Child and Parent Influences on Food Purchases: Contributions to Obesity

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Dedication

To my incredible parents, Tom and Pearl, for their

unending patience, love and support during this journey

To my niece and nephews,

may you always follow your hearts,

believe in your potential,

seek answers to your questions,

choose a career that makes going to work fun,

and strive to make the world a better place

(p.s. don’t forget to compost)

Abstract

Background

In spite of increased emphasis of healthful diets through campaigns, interventions, and research, obesity rates for adults and school-age children remain high, which suggests novel approaches are needed to work to mitigate and prevent obesity for youth and their parents. Currently, affordability of healthful diets for families in the United States is disputed in the research literature. Additionally, no research to date has comprehensively operationalized or investigated how a set of social-contextual food purchasing influences of parents and children (e.g., cooking ability, cost, store access) associates with home food environment, child dietary, and parent and child weight outcomes. Findings of such research may provide important, novel targets for intervention and future research aiming to positively influence obesity, dietary intake, and home food environments.

Aims

This dissertation aimed to (1) investigate the affordability of a healthful diet in the United States with a systematic review; (2) develop new purchasing influence measures; (3) assess for sociodemographic differences in the new measures; (4) evaluate relationships between the new measures and home food environment, child dietary intake, and parent and child weight outcomes; and (5) examine the strength of the new measures in explaining additional variance of the outcomes when accounting for known potentially influential variables.

Design and Sample

Aim 1 was completed with research literature obtained with a systematic data search. Aims 2-5 were completed using baseline data of the second cohort of parent (n=90) and child (n=90) participants of the Healthy Home Offerings via the Mealtime Environment (HOME) Plus randomized controlled trial conducted in the Minneapolis Metropolitan area of Minnesota.

Method

Aim 1. All identified Market Basket Surveys (MBS) included for review underwent systematic data extraction. MBS methodology, price and affordability findings, and limitations were reviewed; suggestions regarding related policy and practice implications are provided.

Aim 2-5. Qualitative and descriptive research and the social ecological framework were used to identify purchasing influence constructs (i.e., cooking ability, concern for nutrition, cost, family food preferences, social pressure, store access, and time) to be operationalized with items from existing HOME Plus surveys and those newly created/adapted from the literature. Each construct underwent exploratory factor analysis with principal axis factoring with promax rotation to develop psychometrically-sound scales, summative indices, and composite items measuring social-contextual food purchasing influences. Convergent validity was tested, when possible, to assure new measures were meaningful. Bivariate analyses (e.g., Pearson correlations, Chi-square) were used to test whether the new measures differed by sociodemographic characteristics.

Pearson correlations, general linear models, and hierarchical blocked regression models were used to assess relationships between food purchasing influence measures and home food environment, dietary, and weight outcomes.

Results

Aim 1. MBS methodology varied across studies. In comparison to the Supplemental Nutrition Assistance Program (SNAP) benefits, 90% of studies included for review found diets meeting dietary recommendations for families purchased from small/medium-sized stores were unaffordable, and 60% of studies found diets meeting recommendations for families purchased from supermarkets were also unaffordable.

Aim 2-5. Nineteen new food-purchasing influence measures were operationalized, and statistical tests generally supported convergent validity. Few sociodemographic differences were found. Bivariate and multivariate results indicated many (between 5-11) social-contextual purchasing influence measures (i.e., mostly from the time, cooking ability, store access, and concern for nutrition constructs) were significantly associated with each of the home food environment and dietary outcomes. Few measures were significantly associated with weight outcomes and no significant associations remained in multivariate analyses. Hierarchical models suggested blocks of purchasing influences (i.e., time, cooking ability, store access, and nutrition concern) were robust at explaining additional variability of home food environment outcomes; more specifically, beyond the variance explained by sociodemographic characteristics, the purchasing influence blocks explained an additional 45% of variance in both home fruit and vegetable availability.

However, purchasing influence blocks were less helpful in explaining variability in dietary and weight outcomes.

Conclusion

Affordability of a healthful diet was called into question for low-income American families who receive SNAP benefits. Consistent with a social ecological approach, nurses are prime advocates for increased affordability of healthful foods. Particular emphasis should be placed on policy advocacy in support of SNAP benefits for low-income families, which must be bridged with efforts at the local level to improve access to and affordability of healthful diets.

Additionally, purchasing influence research findings, in this particular sample, indicate many social-contextual food-purchasing influences, especially those related to the time, cooking ability, concern for nutrition, and store access constructs, were significantly associated with home food environments. Exploring interventions focused on multiple (rather than just one) social-contextual food purchasing influences/constructs should be considered as possible targets to positively impact home food environments, and through home environments, potentially dietary intake and obesity. Future, more highly powered, research should validate measures in a more a generalizable sample and should consider evaluation of longitudinal relationships.

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Preface

This dissertation is written in the three-manuscript format. Chapter 1 provides an introduction to and overview of the aims and content of the dissertation. Chapters 2, 4, and 5 will be presented in manuscript form. Chapter 3 provides a detailed description of the methods used in analyses of Chapters 4 and 5. Chapter 6 provides a concluding discussion and synthesis of findings from each manuscript and directions for future research and practice.

Chapter 1: Introduction

Obesity affects 38% of adults and 17% of children (Ogden, Carroll, Kit, & Flegal, 2012), and research has shown that being overweight or obese as a child increases the likelihood of being overweight or obese as an adult (Singh, Mulder, Twisk, Van Mechelen, & Chinapaw, 2008). For both children and adults, obesity is associated with chronic health conditions such as hypertension, type 2 diabetes, hyperlipidemia, and joint and psychosocial problems (Centers for Disease Control [CDC], 2012; Ogden et al., 2012). Obesity and obesity-related health conditions threaten the health and longevity of future generations of Americans (Olshansky et al., 2005), which contribute to obesity-related health care costs, estimated to be $147 billion dollars annually (Finkelstein, Trogdon, Cohen, & Dietz, 2009).

Given these implications, a significant amount of work has taken place to both understand and intervene on the factors contributing to obesity in order to prevent and reduce obesity's impact on health. A major known contributing factor to obesity is excessive caloric intake (CDC, 2012; CDC, 2013), which has led to myriad healthful eating campaigns, policy change, intervention, and research. For example: (a) the MyPlate campaign recommends, at mealtimes, filling half the plate with fruits and vegetables to support a healthful and well-balanced diet (United States Department of Agriculture [USDA], Center for Nutrition Policy and Promotion., 2011); (b) the National School Lunch program has changed policy to improve the types and healthfulness of foods served and available to youth in schools (Food and Nutrition Services, USDA

2013); (c) programming like the Share Our Strengths Cooking Matters program teaches families how to cook affordable, healthful foods with the goal of increasing the healthfulness of dietary intake (Share Our Strengths Cooking Matters., n.d.); and (d) research programs are being developed nationwide to prevent obesity through improved dietary intake (Waters et al., 2011). All such work stresses the importance of and encourages adopting a healthful and well-balanced diet.

Affordability

However, the affordability of a healthful and well-balanced diet has been cited by individuals, families, and research as a significant barrier to healthful eating (Drewnowski, 2004; Drewnowski & Eichelsdoerfer, 2010; Minnesota Food Charter, 2014; Share Our Strengths Cooking Matters., 2012; Yeh et al., 2008). Other literature suggests healthful foods are affordable (Andreyeva, Blumenthal, Schwartz, Long, & Brownell, 2008), even for those with low-incomes receiving Supplemental Nutrition Assistance Program (SNAP; formerly referred to as food stamps) benefits (Lino, 2011). Yet, if healthful foods are cost-prohibitive, energy-dense, nutrient-poor, low-priced foods are satiating options that may stretch food budgets but may increase risk of higher weight status (Dinour, Bergen, & Yeh, 2007). Therefore, it is necessary to investigate the affordability of healthful diets for low-income families.

Purchasing Influences

In addition to assessing the affordability of healthful diets, more research is needed to understand the influences on food purchases of families of all backgrounds and

income levels (Beaulac, Kristjansson, & Cummins, 2009; Fulp, McManus, & Johnson, 2009; Gustafson, Hankins, & Jilcott, 2012; Robert Wood Johnson Foundation Working Group on In-Store Marketing, 2014). Foods purchased by families comprise the home food environment, and home food environments have been linked to dietary intake (Campbell et al., 2007; Ding et al., 2012; Grimm, Harnack, & Story, 2004; Larson, Story, Wall, & Neumark-Sztainer, 2006; Lipsky, Nansel, Haynie, Mehta, & Laffel, 2012; Neumark-Sztainer, Wall, Perry, & Story, 2003; Raynor, Polley, Wing, & Jeffery, 2004; van Ansem, Schrijvers, Rodenburg, & van de Mheen, 2012), and consequently, obesity. Yet, how a set of comprehensive, social-contextual influences impacts these purchases is relatively unknown. The research to date investigating the food purchases of adults (i.e., what and where they buy) focuses on differences by sociodemographic characteristics (e.g., race), location of purchase, price, and additional social-contextual influences, the latter often only studied qualitatively or with descriptive statistics.

Although, children have an annual purchasing power of $40 billion and purchasing influence of $700 billion (The Economist, 2006), children's food purchases are largely unstudied. Although foods purchased and made available to children are largely under parental discretion, children have substantial influence on the types of foods purchased and available in their homes (Institute of Medicine Committee on Food Marketing and the Diets of Children and Youth, 2006). Therefore, a broader analysis of the social-contextual influences on parent and child food purchases is needed, as foods

purchased by families are impacted by a host of influences that fall within the social ecological framework.

Review of Food Purchasing Literature

The research literature of food purchases, to date, informs this dissertation research. This literature is reviewed below and includes the sociodemographic differences in purchasing and the social-contextual purchasing influences (grouped by construct: cooking ability, concern for nutrition, cost, family food preferences, social pressure, store access, and time).

Sociodemographic Differences in Purchasing. Research on food purchasing influences has focused largely on the sociodemographic differences of adult food purchases. Specifically, unhealthful food purchases differ across race (Dammann & Smith, 2010; Lip, Malik, Luscombe, McCarry, & Beevers, 1995) and are higher for those residing in low socioeconomic neighborhoods (Turrell et al., 2009), with lower household income levels (Kirkpatrick & Tarasuk, 2003; McKinnon, Giskes, & Turrell, 2014; Ricciuto, Tarasuk, & Yatchew, 2006; Turrell et al., 2009), and with lower education levels (Blitstein & Evans, 2006; Ricciuto et al., 2006; Turrell & Kavanagh, 2006). Nutrition knowledge may mediate unhealthful food purchases for those with lower socioeconomic statuses (McKinnon et al., 2014) and education levels (Turrell & Kavanagh, 2006). In addition, food purchasing frequency and place of purchase have been found to vary with race and education (Yoo et al., 2006). Knowledge of these factors is critical to understanding food purchasing behavior, as it highlights how one's

background affects the way foods are purchased, made available at home, and consumed. *However, this research has not identified what influences on food purchases (aside from place of purchase or nutrition knowledge) may contribute to these sociodemographic differences in healthful food purchasing.*

Purchasing influence constructs.

Cooking ability. Self-efficacy for cooking, meal preparation skills (Hollywood et al., 2013), ease of preparation (Hughner & Maher, 2006) and advanced planning (Darko, Eggett, & Richards, 2013) have been qualitatively found to be important influences on food shopping, as was prioritizing food purchases to allow for families to be able to cook and eat together at home (Putrevu & Ratchford, 1997). For youth, limited or lack of cooking skills may limit purchase of foods that would require cooking or preparation (Nelson, Corbin, & Nickols-Richardson, 2013). *Therefore, **cooking ability** may be an important social-contextual influence on the foods purchased by parents and children.*

Concern for nutrition. Research has also found that having a priority for health and nutrition and/or nutrition knowledge influences food purchases (Blitstein & Evans, 2006; Chase, Reicks, Smith, Henry, & Reimer, 2003; Dachner, Ricciuto, Kirkpatrick, & Tarasuk, 2010; Freedman, Blake, & Liese, 2013; Henry et al., 2003; Hughner & Maher, 2006; Peterson, Dodd, Kim, & Roth, 2010; Wingert, Zachary, Fox, Gittelsohn, & Surkan, 2014). In addition, studies have looked at relationships with food shopping practices (e.g., planning for healthy purchases, reading nutrition labels) and found them to be associated with higher nutrient intake (Hersey et al., 2001) and higher home fruit and

vegetable availability (Baranowski et al., 2006; Baranowski et al., 2008). A recent pilot study has shown that a tailored nutrition education intervention increased the healthfulness of foods purchased (Cortés, Millán-Ferro, Schneider, Vega, & Caballero, 2013). Additionally for 10-14 year old youth, an increased frequency of healthier food purchases has been linked with healthier food behavior intentions for girls and to higher caregiver self-efficacy for healthful food purchasing (Surkan et al., 2011). In addition, providing youth easily understandable caloric information (Bleich, Barry, Gary-Webb, & Herring, 2014) reduced sugar-sweetened beverage purchase. *Like cooking ability, the literature supports that* ***concern for nutrition*** *influences parent and child food purchases.*

Cost. Price of food items consistently has been found to influence actual food purchases (Andreyeva, Long, & Brownell, 2010; Powell, Chriqui, Khan, Wada, & Chaloupka, 2013), as does food insecurity (Dachner et al., 2010), and use of coupons and store sales (Chase et al., 2003; Darko et al., 2013; Dubowitz et al., 2007; Henry et al., 2003; Hersey et al., 2001; Peterson et al., 2010; Putrevu & Ratchford, 1997). For youth, low fruit and vegetable prices and high fast food prices were also associated with higher fruit and vegetable consumption and lower BMI (Powell, Han, & Chaloupka, 2010). *For youth and parents alike,* ***cost*** *of foods influences purchases, and thus, is an important purchasing influence construct.*

Family food preferences. Additional research has suggested family food preferences, which includes knowing your family will eat a food, taste, children's fear of new foods, picky eating, and avoiding conflict also influence food purchases (Chase et

al., 2003; Dachner et al., 2010; Dubowitz et al., 2007; Henry et al., 2003; Hollywood et al., 2013; Maubach, Hoek, & McCreanor, 2009; Peterson et al., 2010). *Given this research, the social-contextual purchasing influence construct of* ***family food preferences*** *may be important.*

