessibility of fruits and vegetables, fruit juice, milk, potato chips/salty snacks, milk, soda • Child-reported questionnaire adapted from Project EAT (number of items not provided)	• Overweight/ obese vs. normal weight • Measured weight and height	• Analysis not specified: No significant differences were found in the home food environment variables between overweight/obese and normal weight children (data not provided).

	Study Design/Purpose	Sample	Measures	Outcome Variable	Results
Hume nikova 2008	• Cross-sectional • To examine the relationship between environmental factors that influence BMI-for-age and their differences between American and Czech youth.	• 4th-6th grade students (10.8 ± 0.2 yrs) • Recruited from 5 schools • Midwest, U.S. and Czech Republic • n=142	• Home availability of healthful foods including: low-fat dairy, fresh fruits and vegetables, frozen vegetables • Parent-reported shelf inventory (number of items not provided)	• BMI-for-age z-score (continuous variable) • Measured weight and height	• Bivariate correlations: For the sample of Czech children, **lower** BMI-for-age z-scores were significantly associated with greater home availability of healthy food items (r= -0.203, p<0.05). No data provided for the sample of American children. • Multiple regression: For the sample of Czech children, a greater number of frozen vegetables available in the home was significantly associated to lower BMI-for-age z-scores after controlling for age and parental BMI (β=-0.35, p<0.01). No data provided for the sample of American children.
Byrd-Bredbenner 2009	• Cross-sectional • To nutritionally describe household food supplies of families and compare food inventories of households with overweight individuals to households without overweight individuals.	• Mothers with at least one child less than 12 yrs-old • Recruited by word-of-mouth and community announcements • U.S. • n=100	• Nutrient Adequacy Ratio of household nutrient supply for: calories, protein, fat, saturated fat, carbohydrate, sugar, sodium, vitamins, minerals, and food groups • Researcher-conducted complete household inventory	• Households with an obese child vs. households without an obese child • Parent-reported weight and height	• Bivariate Correlations: Households with obese children had significantly **lower** nutrient adequacy ratios for calories (p<0.03), fat (p<0.04), and saturated fat (p<0.03) than household without obese children.

FFQ=Food Frequency Questionnaire