Social pressure. Research has found social support for healthful eating is associated with a healthier purchasing outcome (Baranowski et al., 2006; Baranowski et al., 2008). Additionally, youth, with parents who are not in-support of sugar-sweetened beverage consumption, purchased less sugar-sweetened beverages (Nickelson, Roseman, & Forthofer, 2010). Research has also found children's requests for foods influenced parents' purchases (Maubach et al., 2009; O'Dougherty, Story, & Stang, 2006; Wingert et al., 2014). Children have been found to use multiple strategies like bargaining, persuasion, and begging to request food purchases made by family members; moreover, use of these strategies was predicted by eating in front of the TV, being influenced by foods seen on TV, wanting to eat what others are eating, and concerns for others opinions (Marquis, 2004). Marketing and brand names are also important pressures on purchases (Hughner & Maher, 2006; Maubach et al., 2009). *Therefore,* ***social pressure*** *from a variety of sources is also an influence for purchasing for youth and parents.*

Store Access. Research has shown that lack of access to larger grocery stores, (Dammann & Smith, 2010; D'Angelo, Suratkar, Song, Stauffer, & Gittelsohn, 2011; Gustafson et al., 2013; Zenk et al., 2005) and shopping at big box retail stores (Dammann & Smith, 2010) has been associated with unhealthful food purchases. For

youth, access to supermarkets has been associated with healthier outcomes (Powell et al., 2010) but access to and purchasing from food stores and vending machines has also been associated with unhealthful outcomes (Hearst, Pasch, & Laska, 2012; Laska, Hearst, Forsyth, Pasch, & Lytle, 2010; Park, Sappenfield, Huang, Sherry, & Bensyl, 2010; Rovner, Nansel, Wang, & Iannotti, 2011; Thompson, Yaroch, Moser, Finney Rutten, & Agurs-Collins, 2010). Additional research has found store features and characteristics (Aylott & Mitchell, 1999; Dubowitz et al., 2007; Freedman et al., 2013; Gustafson et al., 2013), and food availability, selection, and quality (Dachner et al., 2010; Freedman et al., 2013; Henry et al., 2003; Peterson et al., 2010; Zenk et al., 2005) may be important in food purchasing. Improved dietary quality has been associated with perceptions of a convenient, store location with good quality and selection (Blitstein, Snider, & Evans, 2012) and proximity to and use of farmer's markets (Blitstein et al., 2012; Evans et al., 2012; Gustafson et al., 2013; Racine, Mumford, Laditka, & Lowe, 2013). *Given this large body of literature**, store access** is likely an important social-contextual influence on food purchases for youth and parents.*

Time. Research has highlighted that the need for convenience (Bava, Jaeger, & Park, 2008; Dubowitz et al., 2007; Henry et al., 2003; Hughner & Maher, 2006; Maubach et al., 2009; Peterson et al., 2010) and time pressures of families' busy lives and schedules (Aylott & Mitchell, 1999; Bava et al., 2008; Dubowitz et al., 2007; Freedman et al., 2013) may influence food purchases. *Therefore, **time** is included as an important social-contextual purchasing influence construct.*

Social Ecological Framework

This dissertation research utilizes the social ecological framework to understand both the affordability of a healthful diet and social-contextual influences on food purchases of children and their parents. The social ecological framework outlines the social-contextual dimensions of ecology that interplay to shape and influence human development and behavior. The dimensions of ecology include the environmental contexts (interpersonal/family, community, and systems) surrounding individuals (Bronfenbrenner, 1994). This framework has often been applied to community health promotion efforts, as it considers how the contextual environment impacts all aspects of health promotion research and intervention (Stokols, 1996). For example, the importance of the ecological framework has been emphasized for creating healthful eating environments and food choices (Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008); failing to consider contextual community issues (e.g., store access, food affordability) that are vital to changing a health-related behavior (e.g., increasing healthful food purchases) may entirely negate the effectiveness of a dynamic, innovative behavioral intervention.

The social ecological framework is also aligned with recommendations for childhood obesity prevention and mitigation, which stress the importance of family involvement; families influence the food environment, food choices, taste preferences, and mealtimes (Casazza et al., 2013; Espinoza, Ayala, & Arredondo, 2010). Additionally, involving parents and children is especially important because children are gaining more

independence with food choices and purchases at school and in the community but are still significantly influenced by their families and home environments (Pedersen, Grønhøj, & Thøgersen, 2015). Therefore, investigating the social-contextual purchasing influence constructs (depicted in Figure 1.1) that fit within the ecological framework for children and parents is critical for informing future intervention work.

Summary

For adults, research to date has found that price, place of purchase, and sociodemographic differences affect how and why adults purchase food and a host of additional social-contextual influences on purchases have also been described. Much less research has focused on influences of children's food purchases, but the research which does, highlights the need for looking at parent and child purchasing influences together, as parents and children may be influenced by each other and similar social-contextual purchasing influence constructs.

Therefore, although many possible food purchasing influences have been discussed in the literature, studies have not assessed relationships between a comprehensive set of social-contextual food purchasing influences and food purchasing outcomes for children and their parents including home food environment, dietary intake or weight outcomes. Of the studies that do assess the relationship between food purchasing influences and outcomes, no studies to date comprehensively assess the influences on child and parent food purchases—a key missing link that is essential for future programming.

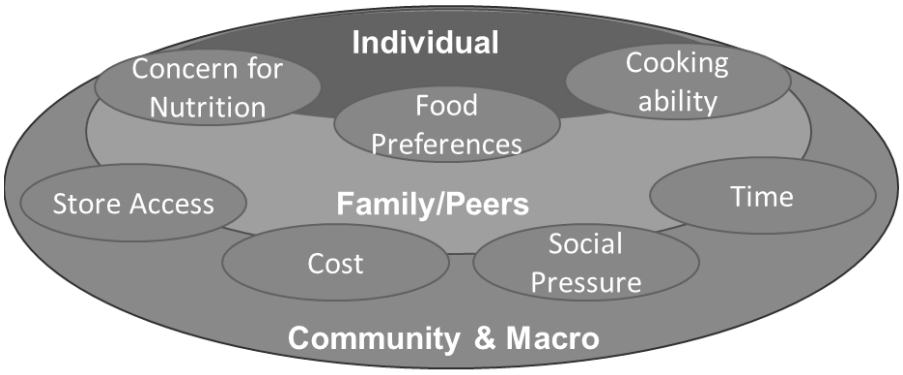

Figure 1.1 Social-Contextual Food Purchasing Influence Constructs within the Social Ecological Framework

Purpose

The purpose of this dissertation research is two-fold. First, the affordability of healthful diets for families in the United States will be assessed with a systematic review of the market basket survey (MBS) literature (Horning & Fulkerson, 2015); MBS research assesses the affordability of healthful diets (Cohen, 2002). Results from this review will be placed into context for both nursing science and policy.

Then, the second focus of this dissertation will be to investigate child and parent influences on food purchases through a secondary data analysis study. This purchasing influence research study will use data from the Healthy Home Offerings via the Mealtime Environment (HOME) Plus study, a community-based trial working with families to promote family meals, healthful eating behaviors, and home food environments to prevent childhood obesity (R01DK084000, PI: Fulkerson). Some of the HOME Plus data to be used for the purchasing influence research were collected with new HOME Plus purchasing items developed by this researcher and her academic advisor. The social

ecological framework and the literature review guided development of new HOME Plus purchasing items; these items were developed to specifically measure a comprehensive set of purchasing influence constructs of parents and children (e.g., cooking ability, time; depicted in Figure 1.1).

Using both existing HOME Plus data and the new HOME Plus purchasing items, this dissertation research study will develop, create and assess new measures to operationalize social-contextual purchasing influence constructs on food purchases for parents and children. In addition, the present research will analyze associations between the new parent and child food purchasing influences measures, sociodemographic characteristics, and outcomes (e.g., home food environment, dietary intake, weight outcomes). The written aims/research questions guiding this dissertation are provided below.

Dissertation Aims

Aim 1

Systematically review the market basket survey literature to assess the affordability of healthful diets for families. **Research question:** Are healthful diets affordable for low-income families receiving Supplemental Nutrition Assistance Program (SNAP) benefits in the United States? (Data retrieved from a systematic search of the literature.)

Aim 2

Assess psychometric properties of novel survey items of food purchasing influences for both parents and children and explore development of psychometrically-sound scales. (Data from HOME Plus.)

Aim 3

Describe influences on food purchases and compare them by age, race and other child and parent sociodemographic characteristics. **Research question:** Will food purchasing influences vary by parent and child sociodemographic characteristics (e.g., age, race, etc.)? (Data from HOME Plus.)

Aim 4

Evaluate relationships between influences on food purchases for parents and children and home food environment, child dietary, and parent and child weight outcomes. **Research question:** How strongly do parent and child food purchasing influences associate with outcomes? (Data from HOME Plus.)

Aim 5

Examine the strength of the influences on food purchases to explain home food environment, child dietary intake, and parent and child weight outcomes while accounting for other influential variables. **Research question:** Do influences on food purchases contribute to additional explained variance for the outcomes? (Data from HOME Plus.)

HOME Plus

The HOME Plus trial is the data source for the purchasing influence research (dissertation aims 2-5); therefore, information on HOME Plus is provided here for context. The goal of the HOME Plus randomized controlled trial was to prevent excess weight gain in 8-12 year old children and included behavioral programming to increase family meal frequency, improve healthfulness of meals, snacks and the home food environment, and reduce sedentary behavior, in particular, screen time. HOME Plus used a staggered cohort design for recruitment of two cohorts. Families with at least one 8-12 year old child were recruited from the city of Minneapolis and surrounding metropolitan cities, as intervention sessions were held in Minneapolis Park and Recreation Centers in Hennepin County, Minnesota. Trained study staff collected data in participant family's homes following informed consent and assent (Fulkerson et al., 2014). The purchasing influence research uses baseline data from families of the second cohort (n=90), as child and parent purchasing influence questionnaires were developed between recruitment of cohorts 1 and 2.

Significance

Given mixed research findings on affordability of healthful diets and the paucity of research on a comprehensive set of social-contextual influences on parents' and children's food purchases, this research is innovative. This dissertation research will provide evidence on the affordability of healthful diets and will develop and test new

measures to operationalize a comprehensive set of food purchasing influences, contributing to measurement for future research.

Findings will also estimate how the influences on food purchases explain relationships with home food environments, child dietary intake, and parent and child weight outcomes, providing the scientific foundation to inform and personalize interdisciplinary practice, community-based research, and innovative interventions, which may lead to improvements in the healthfulness of foods purchased, eating environments, and dietary intake, contributing to overall obesity prevention for both children and their parents. Results may also reveal critical social and environmental influences of purchases and expand targets for obesity prevention.

Therefore, this dissertation research is directly aligned with the nationally-identified health goal of HealthyPeople2020 to improve the nutrition and weight status of Americans (Healthy People 2020, 2012) and with the focus of the National Institute of Nursing Research to promote health and prevent diseases, which includes studying the behavior of family units (National Institute of Nursing Research, 2011).

Organization of the Dissertation

This dissertation work is organized by chapter. Chapter 2 is written in published manuscript form and is titled: A Systematic Review on the Affordability of a Healthful Diet for Families in the United States. Chapter 2 fulfills Aim 1 and presents evidence of the need for further study of purchasing influences of parents and children. Chapter 3 provides detailed methods for the purchasing influence research portion of this

dissertation that investigates child and parent influences on food purchases (Aims 2-5). Chapter 4 is presented in manuscript form and provides a background to measure development, analysis of the psychometric properties of the new measures (Aim 2) and results of sociodemographic differences in the new measures (Aim 3). Chapter 5, written in manuscript form, evaluates associations between the new measures and home food environment, child dietary, and child and parent weight outcomes (Aim 4). Chapter 5 also presents results from multivariate models to detect how strongly children's and parents' influences on food purchases explain variability in outcomes when accounting for confounders (Aim 5). Chapter 6 summarizes and discusses dissertation findings as a whole, intervention and research implications, and limitations.

Note: References for Chapters 1, 3, and 6 are found in the dissertation bibliography following Chapter 6. References for Chapters 2, 4, and 5 are found following each manuscript and in the dissertation bibliography.

Chapter 2: Manuscript One

This chapter is a systematic review on the affordability of a healthful diet for American families receiving Supplemental Nutrition Assistance Program (SNAP, formerly referred to as food stamps) benefits. This manuscript is published in Public Health Nursing of Wiley Periodicals; see Appendix A for copyright permission.

A Systematic Review on the Affordability of a Healthful Diet for Families in the United States

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Overview

Objectives

As obesity rates remain alarmingly high, the importance of healthful diets is emphasized; however, affordability of such diets is disputed. Market basket surveys (MBSs) investigate the affordability of diets for families that meet minimum daily dietary requirements using actual food prices from grocery stores. This review paper describes the methods of MBSs, summarizes methodology, price and affordability findings, limitations, and suggests related policy and practice implications.

Design and Sample

This is a systematic review of 16 MBSs performed in the United States from 1985 to 2012. A comprehensive multidisciplinary database search strategy was used to identify articles meeting inclusion criteria.

Results

Results indicated MBS methodology varied across studies and price data indicated healthful diets for families are likely unaffordable when purchased from small- to medium-sized stores and may be unaffordable in larger stores when compared to the Thrifty Food Plan.

Conclusion

Using a social ecological approach, public health nurses and all public health professionals are prime advocates for increased affordability of healthful foods. This includes policy advocacy, particularly in support of Supplemental Nutrition Assistance

Program benefits for low-income families. Future research implications are provided, including methodological recommendations for consistency and quality of forthcoming MBS research.

Key words

Nutrition, diet, family health, market basket survey, Thrifty Food Plan, food affordability

Background

U.S. obesity rates remain alarmingly high, are associated with serious health conditions (Ogden, Carroll, Kit, & Flegal, 2012), and threaten to reduce the life expectancy of our nation's youth (Olshansky et al., 2005). Many efforts exist to increase healthful eating, as excessive caloric intake is a known contributing factor to weight gain (CDC, 2011a; CDC, 2011b). However, cost continues to be cited as a significant barrier to healthful eating (Drewnowski & Eichelsdoerfer, 2010; Share Our Strengths, 2012; Yeh et al., 2008).

The Supplemental Nutrition Assistance Program (SNAP) is a federal food assistance program (formerly known as food stamps) that assists low-income families (at or below 130% of federal poverty guidelines) in affording a nutritious diet (United States Department of Agriculture [USDA], n.d.). SNAP uses the mathematical model of the Thrifty Food Plan (TFP) to calculate projected standardized costs of nutritious diets, those meeting minimum daily dietary requirements (MDDR) based on the USDA's dietary guidelines using foods frequently consumed by a nationwide NHANES sample (Carlson, Lino & Fungwe, 2007). This projected standardized cost is used to determine the amount of cash food benefits allocated to families through the SNAP program (USDA, n.d.; Carlson et al., 2007). Yet, current literature offers mixed results on whether SNAP cash food allowances are adequate to support a healthful diet (Andreyeva,

Blumenthal, Schwartz, Long, & Brownell, 2008; Drewnowski & Eichelsdoerfer, 2010; Lino, 2011).

Reviews on food cost disparities are present in the literature (Beaulac, Kristjansson, & Cummins, 2009; McKinnon, Reedy, Morrissette, Lytle, & Yaroch, 2009; Walker, Keane, & Burke, 2010); however, to our knowledge, a review of market basket survey (MBS) methods and findings does not exist. MBSs directly investigate the affordability of a family's healthful diet by surveying grocery stores for the prices of a market basket food list, a list containing the foods necessary to meet MDDRs for a family of four. Then, the prices are used to calculate the market basket price, the total amount a family would have to spend to meet MDDRs. Comparing the market basket price to the TFP's modeled price from the same time frame allows researchers to assess families' ability to purchase a healthful diet with SNAP benefits. Therefore, a systematic review of MBSs will provide important methodological and cost information on the affordability of food for families receiving SNAP benefits. The present systematic review will investigate (a) similarities and differences of MBS methodology since 1985, (b) MBS affordability and price outcomes, and (c) how limitations in MBS methodology may affect findings. Methodology, limitations and price outcomes will be placed into context with discussion of policy and nursing practice implications.

Method

Design and Sample

Multidisciplinary databases were systematically searched to identify relevant articles and are shown in Figure 2.1. Search terms can be obtained from the primary author. Results were limited to the English language and publication dates between 1/1/1985 and 6/14/2012 to ensure a comprehensive review. Studies were included for full review if they were MBSs assessing the affordability of market baskets that meet families' MDDR using food prices from actual stores in the U.S. Articles were excluded if they did not provide the complete cost of a market basket. Reference lists of articles included for full review were hand searched for articles not yet identified. Figure 2.1 depicts data flow using PRISMA standardized reporting guidelines for systematic reviews (Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009).

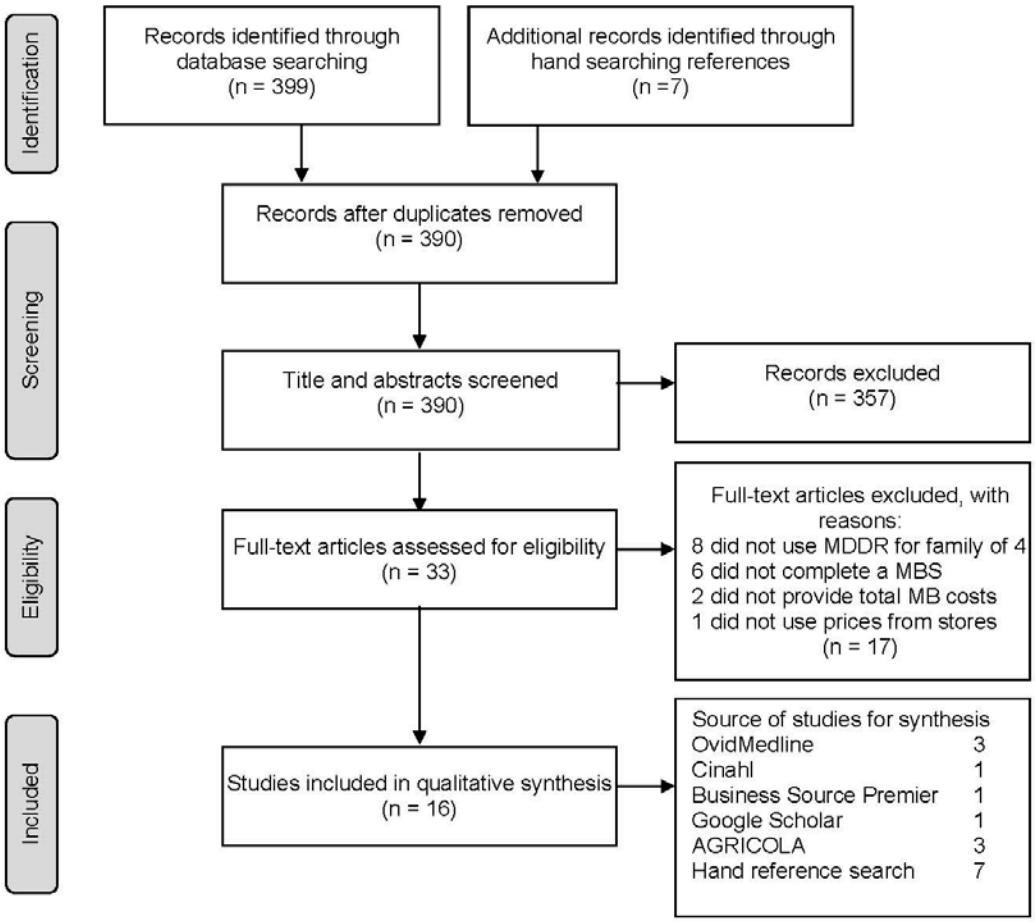

Figure 2.1. Data flow diagram using the PRISMA guidelines

MBS = Market Basket Survey; MDDR = Minimum Daily Dietary Requirements; MB = Market.

Sixteen articles met criteria for inclusion; study information and results are summarized in the results section below and in Table 2.1. The following information was extracted to describe the similarities and differences of MBS methodology: (a) aims/research questions; (b) location of study; (c) number of stores sampled and selection method; (d) number of items on the food list and selection criteria; (e) how MDDR and

prices of the market baskets were calculated; (f) policy implications based on findings; and (g) study quality indicators. Data extracted to summarize the results and outcomes were: (a) types of stores surveyed (categorized into three levels: small/medium, supermarkets, and bulk discount stores); (b) neighborhood income level of stores (low or non-low income); (c) market basket prices for each store type and neighborhood income level; and (d) the referenced TFP price. If the TFP price was not identified, it was obtained from the USDA by the primary author of this review (USDA, 2012; USDA 1992). Individual study quality was graded using a 31-item checklist developed by combining established quality reporting guidelines of economic analyses (Siegel, Weinstein, Russell, & Gold, 1996) and surveys (Kelley, Clark, Brown, & Sitzia, 2003), including substantial detail on study framework (e.g., boundaries of analysis), data/methods (e.g., sample selection), results (e.g., total costs), and discussion (e.g., study limitations). Each study received a score from one to five as noted in Table 2.1 (5=31, 4=25-30, 3=20-24, 2=15-19, and 1≤14 quality criteria were present).

Table 2.1. ***Study Characteristics***

Study number, authors, (date)	Location, rural (R), urban (U)	Store selection method	*N*	Number of MB food list items	MB MDDR and price	Comparison measure	Quality rating
1. Morris, Neuhauser and Campbell (1992)	22 states, (R)	3 stage, stratified random sample	133	77 inexpensive and common food items noted in the literature.	Items were price by weight, averaged by food category (e.g. fruits), and weighted for MDDR amount as allowed by TFP. Weighted food categories were summed by store to get MB price.	T-test	4
2. Crockett, Clancy and Dowering (1992)	3 cities, NY, (U&R)	NS	88	83 commonly used food items from a national survey.	Items were unit priced and multiplied by TFP item quantities to meet MDDR; these prices were summed by store for MB price.	T-test	4
3. Troutt (1993)	1 city, CA (U)	Census	7	75 food items from TFP list modified to local preferences.	Items were unit priced and multiplied by TFP item quantities to meet MDDR; these prices were summed by store for MB price.	Statistical, NS method	4
4. Johnson, Percy and Wagner (1996)	1 city, WI (U)	Random and census sample	55	50+ food items selected by nutritionists, brand names specified.	Items were unit priced for in a prespecified package size to meet MDDR, averaged over store type or neighborhood, sum totaled by variable for MB price.	Descriptive	4
5. Chung and Myers (1999)	2 counties, MN, (U)	Random sample	55	45 food items selected by a nutritionist, popular-brand names specified.	Items were unit priced and multiplied by TFP item quantities to meet MDDR; these prices were summed by store for MB price.	Descriptive	4
6. Andrews, Kantor, Lino and Ripplinger (2001)	1 city, DC, (U)	Superma-rkets with high food stamp use	34	68 food items from a two week TFP meal plan.	Items were unit priced and multiplied by TFP item quantities to meet MDDR; these prices were summed by store for MB price.	Descriptive	4
7. Smith (2003)	1 county, OR (U&R)	Census of super-markets	27	68 food items from a two week TFP meal plan.	Items were unit priced and multiplied by TFP item quantities to meet MDDR; these prices were summed by store for MB price.	Descriptive	4
8. Block and Kouba (2006)	1 city, IL, (U)	Census	134	NS food item number from culturally adapted TFP food list.	Items were unit priced in lowest price per unit of a prespecified common package size, multiplied by TFP item quantities specified to meet MDDR, and summed by store.	T-test	4

Study number, authors, (date)	Location, rural (R), urban (U)	Store selection method	*N*	Number of MB food list items	MB MDDR and price	Comparison measure	Quality rating
9. Brown and Sperow (2005)	1 city, NS, (U)	NS	NS	104 food items on modified TFP list to include organics on one MB list.	The lowest price of the item was used with TFP quantities to determine MDDR with NS method. Calculated price of an organic and traditional MB.	Statistical, NS method	2
10. Neault et al. (2005)	1 city, MA, (U)	Key informant recomme-ndations	9	NS food item number from TFP food list.	Items were unit priced, multiplied by TFP item quantities to meet MDDR, and summed by store for MB price. Healthier items were unit priced, multiplied by prespecified quantities to meet healthier MB guidelines, and summed by store for healthier MB price.	Descriptive	3
11. Jetter and Cassady (2006)	2 cities, CA, (U)	NS	25	NS food item number. TFP two week shopping list adjusted for healthier options.	Items were unit priced, multiplied by TFP item quantities to meet MDDR and summed by store for MB price. Healthier items were unit priced, multiplied by prespecified quantities to meet healthier MB guidelines and summed by store for healthier MB price.	T-tests	2
12. Short, Guthman, and Raskin (2007)	1 city, CA, (U)	Random sample/ NS	6	40 culturally adapted TFP food items for use in cultural areas or 47 food items from TFP list for all other areas.	Items were unit priced in highest volume for lowest price per unit, multiplied by TFP item quantities specified to meet MDDR, and summed by store.	Descriptive	3
13. Raja, Changxing, and Yadav (2008)	1 county, NY (U)	Focus group input/NS	20	22 food items from the TFP food list obtainable locally.	Referenced USDA guidelines used to calculate MDR. No other details given.	Descriptive	2
14. Fulp et al. (2009)	1 city, MA, (U)	Focus group's store use	2	NS food item number. Dietitians made meal plans based on focus groups and adapted into a food list.	Items were unit priced, multiplied by quantities specified by dietitians to meet Food Guide Pyramid recommendations, and summed by store.	Descriptive	4
15. Sheldon et al. (2010)	1 city, RI (U)	NS	21	58 food items from the TFP food list obtainable locally.	Items were unit priced, multiplied by TFP item quantities specified to meet MDDR, and summed by store for MB price.	Descriptive	3

Study number, authors, (date)	Location, rural (R), urban (U)	Store selection method	*N*	Number of MB food list items	MB MDDR and price	Comparison measure	Quality rating
16. Breen, Cahill, Cuba, Cook, and Chilton (2011)	1 city, PA, (U)	NS	16	108 items from TFP food list.	Food list was specified to meet TFP 2006 dietary guidelines. No other details given.	Descriptive	2

Note. N = number of stores surveyed. NS = not specified. MB = market basket. MDDR = minimum daily dietary requirements of all food groups to meet nutrition and dietary recommendations. Quality is out of five; five indicates highest quality.

Outcome Measures for Review

Given the data available in the published studies, a common standardized outcome measure (e.g., effect size) could not be used as in a typical meta-analysis. However, a robust standardized outcome measure was essential to account for rising food costs and subsequent TFP prices over time. Therefore, the outcome measure created and used in this review paper involved several calculations. For each study, first, we averaged market basket prices by each store size and each store neighborhood income level and divided the average prices by the price of the TFP at that time. Second, to assess the affordability of market baskets in relation to the TFP, 1 was subtracted from each value and multiplied by 100 (a calculation that is similar to the calculation of a relative risk). For example, if the average market basket price for small stores in Study X was $116 and the TFP price at that time was $102 then the calculation of [((116/102)-1)*100=13.7] means the average market basket price in small stores in Study X is 13.7% above the TFP price. Since the average market basket price and the TFP price are from the same timeframe, this calculation minimizes the influence of time. This outcome also allowed for uniform comparison of the affordability of a healthful diet, in the form of percentage points that a market basket price is above or below the TFP price, across all studies.

Results

Store Selection

Stores surveyed were selected by several methods, including random sampling (25%; studies 1, 4-5, 12 as listed in Table 2.1), census sampling (19%; studies 3, 7-8), and sampling based on input from key informants (6%; study 10), focus groups (13%; studies 13, 14) and stores with high food stamp use (6%; study 6). The remaining studies failed to describe store selection. Most studies surveyed stores only in urban areas; however, 13% surveyed in both urban and rural areas (studies 2, 7) and 6% surveyed in multiple geographic rural locations (study 1).

Market Basket Food Lists

The number and selection of food items also varied across studies. Of the 16 studies, 75% identified the number of food items in the market basket, which ranged from 22 to 108 (studies 1-7, 9, 12-13, 15-16). Most food lists were variations of the USDA TFP shopping list and included commonly used food items. However, 19% of studies adapted their food lists to be culturally-appropriate (studies 3, 8, 12), and another 19% of studies utilized nutritionists/dietitians or focus groups to design food lists (studies 4-5, 14). An additional 19% of studies had two food lists: one list contained common TFP market basket food items and the other adapted the TFP list to include healthier items like whole grains (studies 10-11) or organic food items (study 9).

Pricing Methods

Pricing methods also varied by study with 13% specifying food brands (studies 4-5) and 38% specifying package size (studies 2-4, 6, 8, 12). The remaining 50% priced the lowest price per unit (e.g., lowest cost/pound). Thirty-one percent of studies noted whether sale prices were used during unit pricing (studies 5, 6-7, 9, 14), 25% allowed for food item substitutions if specified items were unavailable (studies 1, 5-6, 9), and 44% discussed pricing of missing food items (studies 1, 5-8, 10, 16). Nineteen percent accounted for seasonal price changes (studies 2, 10-11), and 6% discussed data verification with food price checks (study 11).

Minimum Daily Requirements

The method for calculating MDDR varied as well. Of the 16 studies, 63% calculated MDDR of market baskets by calculating the unit price for each food item (e.g., cost/ounce), multiplying the unit item price by the specified TFP item quantity to meet MDDR, and summing these food item prices for the total market basket price (studies 2-3 5-8, 10-12, 15). Of these, two studies also priced healthier market baskets (studies 10-11) and another 6% only examined healthier market baskets (study 14). These healthier market baskets calculated MDDR as described above, except unit item prices were multiplied by prespecified amounts to meet healthier dietary guidelines (e.g., American Heart Association) versus the TFP quantity. Six percent of studies calculated MDDR by averaging the price per weight of food items by each food category (e.g., fruits), multiplying by the minimum amount allowed by the TFP to meet MDDR for each food

category, and then summing the weighted food categories by store for total market basket price (study 1). Another 6% of MBSs priced food items in prespecified quantities and averaged each food item price across the variable of interest (i.e., for each store type and neighborhood income level). The average price for each food item was summed for the total market basket price by store type or neighborhood income level (study 4). Although, the remaining 19% of studies noted market baskets met MDDR, calculation details were not reported (studies 9, 13, 16).

Market Basket Price Comparison

Most MBSs compared the market basket price of a specified food list by variable of interest (store size and/or store neighborhood income level) and the USDA TFP price (studies 1-3, 5, 7, 10, 12-16). However, 19% of studies compared individual market basket prices to one another (studies 3-4, 8), and 13% compared healthier or organic market basket prices to those of traditional market baskets (studies 9, 11). Study 11 also descriptively compared the market basket price to a referenced food budget for a low-income consumer unit (Department of Labor, 2004); however, this quoted budget was not directly comparable to the market basket cost of a family of four. Most studies provided descriptive cost comparisons, although, some statistically compared price differences (see Table 2.1).

As shown in Table 2.2 and Figure 2.2, in small/medium stores, 90% of studies found average market basket prices were higher than the TFP. In supermarkets, 60% of studies found average market baskets prices were higher than the TFP. Four studies also

looked at prices of market baskets in bulk stores, which were lower than the TFP. The average market basket price of studies with low quality scores (less than three) varied above and below the prices of studies with higher quality scores in no apparent trend in small/medium and bulk stores (see Figure 2.2). However, in supermarkets, studies with low quality scores generally had higher average market basket prices than those with quality scores of four; additionally, the quality of MBSs was higher for studies published prior to 2005. Of the MBSs that separated market basket price data by store neighborhood income level, 42% of studies in low-income areas and 57% of studies in non-low income areas found average market basket prices were higher than the TFP (see Table 2.2). The organic market basket (study 9) and two of the three studies pricing healthier market baskets found them to be more expensive than the TFP (studies 10, 14).

Table 2.2. ***Market Basket Price Compared to TFP Price***

Year	Study, listed by number and first author	Average percent of MB cost above or below the TFP by store type			Average percent of MB cost above or below the TFP by neighborhood income level	
		Small/medium stores	Supermarkets	Bulk stores	Low income	Non-low income
1992	1. Morris	36.0%	8.0%			
1992	2. Crocket	8.9%	-2.0%		-3.0%	0.01%
1993	3. Troutt		-10.1%		-6.4%	-12.9%
1996	4. Johnson	28.8%	11.8%		24.3%	18.9%
1999	5. Chung	18.9%	1.0%		19.4%	13.9%
2001	6. Andrews		-0.01%	-16.3%	-3.3%	-2.0%
2003	7. Smith		-4.9%			
2004	8. Brown		33.2%, 67.1%[b]			
2005	9. Block	6.5%	-1.0%	-32.9%	2.3%	13.0%
2005	10. Neault	3.4%, 20.0%[a]	9.8%, 49.0%[a]			
2006	11. Jetter	-13.0%, -1.0%[a]	-11.6%, 4.9%[a]	-26.5%, -10.4%[a]	-18.6%	-7.9%
2007	12. Short	8.4%	40.1%			
2008	13. Raja	37.1%	21.8%			
2009	14. Fulp		43.0%[a]			
2010	15. Sheldon	13.6%				
2011	16. Breen	33.9%	15.6%			

Note. Negative percentages are those that are below the TFP costs. Positive percentages are those that are above the TFP costs. Empty cells indicate that this information was not given or able to be calculated from data given.

[a]This percentage is the amount a healthier market basket price is above or below the TFP price as set by the USDA.

[b]This percentage is the amount an organic market basket price is above or below the TFP price as set by the USDA.

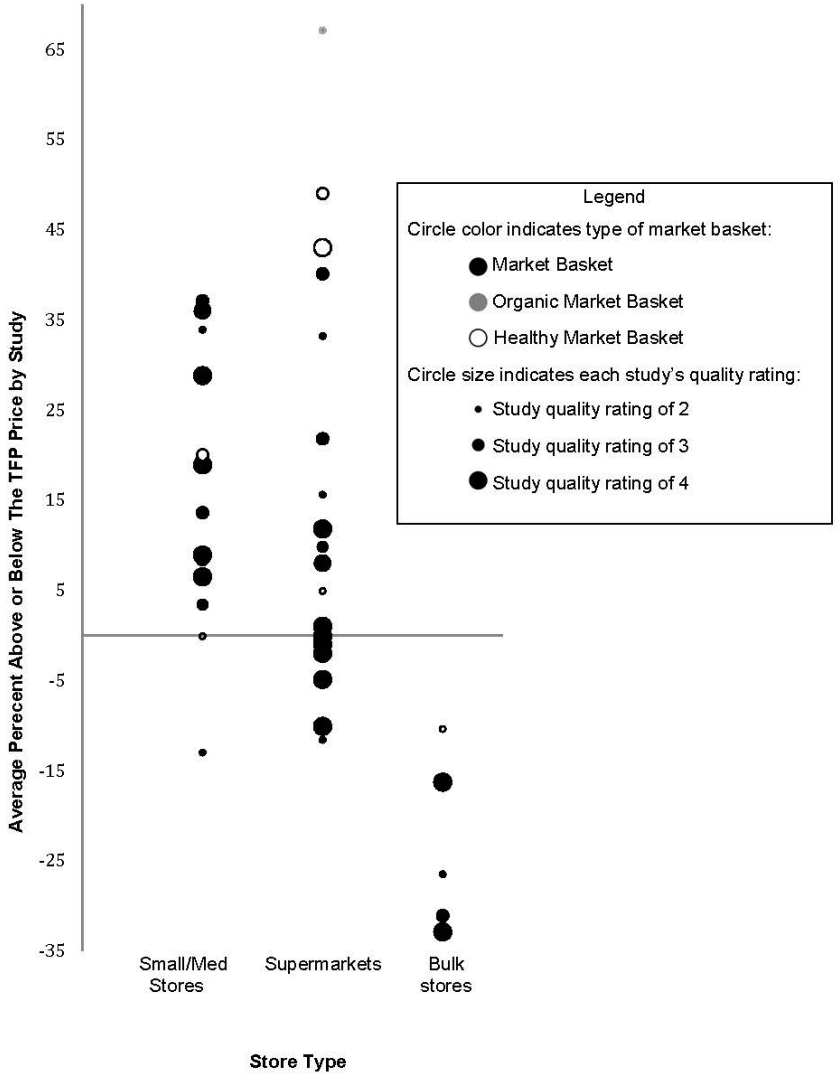

Figure 2.2. Average percent the market basket price is above or below the TFP price by store type for each study.

Quality is out of five with five indicating the highest quality.

Discussion

This review provides a summary of MBSs since 1985, identifies a set of addressable limitations, suggests future research directions to advance the field in making accurate assessments of the affordability of a healthful diet for families in the U.S., and informs important legislation. Over half of studies found market basket prices in supermarkets to be higher than the TFP, and almost all studies found higher market basket prices at small/medium stores; this suggests families relying on groceries from these stores may not have sufficient funds to purchase a diet meeting MDDR, regardless of the store's neighborhood income level. Although the TFP was sufficient to purchase market baskets at bulk stores, access to bulk stores varies widely based on store location, as well as, transportation availability, and these stores may not have all market basket items.

Methodological Variation Across Studies and Recommendations

There was significant methodological variation between each MBS. Store sampling bias and representativeness of prices are questionable for studies that did not use random or census sampling for store selection or for studies sampling only a few stores (range of stores surveyed was 2-134). Therefore, future MBSs should complete random or census store sampling in the targeted geographic area (Beaulac et al., 2009) for an accurate assessment of market basket price. Also, many studies did not use statistical analyses to compare prices and no studies assessed for adequate power, both of which are recommended to determine whether true market basket price differences exist. In

addition, failing to specify details of price data collection regarding sale prices, food substitutions and/or missing food items, decreases transparency of prices collected and may influence overall market basket prices.

The variation in methodology identified in this review asserts the need for use of a consistent methodology, like that described by Cohen (2002). However, four of the studies (studies 8, 10, 12-13) that reported to use Cohen's methodology did not consistently report all methodological details. Thus, it is recommended that future MBSs explicitly report the following details of their study: effect size, number of stores sampled, sampling method, number of food items in the market basket, rationale for the selection of food items, method for calculating MDDR, time(s) and reliability of data collection, allowance of food substitutions and/or use of sale prices, and method for calculating prices of missing food items. Specifying such details will enhance methodological consistency of MBS study design and quality in reporting. These recommendations will strengthen the rigor of the data and results of MBSs.

Implications of Underestimating Market Basket Costs

Investigation of the variations in methodology highlights how MBSs likely underestimate the actual cost of a family's market basket. For example, recording the lowest cost per unit means bulk items may be priced more often, as bulk items are often cheaper per unit. However, in daily living, families may not know how to calculate lowest cost per unit, which may underestimate the actual market basket price. Likewise, studies 1, 5-8, 10, and 16 suggested pricing missing foods by averaging prices from the

stores in the MBS that carried the item may underestimate actual cost. Additionally, the most common method used to calculate the cost of meeting MDDR does not account for package sizing. Hence, purchasing the amount to meet MDDR (e.g., 20 ounces of frozen peas) may require a family to purchase more than one package (e.g., two 16 oz packages), which requires money up front that may not be available. Similarly, using sale items to calculate market basket costs likely underestimates actual cost, as sale prices vary greatly over time. If a market basket has a limited number of items on the food list (or the number is not specified, which happened in 25% of studies), it is possible this basket fails to capture the price of a typical, varied diet (Drewnowski & Eichelsdoerfer, 2010). Thus, in evaluating the pricing methods of the studies, it is clear MBSs likely underestimate the cost of a market basket. This suggests the results of the price differences between the market baskets and the TFP are likely greater than the numbers provided suggest.

Implications for Families and Related Policy

When the TFP does not sufficiently cover the cost of a market basket, low-income families may struggle to afford food to meet basic MDDR. Low-priced foods with high energy density stretch the food budget and are more satiating but are often high in empty calories, low in nutrients (Dinour, Bergen, & Yeh, 2007), and contribute to obesity. Similarly, with the exception of the studies investigating healthier market baskets prices, all studies in this review used market basket food lists with food items to meet *basic* MDDR for families, including foods like white bread and rice, which are cheaper but less

nutritious than their healthier counterparts. If the TFP does not sufficiently or only minimally covers the cost of meeting basic MDDR, inexpensive high-energy, low-nutrient foods may seem like the best choice for low-income families, which may increase risk for becoming or remaining overweight/obese.

Despite evidence that SNAP benefits set by the TFP may not be sufficient, within the past year, these benefits have been drastically reduced by $14 billion as a result of farm bill negotiations and non-renewal of the economic stimulus package (Nixon, 2014). These cuts will likely decrease low-income families' ability to afford food to meet MDDR and may preclude healthful food purchases (Marks, 2012) contributing to poor dietary intake, obesity, and increased obesity-related health care costs estimated to be $147 billion annually (Finkelstein, Trogdon, Cohen, & Dietz, 2009). Thus, given the data from this review that suggests low-income families may not have enough to afford MDDR prior to recent cuts, it is essential that nurses advocate for increased funding for SNAP benefits for their clients and patients.

Implications for Improving the Food Environment

In addition to advocating for increased SNAP benefits, improving access, availability and quality of food items are also critical steps to address the affordability of healthful diets (e.g., Chung & Myers, 1999). Examples of such measures include: supporting development of both supermarkets and small/medium grocery stores in devoid areas (Chung & Myers, 1999; Jetter & Cassady, 2006) and increasing access to farmer's markets and community supported agriculture programs (Cassady, Jetter, & Culp, 2007);

these measures are supported by a review on political and environmental approaches to creating healthful food environments (Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008). Additionally, addressing lack of transportation to and from stores with better selection, quality, and prices may improve access (Block & Kouba, 2006; Sheldon et al., 2010; Walker et al., 2010). Price reduction of food items in poor, inner-city neighborhoods may increase the affordability of foods in these areas (Chung & Myers, 1999). If price reduction is targeted at healthful foods, this intervention has potential to make healthful foods more affordable, as research has demonstrated reducing the vending price of low-fat snacks increases their sales (French et al., 2001). Additional research on the relationship between food choice, food purchasing behaviors, and health is also needed (Beaulac et al., 2009; Fulp et al., 2009; Neault et al., 2005).

Implications for Nursing Practice

Nurses are first-line advocates for healthful eating in both clinical and public health capacities, as nurses have access to and work with populations of all ages at the individual, community, and national level. In addition to obesity, poor nutrition and health-related sequelea (e.g., chronic disease management, poor wound healing, delayed child growth and development) can negatively impact health for all nursing clients. Thus, the burden of prevention and management of obesity and poor dietary intake cannot be solely in the hands of nutritionists and dietitians, just as the burden of prevention and management of congestive heart failure is not on cardiologists alone. All health team members need to be able to discuss "affordable healthy [food] options" (Fulp et al., 2009,

p. 215); such team members include both clinical health care staff (e.g., doctors, nurses, dieticians) and their community based counterparts (e.g., public health nurses and professionals, social workers, community based dieticians). The holistic scope of nursing and the rank of being the most honest and ethical profession in the public's eyes (Newport, 2012) gives nurses a critical opportunity and responsibility to work, intervene, collaborate, research, and advocate for affordability of healthful diets as members on this interdisciplinary team.

Nurses and all health professionals must recognize health promotion campaigns around behavior change often focus on the individual responsibility of making healthful choices and behavior changes. Yet, despite how healthful eating is a choice, this review makes it increasingly clear that this choice may be cost-prohibitive for low-income families reliant on SNAP benefits when high-energy, low-nutrient foods are less expensive. If families struggle to afford food to meet basic MDDR, standalone dietary recommendations for behavior change and education on choosing more healthful options are not likely to be effective or ethically appropriate.

Limitations of This Review

Our conclusions on affordability are based on results from MBSs with varying quality, methodologies, and reporting methods; however, we took care in standardizing the outcomes as well as measuring and reporting MBS quality to account for these differences. Additionally, most studies assessed MBSs in one geographic location, which may limit generalizability, although the studies reviewed as a whole represent geographic

locations from across the country. More research is needed, particularly in understudied rural areas. This review was unable to assess how other national, state and local food support programs (e.g., National School Lunch Program, Women, Infants, and Children, food shelves, and soup kitchens) help families meet their MDDR. Further research on how these programs assist low-income families is needed.

Conclusion

This review indicates the need for consistent methodology and reporting of MBSs, as well as, adequate store sampling in target areas and comparison of market basket prices to the TFP through statistical analysis. Further research is needed to investigate the affordability of healthier market baskets to meet MDDR. Additionally, the results of this review call into question the affordability of meeting MDDR using SNAP benefits, which are guided by the mathematical model of the TFP. The SNAP benefits set by the TFP may not be sufficient to purchase a diet meeting basic MDDR, especially in small/medium stores. Therefore, nurses and all health team members need to intervene to increase the affordability of healthful foods at national, local, and individual levels, consistent with a social ecological approach (Stokols, 1996). This involves advocacy for policy changes to support healthful diets, which includes increasing SNAP benefits for low-income families and increasing access to affordable healthful foods. Such efforts must be bridged with research and work at the grass-roots level, including movements to improve the healthiness of the local food environment, comprehensive education, counseling, and referrals for those needing assistance. Such interventions will be

enhanced by future research on families' food purchasing behaviors and how such behaviors intersect with food choices, food consumption, and health outcomes. Poor dietary intake and obesity threaten the health of our future generations; a team effort, including nurses, is need to address them.

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Chapter 3: Methods for the Purchasing Influence Research

The purchasing influence research portion of this dissertation (Aims 2-5) uses data from the HOME Plus trial. This chapter includes important details about the HOME Plus trial in order to provide a thorough context for the data used in this dissertation; in addition, the methods and methodological decisions for the purchasing influence research (Aims 2-5) are detailed here at length to provide complete background. It is important to note that there will be some overlap between this chapter and the method sections of the manuscripts in Chapters 4 and 5. More specifically, the method sections of the manuscripts in Chapters 4 and 5 will provide standalone methodological details needed for a reader to follow and understand each research manuscript, whereas this chapter will explain rationale behind the methods and methodological decisions at length, by first describing details of the HOME Plus trial and then the details of the purchasing influence research sample, measures, and analysis plan for each aim.

HOME Plus

HOME Plus Study Design

The purchasing influence research portion of this dissertation uses data collected during the second cohort of the HOME Plus Randomized Controlled Trial (RCT). The HOME Plus trial recruited 160 families in a staggered cohort design with two cohorts, one in 2011 (n=70) and the other in 2012 (n=90; Fulkerson et al., under review). Following baseline data collection, families were randomized into either the intervention (n=81) or attention-control (n=79) group. Families in the attention-control group received

10-monthly newsletters with healthful eating tips. Intervention families attended 10, multiple-family, group intervention sessions held at local Minneapolis Park and Recreation community centers in Hennepin County, Minnesota (Flattum et al., 2015) and received five motivational-interviewing, goal-setting, encouragement calls (Draxten, Fulkerson, & Flattum, in press).

HOME Plus intervention programming targeted increasing frequency of family meals and the healthfulness of meals, snacks, and home food environment, while decreasing sedentary activity especially screen time, to prevent excess weight gain for children. Registered Dieticians and a Registered Nurse (this researcher, M. Horning) facilitated the 10-monthly intervention sessions using a standardized teaching curriculum and protocol; process evaluations were regularly conducted. Sessions included a welcome/introduction, group discussion, healthy meal preparation time for parents and children together, taste-testing fruits and vegetables, and separate break-out nutrition education sessions for parents and children. Separate break-out sessions included hands-on interactive and developmentally appropriate activities designed to facilitate learning and behavior change. Each session concluded with a family style meal of the foods prepared by the families and a summary (Flattum et al., 2015). The Institutional Review Board (IRB) at the University of Minnesota approved all HOME Plus study protocols and procedures (see Appendix B).

HOME Plus Recruitment and Sample

Families with at least one 8-12 year old child from the Twin Cities metropolitan area of Minnesota were recruited for the HOME Plus trial. Using successful recruitment strategies from the pilot study (Fulkerson et al., 2010) and focus groups, recruitment occurred via newspaper, radio, website, emails, flyers, and one-on-one recruitment at sporting events/camps, community events, childcare sites, and businesses. Minneapolis Park and Recreation site staff also assisted with recruitment (Fulkerson et al., 2014). Specifically, primary meal-preparing parents with at least one 8-12 year-old child from the specified geographical area were targeted for recruitment. See Table 3.1 for a list of recruitment inclusion and exclusion criteria.

The primary meal-preparing parent was recruited from each family to increase the likelihood of family level change around mealtimes and home food environments (Davison & Birch, 2001). In addition, interventions with family and parent involvement in childhood obesity prevention interventions are more likely to be effective (Casazza et al., 2013; Espinoza, Ayala, & Arredondo, 2010). The age of the target child was 8-12 years old. This age range was selected in part because preadolescent children are able to fill out their own surveys, have more input in their development of healthful eating habits, and are gaining more independence but are still influenced by their families and home environments (Pedersen, Grønhøj, & Thøgersen, 2015). These characteristics make the 8-12 year old age range ideal for child participants in healthy eating interventions.

Special emphasis was placed on recruiting families of diverse backgrounds (i.e., racial, ethnic, and/or socioeconomic status) to ensure the sample was representative of the local population. The HOME Plus study met diversity recruitment goals through site selection and recruitment locations. However, due to financial limitations of the HOME Plus trial, a translator was not available to recruit, collect data, translate intervention materials, or interpret the intervention in languages other than English. Therefore, the HOME Plus sample does not represent minorities who do not speak, write, or understand English.

Table 3.1. HOME Plus Criteria for Inclusion and Exclusion

Inclusion Criteria	Exclusion criteria
• Primary meal-preparing parent • 8-12 year-old girl or boy at or above the 50th percentile for age- and gender-adjusted BMI • Willingness to be randomized to a 10-month intervention at a Minneapolis Park and Recreation site or receive a monthly newsletter for 10 months • Child must live with the primary meal-preparing parent at least 50% of the time	• Family member has severe food allergies, limitations, or medical conditions, which would not allow full participation in program activities or measurements • Family planning to move within 6 months of study start • Family members do not speak or write in English • Parent unwilling to consent or child unwilling to assent to participation

HOME Plus Data Collection

Following informed parental consent and child assent, trained study staff collected data in participant family's homes from the primary meal-preparing parent and one 8-12 year old child per family. Data collection occurred at baseline, immediately following the 10-month intervention (post-intervention), and at 9 months post-intervention (follow-up). Blinding was not feasible given the nature of the intervention study. For cohorts 1 and 2 respectively, baseline data were collected in summer/fall of

2011 and 2012, with post-intervention data collected in summer/fall of 2012 and 2013. Final follow-up data were collected in spring/summer of 2013 and 2014.

HOME Plus Measures. The HOME Plus trial used a variety of validated measures. Both parents and children completed separate psychosocial surveys that included several psychometrically-sound scales. Parents also completed a valid and reliable household home food inventory (Fulkerson et al., 2008), a 7-day evening-meal screener (Fulkerson et al., 2012), and a 7-day snack screener. Children also completed a pubertal developmental screener, questions about food preferences, and 3-day (i.e., two weekdays, one weekend day) dietary recall interviews. Trained study staff objectively measured both parent and child height and weight (which were used to calculate body mass index [BMI]) using standardized procedures and protocols. Each of the measures to be utilized in this dissertation research will be discussed at length under the section: Measures Utilized in the Purchasing Influence Research.

Purchasing Influence Research

Sample

The purchasing influence research (Aims 2-5) will include only baseline data from parent and child participants of the second cohort (n=90 families), as the newly developed HOME Plus purchasing items (described below) were approved by the University of Minnesota's IRB and were added to the data collection procedures of the HOME Plus study just prior to the recruitment of cohort 2 (see Appendix C). The purchasing influence dissertation research was also approved by the IRB (see Appendix

D). Only baseline data were used in the present dissertation study given (a) the exploratory nature of the study, (b) sample size limitations with longitudinal work (e.g., sample size is small (n=90) at baseline and would be smaller (n=83) at post-intervention as a result of attrition), and (c) group assignment (i.e., intervention or control group) would have to be accounted for or only control group data used, which would further limit sample size.

The sociodemographic characteristics of the purchasing influence research sample are presented in Table 3.2. In this sample, child sex is balanced between boys (53%) and girls (47%). Seventy-seven percent of children were identified by their parents as being white and 23% were identified as being from a diverse background (i.e., American Indian or Alaskan Native, Asian, Black or African American, Native Hawaiian or Pacific Islander, Other, or more than one race). Eight percent of participant children were identified by their parents as Hispanic or Latino. These demographic characteristics are similar to those of Hennepin County (the location of participant recruitment) where 77% identify as white, 23% identify as being from diverse backgrounds, and 7% identify as Hispanic or Latino (United States Census Bureau, 2013).

Eighty-three percent of parents identified themselves as being white and 17% identified themselves as being from a diverse background. Two percent of parents identified as being Hispanic or Latino. Women are overrepresented (96%) in the parent sample. However, this overrepresentation was expected because the target sample is primary meal-preparing parents, which are most often women (Harnack, Story,

Martinson, Neumark-Sztainer, & Stang, 1998; Mancino & Newman, 2007). Parents were highly educated with 78% having an education level at or above an associate's degree. Nearly half of parents reported full-time employment outside of the home (i.e., ≥35 hours per week); 20% of parents worked part-time (i.e., 1-34 hours per week), and 37% were not employed outside of the home. Thirty-four percent of families reported receiving some form of economic assistance.

Table 3.2. Sociodemographic Characteristics of the Purchasing Influence Research Sample (N=90)

Sociodemographic Characteristics	n(%) / mean(SD)	
Child Age	10.1	(1.4)[a]
Child Sex		
Female	42	(46.7%)
Male	48	(53.3%)
Child Race		
American Indian	2	(2.2%)
Asian	1	(1.1%)
Black/African American	11	(12.2%)
White	69	(76.7%)
More than one race	7	(7.8%)
Child Ethnicity		
Hispanic/Latina(o)	7	(7.8%)
Non-Hispanic/Latina(o)	83	(92.2%)
Parent Age	40.7	(6.9)[a]
Parent Education Level		
Some HS or HS diploma	4	(4.7%)
Some college	15	(17.4%)
An associate's degree or higher	67	(77.9%)
Parent Sex		
Female	86	(95.6%)
Male	4	(4.4%)
Parent Race		
American Indian	2	(2.2%)
Black/African American	10	(11.1%)
White	75	(83.3%)
More than one race	3	(3.3%)
Parent Ethnicity		
Hispanic/Latina(o)	2	(2.3%)
Non-Hispanic/Latina(o)	87	(97.8%)
Receives Economic Assistance		
No	59	(65.6%)
Yes	31	(34.4%)
Hours worked outside the home per week		
Not employed outside the home	33	(36.7%)
Part-time (1-34 hours/week)	19	(21.1%)
Full-time (35+ hours/week)	38	(42.2%)

Notes. [a] Reported as mean(SD).

Measures Utilized in the Purchasing Influence Research

There are four categories of measures (i.e., sociodemographic characteristics, food purchasing influences, construct validity, and outcome measures) from the HOME Plus Study that are used for this purchasing influence dissertation research. The measures that make up each category are described below.

Sociodemographic characteristics.

Age. Date of birth was collected for both parent and child. Age at the date of the data collection visit was calculated by subtracting the date of the visit from date of birth. Age was measured in years.

Sex. Primary meal-preparing parents reported their sex by answering the following question: "What is your relationship to the child who is participating in the HOME Plus study?" Response options were: *Mother, Other female guardian, Father,* or *Other male guardian.* The first two response options were collapsed into women and the latter two response options were collapsed into men. Children reported their sex by responding to the question: "Are you a boy or a girl?" Response options were: *Boy,* or *Girl.*

Education level. Parents reported their highest education level by selecting from categorical response options: *Less than high school, High school diploma or equivalent, Associate's degree, Bachelor's degree,* or *Master's, professional or doctoral degree* (United States Census Bureau, 2012). Because the study sample is small, the purchasing influence research treated education as a binary variable (i.e., 0=parent completed some college, high school, or some high school; 1= parent has an associate's, college or graduate degree).

Race. The United States Office of Management and Budget (2013) prescribes the standard measurement for race. Parents selected the race(s) that best fit their child and the race(s) that best fit themselves from the following categories: *American Indian or*

Alaskan Native, Asian, Black or African American, Native Hawaiian or Pacific Islander, White, Other. For analysis, due to the homogeneity of the sample, race was collapsed into two groups: white and diverse backgrounds; diverse backgrounds included all those selecting racial categories other than white or those selecting more than one race.

Socioeconomic status. Family income was measured by parent report of gross earnings before tax in the previous year. However, given that households do not necessarily file joint taxes and that household size is directly related to socioeconomic status (e.g., consider how the annual gross income of $50,000 is different if the household size is two versus six), a proxy variable will measure household economic resources. This proxy variable measures family receipt of economic assistance and is measured by two items: (1) "Does your child receive free or reduced priced lunches at school?" (2) "Does your household receive public assistance (like food support/stamps, EBT, WIC,TANF, SSI or MFIP)?" Both items had binary responses: *yes* and *no*. Families, who answered yes to either or both questions, received an economic assistance score of 1, otherwise families received an economic assistance score of 0.

Hours worked per week outside of the home. The primary meal-preparing parent reported the number of hours worked per week outside the home by selecting one of the following categories: *choose to work in home/homemaker, not working* (*unemployed, retired, student), 1-14 hours per week, 15-34 hours per week, 35-39 hours per week, 40 hours per week,* and *more than 40 hours per week.* For analytic purposes, responses were collapsed into three frequently used categories of the Bureau of Labor Statistics (2014):

(0) those who are not engaged in paid employment; (1) those who work part-time, between 1 and 34 hours per week; and (2) those who work full time, at least 35 hours per week.

Food Purchasing Influence Items.

A comprehensive list of items measuring social-contextual food purchasing influences was required to achieve Aim 2 of this dissertation research. Therefore, a literature search on purchasing influence items was completed Spring 2012; all relevant items from the literature were included or adapted (shown in column 2 of Table 3.3) for the HOME Plus purchasing influence questionnaires, which were in development at that time. In addition to those items, the social ecological framework was used to define additional purchasing influences, and new survey items were developed to capture these purchasing influences (e.g., time constraints and family food budgeting; shown in column 3 of Table 3.3).

Four experts and four dieticians working in the areas of community-based nursing and nutrition-related family interventions reviewed the new HOME Plus purchasing influence questionnaires for content validity. Reviewers suggested minor revisions to enhance face validity, including readability. These revisions were made prior to pilot testing the new purchasing items with six children and two parents using cognitive interviewing techniques. This process ensured questions accurately represented intended content, further supporting face and content validity. Questions that poorly discriminated between pilot respondents were eliminated, as using the full response-option range is

desired (DeVellis, 2012). The final child and parent HOME Plus purchasing item questionnaires are provided in Appendix E and Appendix F; these questionnaires were administered to the second cohort of HOME Plus participants in the summer of 2012.

In addition to the influences being measured with the new HOME Plus purchasing influence questionnaires, purchasing influences (i.e., identified with the literature review or social ecological framework) already being measured by the original HOME Plus parent and child psychosocial surveys (e.g., cooking ability and food preferences, shown in column 4 of Table 3.3) were included for study. Potential purchasing influence constructs to be evaluated in the present research (Column 5) and the level of influence that corresponds to the conceptual framework for the item topics (Columns 6) are shown in Table 3.3. Appendix G lists all purchasing influence items analyzed in the present research by purchasing influence construct and provides descriptive statistics. Appendix G also notes whether each item was from existing HOME Plus surveys or was newly adapted/created for the present research measured with the HOME Plus purchasing influence questionnaires.

An updated literature search was conducted in 2014-2015 for this dissertation and can be found in Chapter 1. This literature review highlighted seven purchasing influence constructs (i.e., Cooking Ability, Concern for Nutrition, Cost, Family Food Preferences, Social Pressure, Store Access and Time, summarized with sources in Table 3.4). These constructs were aligned with the purchasing influence items and constructs identified with the initial literature search and social ecological framework.

Table 3.3. Purchasing influences as measured by HOME Plus and the new purchasing items.

Purchasing Influences	Existing in/adapted from literature[a]	Newly Developed[b]	HOME Plus Items[c]	Proposed Construct	Level of Influence
Ease of food prep	(Hughner & Maher, 2006)			Cooking Ability	Parent, Child
Cooking skills			(Devine et al., 2009; Cullen et al. 2004; Fulkerson, 2010)	Cooking Ability	Parent, Child
Concern for healthfulness/nutrition label use	(Finch et al., 2006; Hughner & Maher, 2006; Surkan et al., 2011)		(Mackison et al. 2010; Fulkerson et al., 2010)	Concern for Nutrition	Parent, Child
Coupon use		X		Cost	Community
Food is on sale		X		Cost	Community
Family food budget		X	(Fulkerson, 2010)[c]	Cost	Family
Concern for cost of food		X		Cost	Family
Taste/food preferences		X		Food Preferences	Family
Family will eat it		X	X	Food Preferences	Family
Parent present during purchase		X		Social Pressure	Family
Friend present during purchase		X		Social Pressure	Family
Child requests		X	(Gross, Pollock, & Braun, 2010)	Social Pressure	Family
Brand names	(Hughner & Maher, 2006)			Social Pressure	Community
TV ads	(Fulkerson, 2010; Marquis, 2004)		(Fulkerson, 2010)	Social Pressure	Community
Family gardens		X		Store Access	Family
Farmer's market / CSA use		X		Store Access	Community
Store features, access, and utilized most	(Dennisuk et al 2011; Finch et al., 2006; Finch et al., 2007; Zenk et al.,. 2005)		(Laska et al., 2010)	Store Access	Community
Family time constraints		X	(Crawford et al., 2007; Devine et al., 2009)	Time	Family

Notes:[a]Indicates new Home Plus purchasing items adapted from or measured by items in existing literature. [b] X=Newly developed items were grounded in the social ecological framework. [c]Items measured in HOME Plus Parent and Child Psychosocial Surveys to be applied to purchasing influences for the first time.

Table 3.4 Purchasing influences (grouped by construct) described in qualitative or descriptive research and used in outcomes research

Purchasing influence construct & descriptions	Citations of qualitative or descriptive research that describe the listed purchasing influences/construct [a]	Citations of outcomes research evaluating relationships between purchasing influence construct and a purchasing outcome [a]
Cooking Ability: Self-efficacy for cooking, meal preparation skills, meal planning	(Darko, Eggett, & Richards, 2013; Hollywood et al., 2013; Hughner & Maher, 2006)	(Baranowski et al., 2006; Baranowski et al., 2008; Hersey et al., 2001)
Concern for Nutrition: Concern for health and nutrition and/or nutrition knowledge	(Chase, Reicks, Smith, Henry, & Reimer, 2003; Freedman, Blake, & Liese, 2013; Hughner & Maher, 2006; Peterson, Dodd, Kim, & Roth, 2010; Wingert, Zachary, Fox, Gittelsohn, & Surkan, 2014)	(Blitstein & Evans, 2006; Dachner, Ricciuto, Kirkpatrick, & Tarasuk, 2010)
Cost: Price/cost, coupons and store sales	(Chase et al., 2003; Darko et al., 2013; Henry et al., 2003)	(Andreyeva, Long, & Brownell, 2010; Hersey et al., 2001; Peterson et al., 2010; Powell, Chriqui, Khan, Wada, & Chaloupka, 2013; Putrevu & Ratchford, 1997)
Family Food Preferences: Food preferences, knowing family will eat a food, taste, children's fear of new foods, picky eaters, and avoiding conflict	(Chase et al., 2003; Dubowitz et al., 2007; Finch et al., 2006; Henry et al., 2003; Hollywood et al., 2013; Maubach, Hoek, & McCreanor, 2009; Peterson et al., 2010)	(Dachner et al., 2010; Gross et al., 2010)
Social Pressure: Marketing/brand names, social support, children's requests	(Hughner & Maher, 2006; Maubach et al., 2009; O'Dougherty, Story, & Stang, 2006; Wingert et al., 2014)	(Baranowski et al., 2006; Baranowski et al., 2008; Gross et al., 2010; Marquis, 2004)
Store Access: Access, store types, features and characteristics, food selection and quality, farmer's markets	(Aylott & Mitchell, 1999; Dennisuk et al., 2011; Dubowitz et al., 2007; Evans et al., 2012; Freedman et al., 2013; Henry et al., 2003; Peterson et al., 2010)	(Blitstein, Snider, & Evans, 2012; Dachner et al., 2010; Dammann & Smith, 2010; D'Angelo, Suratkar, Song, Stauffer, & Gittelsohn, 2011; Finch et al., 2006; Gustafson et al., 2013; Laska et al., 2010; Racine, Mumford, Laditka, & Lowe, 2013; Zenk et al., 2005)

Purchasing influence construct & descriptions	Citations of qualitative or descriptive research that describe the listed purchasing influences/construct [a]	Citations of outcomes research evaluating relationships between purchasing influence construct and a purchasing outcome [a]
Time: Convenience and time pressures	(Aylott & Mitchell, 1999; Bava, Jaeger, & Park, 2008; Dubowitz et al., 2007; Freedman et al., 2013; Henry et al., 2003; Hughner & Maher, 2006Maubach et al., 2009; Peterson et al., 2010)	

Note. [a] Sources as found in the reference list.

Construct validity measures. Table 3.5 provides thorough descriptions (including items, response options and psychometrics) of the scales that were used to assess convergent validity for newly developed measures. Brief descriptions are provided below and all measures were coded so higher scores indicate higher traits/behaviors being measured (e.g., food insecure, more barriers, more self-efficacy).

Food insecurity. The food security measure calculated household food insecurity with households designated as food secure (0) or food insecure (1), per USDA instructions (Nord, Andrews, & Carlson, 2007). Food insecurity was used to assess convergent validity of the measures to be developed under the cost construct.

Barriers to buying fruits and vegetables. This scale measured barriers to buying fruits and vegetables and was adapted from two scales of Campbell et al. (2007) that separately measured food cost ($\alpha = 0.93$) and food quality ($\alpha = 0.79$). The barriers to buying fruits and vegetables scale was used to assess convergent validity of the measures to be developed under the access construct.

Parent self-efficacy for cooking. This scale measured parents' self-efficacy for cooking a healthful meal and was adapted from Beshara et al. (2010; α=0.85) who adapted the scale created by Nothwehr (2008; $\alpha = 0.92$). The item: "How likely are you to prepare a healthy meal when *ingredients are limited*" was changed to "How likely are you to prepare a healthy meal when *you haven't been to the store recently*," and "How likely are you to prepare a healthy meal when *you are feeling depressed*" was changed to "How likely are you to prepare a healthy meal when *you feel stressed or tense*." The item

"How likely are you to prepare a healthy meal when *you do not have access to a recipe*" was added for HOME Plus. The original, five-point response options (*not at all sure* to *very sure*) were changed to capture parent intent to cook healthful meals (*not at all likely* to *very likely)*. Self-efficacy for cooking a healthful meal was used to assess convergent validity of the measures to be developed under the Cooking Ability construct.

Parental role-modeling of healthful eating. The original parental role-modeling of healthful eating scale measured *child* report of how often their parents' role-modeled healthful eating (Cullen et al., 2001). This scale was adapted to measure *parent* report of how often they role-modeled healthful eating and included an additional item on role-modeling a MyPlate message (i.e., fill half plate with fruits and vegetables at dinner). Parental role-modeling of healthful eating was used to assess convergent validity of new measures to be developed under the Concern for Nutrition construct.

Parental encouragement of healthful eating. This scale measured parental encouragement of their child to eat and drink healthy foods at snacks and dinners. The original scale was developed with factor analysis and had *children* report the frequency of parental encouragement (Neumark-Sztainer, Wall, Perry, & Story, 2003). This scale was adapted to measure *parent* report of how often they encouraged their child to eat healthy foods at snacks and dinners; extra items were added to capture encouragement to eat additional food items and encouragement of the MyPlate message (i.e., fill half plate with fruits and vegetables at dinner). This measure was also used to assess convergent validity of new measures to be developed under the concern for nutrition construct.

Child food neophobia. Child food neophobia was a previously tested and psychometrically-sound scale ($\alpha = 0.88$; Pliner & Hobden, 1992) that measures a child's fear of trying new foods, as reported by the child. This measure was used to assess convergent validity of the measures to be developed under the Family Food Preferences construct.

Table 3.5. Scales with which to measure convergent validity with proposed purchasing influence construct

Scales to assess convergent validity[a]	Response options	P/C[b]	α	n(%) or Mean(SD)	Scale Range	Proposed construct
Food insecurity 1) We worried whether our food would run out before we got the money to buy more. 2) The food that we bought just didn't last, and we didn't have money to get more 3) We couldn't afford to eat balanced meals. 4) Did you or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food? 5) If yes to question 4, how often did this happen? 6) Did you ever eat less than you felt you should because there wasn't enough money for food? 7) Were you ever hungry or did not eat because there wasn't enough money for food? 8) Did you ever lose weight because there wasn't enough money for food? 9) Did you or another adult ever not eat for a whole day because there wasn't enough money for food? 10) If yes to question 9, how often did this happen?	3 point (*never true* to *often true*): Items 1-3 Binary *(yes* or *no*): Items 4, 6-9 3 point (*almost every month* to *only 1 or 2 months):* Items 5, 10 Households were designated as food secure (0) or insecure (1) as calculated per USDA instructions	P	NA	12(13.3%)[c]	NA[c]	Cost
Barriers to buying fruit and veggies scale 1) I don't buy many <u>fruits</u> because they cost too much. 2) I don't buy many <u>vegetables</u> because they cost too much. 3) At the store where I buy my groceries, the variety of fresh fruits and vegetables is limited.	4 point (*strong agree* to *strongly disagree)*	P	0.88	6.4(2.5)	4-16	Store Access

Scales to assess convergent validity[a]	Response options	P/C [b]	α	n(%) or Mean(SD)	Scale Range	Proposed construct
4) At the store where I buy my groceries, the condition of fruits and vegetables is poor.						
Self-efficacy for cooking How likely are you to prepare a healthy meal 1) after a tiring day? 2) when you haven't been to the store recently? 3) when you feel stressed or tense? 4) when you do not have access to a recipe?	5 point (*not at all likely* to *very likely)*	P	0.82	11.4(4.0)	4-20	Cooking Ability
Parental role modeling of healthful eating When you are with your child how often do you 1) eat fruit as a snack? 2) eat vegetables as a snack? 3) eat high fat and/or high sugar snacks? 4) eat fruit at dinner? 5) eat vegetables at dinner? 6) eat salad at dinner? 7) fill ½ of your plate with fruits and vegetables at dinner? 8) drink water? 9) drink sugar sweetened beverages like soda pop?	4 point (*never* to usually/always)	P	0.73	27.5(3.7)	9-36	Social Pressure
Parental encouragement of healthful eating How much do you encourage your child to 1) eat fruit as a snack? 2) eat vegetables as a snack? 3) eat low-fat snacks? 4) eat fruit at dinner? 5) eat vegetables at dinner? 6) eat salad at dinner? 7) fill ½ of his/her plate with fruits and vegetables at dinner? 8) drink water? 9) try new fruits and vegetables? 10) eat fewer high fat and/or high sugar snacks?	5 point (*encourage a lot* to *discourage a lot)*	P	0.81	29.3(9.0)	9-50	Social Pressure
Food neophobia 1) I am always trying new and different foods. 2) I don't trust new foods. 3) If I don't know what is in a food, I won't try it.	3 point (*not true for me* to *very true for me)*	C	0.82	16.9(4.2)	9-28	Family Food Preferences

Scales to assess convergent validity[a]	Response options	P/C [b]	α	n(%) or Mean(SD)	Scale Range	Proposed construct
4) I like foods from different countries.						
5) Ethnic foods look too weird to eat.						
6) At parties, I will try a new food.						
7) I am afraid to eat things I have never had before.						
8) I am very particular about the foods I will eat.						
9) I will eat almost anything.						
10) I like to try new ethnic restaurants.						

Notes: [a] These scales were collected with HOME Plus psychosocial surveys and will be used to test convergent validity of the proposed purchasing constructs listed in the far right column. Items were coded or recoded so higher scale scores indicated a higher level of the trait/behavior being measured with the scale. Sources are listed in the text.
[b] P/C= reporter of the scales with P=parent or C=child.

Outcome measures.

The outcome measures used in the purchasing influence research are those briefly outlined below with psychometric properties provided in Table 3.6.

Home Food Environment. Home food environment data were collected using the Home Food Inventory (HFI), a valid instrument (Fulkerson et al., 2008). This instrument captured the availability of different types of fruits, vegetables, and obesogenic foods in the home. Obesogenic food availability measures the availability of foods that may contribute to obesity (e.g., frozen or prepared desserts, savory snacks, added fats, and sugar sweetened beverages). Fruit availability, vegetable availability, and obesogenic food availability were the home food environment outcomes in the present study.

Child Dietary Intake. Children's dietary intake data were collected using an average of three, 24-hour dietary recall interviews (2 weekdays and 1 weekend day). Recall interviews were completed with child participants by research staff, trained and certified in Nutrition Data System for Research (NDS-R) software (versions 2011 and 2012 were used for data collection; final calculations were completed with the 2012

version). In an extensive review of all dietary intake measures, dietary recalls are considered a gold standard measure of dietary intake (Burrows et al., 2012). Children's dietary outcomes in this study were the average daily servings of fruits and vegetables and total dietary quality. Total dietary quality scores were measured using the Healthy Eating Index (HEI), a valid and reliable measure (calculated from recall data) with higher scores indicating higher dietary quality (Guenther et al., 2013; Guenther et al., 2014).

The total dietary quality measure became available after the original dissertation proposal was written. It was used in place of proposed individual dietary outcomes (i.e., average servings of sugar-sweetened beverages, total energy intake, percent of calories from saturated fat, and total grams of added sugar), as total dietary quality provided a more comprehensive assessment of diet quality than the four individual outcomes. In addition, using total dietary quality in place of the four individual outcomes reduced the number of significance tests and risk of Type I error (finding an association when an association does not exist).

Child Weight Outcomes. In participants' homes, trained and certified staff measured parents' and children's height (cm) with a stadiometer and weight (kg) using a Seca scale calibrated on the first Monday of each month (Lohman, Roche, & Martorell, 1988). Staff followed standardized protocols and procedures, which included measuring height and weight twice; if the height or weight varied between the two measurements by more than 1 cm or 0.5kg, respectively, measures were repeated. Height and weight data were used to calculate the weight outcomes: parent BMI and child age- and gender-

adjusted BMIz scores (BMIz scores were calculated using protocols and Growth Chart LMS Parameters of the CDC; [http://www.cdc.gov/nccdphp/dnpao/growthcharts/ resources/sas.htm; last accessed 2013]).

Table 3.6. **Outcome measures used in the purchasing influence research**

Content	Measures	Mean	SD	Range	Validity
Home Environment Outcomes	Fruit Availability	10.0	4.7	0-26	Kappa = 0.83* Sensitivity = 0.87* Specificity = 0.95* r_s=0.37 (with fruit servings)*
	Vegetable Availability	10.3	3.6	0-20	Kappa = 0.80* Sensitivity = 0.89* Specificity = 0.90* r_s =0.34 (with veg servings)*
	Obesogenic Food Availability	26.9	8.7	0-77	Kappa = 0.79* Sensitivity = 0.83* Specificity = 0.91* r_s =0.16 (with kcal food)*
Child Dietary Outcomes	• Average daily servings of fruits and vegetables	2.5	1.6	0-7.5	
	• Total dietary quality	53.4	11.4	29.4-82.2	
Weight Outcomes	• Child age and gender adjusted BMI-z score	0.94	0.75	-0.22-2.57	
	• Parent BMI	28.20	7.36	18.92-50.34	

Notes. These data are from the 90 parents and children of the purchasing influence research (i.e., the participants of the second cohort of the HOME Plus trial). *from Fulkerson et al., 2008

Analysis Plan Aim 2

Aim 2 is to assess the psychometric properties of novel survey items of parent and child food purchasing influences and explore development of psychometrically-sound scales. Descriptive statistics of all purchasing influence items will be conducted (e.g., for non-binary items: means, standard deviations; for binary items: proportion of respondents answering yes or 1).

Dyadic dependency considerations. Prior to beginning measure development, it is important to note that item/scale responses of parent and child dyads are expected to share nonindependence, as the scores are linked by kinship (Kenny, Kashy, & Cook, 2006, p4). Typically, dyadic data requires special statistical techniques to account for this nonindependence. However, because the parent and child variables are not the same in the present study, both parent and child data can be used simultaneously in analyses (Kenny et al., 2006, p22). Additionally, scales representing family and community dimensions of ecology will be created when possible with both child and parent items using several approaches (e.g., by combining parent and child items in the same scale).

Measure development. To develop new measures, the following protocol will be used to analyze the items within each purchasing construct (as listed in Appendix G) with each step thoroughly detailed directly in paragraphs below. First, items for each of the purchasing constructs will be prepared for analysis. Second, within each purchasing construct, item correlations will be assessed and items with correlations at 0.2 or above will be retained. Third, exploratory factor analysis (EFA) will be used to develop new measures; factor patterns (with more than two items) with scale alpha's at or above 0.65 will be retained as psychometrically-sound scales. If psychometrically-sound scales are unable to be produced, items in each remaining factor pattern will be summed into a topical index score (if theoretically appropriate) or made into a composite item (if only two items load together on a factor and the two items are correlated). Lastly, when possible, convergent validity will be assessed between the newly developed measures and

existing psychometrically-sound scales on similar constructs as measured by HOME Plus.

(1) Item preparation. Important considerations regarding measurement are necessary to address prior to analysis. These include the varying types of response options for each of the items to be used in the analyses, coding of those options and the level of measurement, which will be discussed below in more detail.

Response option coding. Item response options will be reverse coded where necessary (e.g., when response options differ between parents and children, when items are worded so a low score would indicate a higher trait), so total scale scores will represent a higher measured trait (e.g., higher concern for cost). Items will be standardized using Proc Standard in SAS to a mean of zero and a standard deviation equal to 1 (i.e., a z-score: $X_i^* = [(X_i - \overline{X})/s)$ to account for different response options between variables without loss of generality (Kim & Mueller, 1978b).

Continuous and ordered categorical items. Although continuous variables are preferred, ordered categorical items (e.g., those with Likert scale responses) are routinely factor analyzed with success (Floyd & Widaman, 1995); therefore, continuous and ordered categorical items will be used in the present study.

Binary items. It is important to note use of binary items in factor analysis can create biased results (Floyd & Widaman, 1995; Muthen, 1989). This potential bias results from the limited range of Pearson's correlations between binary items (which are called phi coefficients), as unless all respondents answer identically, the full correlation range

(i.e., -1 to 1) can never be obtained (Muthen, 1989). Because of the limited range of the phi coefficients, factor analysis results can be biased and factor loadings attenuated, especially when the proportion of participants answering "1" is extreme (i.e., close to 0 or 1; Muthen, 1989; Parry & McArdle, 1991). Multiple alternatives to using the phi coefficient matrix in factor analysis have been proposed to resolve this issue, which include the G coefficient matrix, the Phi/Phi Max matrix, and the tetrachoric correlation matrix outlined below.

The G coefficient is limited because it measures agreement, but does not take into account agreement between items that is above and beyond what is expected by chance alone; therefore, it cannot accurately analyze latent constructs (Davenport, 1987). The Phi/Phi Max coefficients have also been found to be problematic, as a small shift in the probability of a yes response or a no response (which can occur with as few as one or two participants shifting) can produce different results, especially when proportions saying yes or no are more extreme (Davenport & El-Sanhurry, 1991). The tetrachoric coefficient matrix performs about as well as the phi coefficient matrix when probabilities of a yes or no response are moderate and when the assumptions (that the dichotomous items to be factor analyzed have an underlying normal distribution and the predicted factor scores are normally distributed) are met. However, using the tetrachoric coefficient matrix becomes increasing less accurate when probabilities of yes or no response are more extreme (Davenport, 1989; Muthen, 1989; Parry & McArdle, 1991).

Given the limitations of all the options to deal with binary items, factor analysis results using both the phi and tetrachoric coefficient matrices will be evaluated and compared, without items with extreme probabilities (i.e., < 0.11; >0.89). Results will be cautiously interpreted, yet it is appropriate to proceed, as both methods can work well with dichotomous data in determining factor patterns (Davenport, 1989; Parry & McArdle, 1991), albeit with potentially lower factor loadings but qualitatively-relevant factor structures (Davenport, 1989).

(2) Correlations. Once items have been prepared, items proposed to measure the same construct will be first evaluated with Pearson correlations. All items in each construct with at least one significant correlation to other items (i.e., $r \geq 0.20$) will be retained for factor analysis.

(3) Exploratory Factor Analysis (EFA). As previously mentioned, EFA will be used to evaluate proposed items within each purchasing influence construct.

Factoring method selected. The factoring method determines how factors are extracted from the data, and the goal of extraction is to select factors to reproduce the correlations between the items in the factor analysis. There are many options for factor extraction with some of the most common extraction methods being principal components analysis, principal axis factoring, and maximum likelihood (Kim & Mueller, 1978c). Principal components factoring extracts maximal variance to explain the factors, which includes both the common variance (e.g., the variance between the items) and unique variance (e.g., the variance each item contributes individually). This means the

extracted factors can be used to predict and reproduce the correlation matrix well, but do not represent a latent construct (as the factors explain the variance common between all items and unique variance contributed by each item). Alternatively, principal axis factoring extracts only the common variance between items to explain factors; this process allows for meaningful interpretation of each extracted factor pattern, as each factor represents the latent construct explained by the common variance between the items (Kim & Mueller, 1978c). Therefore, the primary extraction technique to be used is principal axis over principal components. Maximum likelihood extraction will be also be performed, as while principal axis extraction may be the best choice when factor patterns are simple (e.g., no cross loadings of items on factors) or if factor loadings are low (e.g., 0.3), maximum likelihood factoring may be superior when unequal factor loadings are present and/or when factors are correlated (de Winter & Dodou, 2012).

Rotation methods considered. Rotation is a mathematical procedure used to help interpret findings of an initial factor analysis. With rotation, the item locations on the factors do not change, but the axes on which the factors and loadings sit can change locations to maximize the simple structure (e.g., maximize large loadings, minimize small loadings) in order for factors to be interpreted meaningfully (Kim & Mueller, 1978d; Preacher & MacCallum, 2003). Varimax (orthogonal) rotation achieves simple structure and invariant factors (i.e., factors that remain stable and consistently produce factor structures), as it maximizes the variance of the items explaining each factor (Kaiser, 1958) and is widely used for this reason. However, it requires factors to be

statistically independent (orthogonal) and does not allow for correlation between the factors (Kaiser, 1958; Kim & Mueller, 1978d; Preacher & MacCallum, 2003). Given it is plausible that proposed factors from the data to be used in the purchasing influence research may be somewhat related (e.g., those with higher cooking ability may also have children with higher cooking ability), promax rotation will be utilized, as it allows for an oblique pattern structure while also aiming to produce the simplest structure possible (Hendrickson & White, 1964; Preacher & MacCallum, 2003). The promax pattern matrix will be interpreted for meaningful factors based on the number of factors selected and item factor loadings (see below).

Number of factors to be extracted. In order for factor analysis to calculate factor loadings, the number of factors (in each designated set of items for each purchasing construct) must be determined. There are numerous ways to determine the number of factors to be extracted. The most commonly used method, the Kaiser-Guttmann rule, states the number of factors is equivalent to the number of eigenvalues greater than one from a principal component analysis (Preacher & MacCallum, 2003). However, this method is problematic as it can both over- or underestimate the number of factors (Preacher & MacCallum, 2003; Zwick & Velicer, 1986). The other methods to determine number of factors include the scree test, maximum likelihood, and Montanelli and Humphreys' approach, which each have strengths and weaknesses and are discussed at length directly below.

Maximum likelihood determines the number of factors to be extracted by performing a series of analyses (with increasing numbers of factors extracted) and assesses model fit with the Chi Square test statistic (e.g., this method tests the differences between the correlation matrix of the items used in the factor analysis procedure and the reproduced correlation matrix given the number of factors extracted in the analysis with maximum likelihood). If the Chi Square test statistic is significant, this indicates the correlation matrix reproduced by the number of extracted factors of that model is different than the original correlation matrix. Thus, the number of factors to be extracted with this method is the least number of factors needed to reproduce the original correlation matrix so that the Chi Square test statistic is no longer significant, which means that there is no evidence to suggest the original and reproduced correlation matrices are different (Lawley & Maxwell, 1962). However, the Chi Square test statistic can be heavily influenced by sample size, which may result in the wrong number of factors extracted (e.g., with a smaller sample like the one in the present purchasing influence research, it is more likely that a Type II error, that is not-rejecting the null when differences exist, will occur).

The scree test method for determining the number of factors shows the principal component eigenvalues on a visual plot (Cattell, 1966). The number of factors extracted is determined by observing the place on the plot when the eigenvalues begin uniformly decreasing. However, this method is subjective, as the researcher determines when eigenvalues begin uniformly decreasing (Cattell, 1966; Zwick & Velicer, 1986).

The Montanelli and Humphrey approach builds on the scree test and another method called the parallel analysis and uses squared multiple correlations on the diagonal of the correlation matrix (Montanelli & Humphreys, 1976). This approach provides values for a line with simulated random data, which is to be compared with the scree plot. The line of the scree plot and simulated line will cross when factors are not contributing anything more than the line produced by random data. It can be difficult to visually tell exactly where the lines cross, so this method is useful as it provides numerical values for the random line, which are then compared with the eigenvalues. When values of the random line become greater than the eigenvalues, the number of factors is determined; however, in small samples, the random values and eigenvalues may never cross limiting this method of determining number of factors (Montanelli & Humphreys, 1976).

Given the strengths and weaknesses of each method to determine the number of factors, and that each method can produce different results, each method will be used. The number of factors suggested for extraction by each method will be systematically compared and may or may not be consistent among the methods. If this is the case, the method(s) with the number of factors that make the most theoretical sense will be the one selected to determine the number of factors to be extracted.

Factor loadings. Once the number of factors has been determined, factor analysis produces factor loadings, the level at which each item explains the variance of the factor; a higher loading indicates a higher amount of variance of the factor that is explained by that item (Kim & Mueller, 1978a). There is much variation in determining whether a

loading is high enough; however, a common rule of thumb indicates factor loadings at or above 0.3 will be used to measure goodness of fit for items and their latent constructs (Kim & Mueller, 1978a). Because all items potentially related to the purchasing influence construct were included with each factor analysis, there is a chance some items will not load on any factor; in this case, the item(s) will be removed from the analysis and the analysis will be rerun.

Scale scores. Items that define a factor (as determined by high loadings with factor analysis) will be added into a summative scale when the scale's alpha is at or above 0.65 and there are at least three items on the scale. The items will not be weighted by their factor loadings in total scale scores, as both weighting and not-weighting items by factor loadings has been proven to provide similar results (Wainer, 1976). In addition, weighting items provides for results that are difficult to interpret.

Indices and composite items. If psychometrically sound scales are not achievable, it is possible that not all parents and children responded similarly to a set of items of a given factor (i.e., items within a factor are not inter-correlated and are distinct). However, if the sum of these items reported by a parent or child for a given factor can be interpreted as a theoretically meaningful purchasing influence (e.g., more total social pressures could lead to worse outcomes even though it might not be the same social pressures for each family), a summative, topical index score of the items will be considered. If index scores on a topic are inappropriate, individual items will be considered for use in proposed analyses. If only two items loaded on a factor and these items are correlated, while they

do not form a scale (as there are only two items), if they define a meaningful purchasing influence, they will be summed and averaged for a composite score. Detailed documentation of the results of steps 2-3 for Aim 2 can be found in Appendix H.

(4) Measure validity checks. Convergent validity will be tested when possible using existing measures (listed in Table 3.5) collected by HOME Plus (DeVellis, 2012). For example, associations between measures developed from the purchasing influence construct of cooking ability and the parent self-efficacy for cooking a healthful meal expected to be significant, but weak, as they are related but considered different constructs; such results would suggest convergent validity. Additionally, child and parent scales on a similar construct are also expected to correlate as convergent measures.

Following the steps proposed above, the researcher also explored development of scales for both parents and children to represent each level/dimension of the social ecological model. However, the items loaded on factors by underlying theoretical construct rather than level. This result is likely because parents and children were reporting on their perspectives of the influences at each of the levels and objective measures (e.g., of store/farmer's market access) were not used for analysis. As a result no measures were created to capture level of influence as originally proposed, and all newly created measures only operationalize theoretically-meaningful, purchasing influence constructs using the parent- and child- reported data.

Analysis Plan Aim 3

Aim 3 is to describe influences on food purchases and compare them by age, race and other child and parent sociodemographic characteristics. Descriptive analyses of newly developed scales, summative indices, or composite items will be performed using frequencies, means, standard deviations, and other statistics (e.g., ranges), as appropriate. Potential associations between sociodemographic characteristics and food purchasing influences will be examined using Pearson and Spearman correlations, Chi-square tests, or t-tests, as appropriate by variable depending on level of measurement and distributional properties (e.g., Pearson correlations between continuous variables, Chi-square with categorical variables, T-tests with a continuous and binary variable). Findings will highlight if influences vary by sociodemographic characteristics, which will be useful in tailoring future interventions.

Analysis Plan Aim 4

Aim 4 is to examine relationships between influences on food purchases for parents and children and home food environment, child dietary intake, and parent and child weight outcomes. Initially, descriptive analyses of home food environment outcomes (i.e., fruit availability, vegetable availability and obesogenic food availability), children's dietary intake outcomes (i.e., average daily servings of fruits and vegetables and total dietary quality) and parent and child weight outcomes (i.e., BMI, BMI-z score) will be conducted. Then, associations between food purchasing influences (composite items, summative indices, or scales) and outcomes will be performed using Pearson and

Spearman correlations and linear regression, as appropriate by each variable's level of measurement and distribution. General linear models will be then conducted to assess whether bivariate relationships between purchasing influence measures and outcomes remain when accounting for potentially confounding sociodemographic characteristics; all purchasing influence measures associated with two or more outcomes will be retained for analyses in Aim 5. Findings will identify potential areas related to food purchasing influences that should be considered as targets for nutrition and obesity prevention programs.

Analysis Plan Aim 5

Aim 5 will examine the strength of the food purchasing influences to explain variability in home food environment, dietary intake and weight outcomes while accounting for potential confounding variables. Hierarchical blocked regression models will be used to achieve this aim. Hierarchical blocked regression models will estimate the variance explained by each block of variables (R^2 and R^2 change) for each outcome measure. For example, the home fruit availability outcome will be regressed on Block 1 (sociodemographic characteristics) and Blocks of purchasing influences measures retained in Aim 4 (retained measures will be grouped into blocks by purchasing influence construct; Cohen (1983) calls these functional sets). Specifically, this parsimonious process will highlight the amount of variance explained in the outcome variable by each of the blocks of purchasing influences that is above what is explained by demographics (i.e., the robustness of purchasing influence variables).

Then, additional hierarchical blocked models will be estimated to demonstrate the variance explained by each block of variables (R^2 and R^2 change) for children's dietary and parent and child weight outcomes. These models will be the same as those described above, but an additional block (Block 2 containing home food environment variables) will be added to the model after Block 1 (Sociodemographic characteristics) and before the blocks of purchasing influences. Again, this parsimonious process will highlight the amount of variance explained in the outcome variable by purchasing influences that is above what is explained by demographics and also the home food environment.

Hierarchical blocked regression models are advantageous in the present study, as a group of measures (i.e., a block) can be entered into the model as one set (Cohen, 1983), which increases model power to detect changes in explained variance, particularly useful given the smaller sample size of this study. Also, because the measures grouped within each block were intentionally created with promax rotation and there is potential for relatedness between parent and child measures, measures within blocks may be correlated. However, correlation of measures within a block is considered acceptable in hierarchical blocked modeling because the main outcome of interest is the additional variance explained by each block of measures as a whole (Cohen, 1983). Interpretation of beta weights of each individual measure within each block of final models will be done extremely cautiously, as the beta values can be impacted by collinearity and the model is underpowered when each measure is considered individually.

Significance Tests

A Type 1 error rate of 5% will be used to determine statistical significance. No adjustment for multiple comparisons will be performed due to the exploratory nature of the study and results will be interpreted cautiously. Careful attention will be paid to distributional properties (i.e., skewness, outliers).

Software Used

Aims 2-4 were analyzed with SAS software version 9.3 (SAS Inc., Cary, NC, USA), and Aim 5 was analyzed with IBM SPSS Statistics for Windows, Version 22.0 released 2013 (IBM Corp. Armonk, NY).

Power

The purchasing influence research portion of this dissertation (Aims 2-5) uses previously collected data, therefore, no a priori power tests were performed and issues for the proposed factor and multivariate analyses are known (e.g., inadequate power). Thus, analytic plans pay particular attention to parsimony. Monte Carlo research suggests the sample size of 90 is sufficient for defining social constructs using factor analysis (Sapnas & Zeller, 2002). Power in multivariate models (Cohen, 1983; Cohen, 1992) is dependent on the number of independent variables in the model (as well as sample size, alpha level and the effect size to be measured), therefore, grouping purchasing influence measures into blocks helped to maximize power of hierarchical models in explaining changes in variance, which is particularly useful in this research with a small sample size.

Note: References for this chapter can be found in the dissertation bibliography.

Chapter 4: Manuscript Two

This chapter is written in manuscript form for a journal with Uniform Requirements for Manuscripts for Biomedical Journals. It has yet to be submitted for publication.

Measurement Development for Social-Contextual Influences on Child and Parent Food Purchases

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Overview

Objective: The home food environment has been associated with dietary intake and is comprised of foods purchased by families. Research has not yet comprehensively operationalized or explored the impact of a set of social-contextual food-purchasing influences of children and parents (i.e., cooking ability, concern for nutrition, cost, family food preferences, social pressure, store access, *and* time), which may be important targets for intervention. Therefore, this study aimed to operationalize these social-contextual purchasing influence constructs.

Methods: Baseline HOME Plus study parent (n=90) and child (n=90) data were used in exploratory factor analysis to develop psychometrically-sound scales, summative indices, and composite items measuring social-contextual food purchasing influences. When possible, convergent validity was tested to assure new measures were meaningful. Bivariate analyses (e.g., Pearson correlations, Chi-square) were used to test whether the new measures differed by sociodemographic characteristics.

Results: Nineteen new measures were operationalized to capture the aforementioned purchasing influence constructs. Statistical tests generally supported convergent validity and highlighted few sociodemographic differences.

Conclusions: The new measures are important for operationalizing influences on parents' and children's food purchases. Future research needs to assess associations between the new measures and outcomes important to obesity for youth and their parents, namely home food environment, child dietary, and parent and child weight outcomes; findings of such research will indicate if food-purchasing influences are related to these outcomes, thus, potentially providing measures and novel targets for intervention that may impact obesity for children and their parents.

Introduction

Obesity, a major public health problem for youth and adults alike, is associated with several chronic health conditions including hypertension, type 2 diabetes, hyperlipidemia, and joint and psychosocial problems (1, 2). Although the cause of obesity is multifactorial, a major contributing factor is excessive caloric intake (3, 4). As a result, healthful eating campaigns, interventions, and research studies have proliferated in recent years to prevent and mitigate obesity's impact on health. Despite the extra attention on healthful eating, obesity rates for youth and adults continue to be alarmingly high (2, 5). Therefore, new research directions are needed to discover additional avenues for intervention. Specifically, future studies are needed to investigate influences on parent and child food purchases, as research to date has not explored the reasons why parents and children purchase the foods that they do in a comprehensive manner (6-9); findings of food-purchasing influence research may lead to important work to improve the healthfulness dietary intake and prevent obesity.

Most research on food purchases has focused on adults only and has assessed sociodemographic, place of purchase, and price differences in healthful food purchasing (10-22). However, qualitative and descriptive research has described numerous potential social-contextual influences on food purchases, which can be grouped in the following constructs: Cooking Ability, Concern for Nutrition, Cost, Family Food Preferences, Social Pressure, Store Access and Time (See Figure 4.1). Descriptions of these constructs can be found on Table 4.1, Column 1, with reference citations in Column 2. Some

research has assessed relationships between individual or pairs of purchasing influence constructs and food-purchasing outcomes (Table 4.1, Column 3). Yet, to date, no published research has developed a set of social-contextual purchasing influence measures or evaluated how a set of such measures associates with food-purchasing outcomes; this research is needed to understand and measure these purchasing influences for adults, as these influences may be important targets for future intervention.

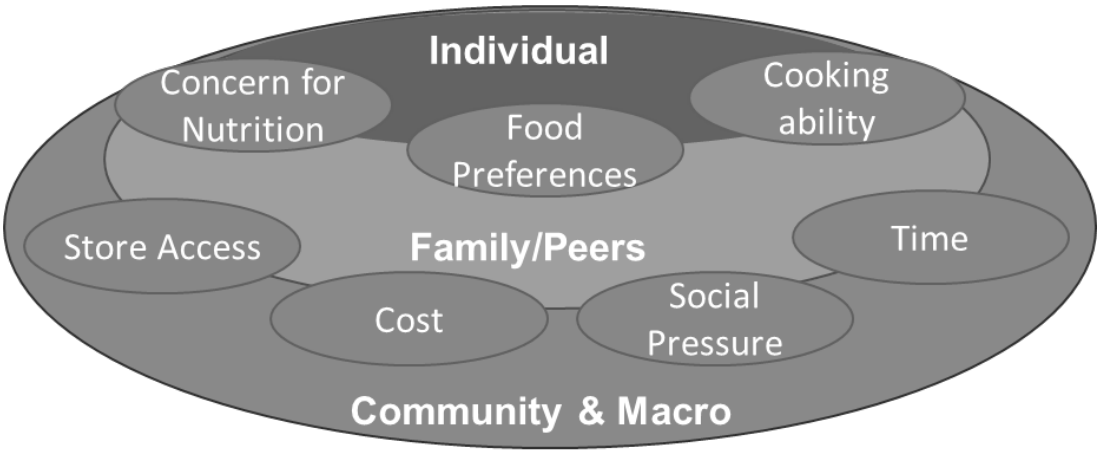

Figure 4.1 Social-contextual food purchasing influence constructs

Table 4.1 Purchasing influences (grouped by construct) described in qualitative or descriptive research and used in outcomes research

Purchasing influence construct: descriptions	Citations of qualitative or descriptive research that describe the listed purchasing influences/construct [a]	Citations of outcomes research evaluating relationships between purchasing influence construct and a purchasing outcome [a]
Cooking Ability: Self-efficacy for cooking, meal preparation skills, meal planning	(23, 24)	(25-27)
Concern for Nutrition: Concern for health and nutrition and/or nutrition knowledge	(28-32)	(17, 33)
Cost: Price/cost, coupons and store sales	(23, 30, 34)	(20, 21, 27, 28, 35)
Family Food Preferences: Food preferences, knowing family will eat a food, taste, children's fear of new foods, picky eaters, and avoiding conflict	(24, 28, 30, 34, 36-38)	(33, 39)
Social Pressure: Marketing/brand names, social support, children's requests	(29, 32, 38, 40)	(25, 26, 39, 41)
Store Access: Access, store types, features and characteristics, food selection and quality, farmer's markets	(28, 31, 34, 37, 42-44)	(13, 15, 16, 33, 36, 45-47)
Time: Convenience and time pressures	(28, 29, 31, 34, 37, 38, 42, 48)	

Note.
[a] Sources are listed numerically as found in the reference list.

Children's food purchases and influences on their purchases are largely unstudied, but children have an estimated annual purchasing power of $40 billion and purchasing influence of $700 billion (49). Research has found children spend $1.07 per shopping trip (50) or $3.96 per day on food purchases (51), which often consist of buying high-energy, low-nutrient foods and drinks that substantially contribute to daily caloric intake (36, 50, 51). In addition, proximity to food stores was associated with sugar-sweetened beverage purchase (52) and intake (53). Access to and purchasing from vending machines was also

associated with unhealthful dietary intake (54-56). In contrast, factors like low prices for healthy foods and access to supermarkets (57), healthier behavior intentions and higher caregiver self-efficacy for healthy food purchasing (58), easily understandable caloric information (59), and parental rules around sugar-sweetened beverages use (60) were associated with healthier purchasing outcomes. Although parental discretion largely determines foods purchased and made available to children, children have substantial influence on the types of foods purchased and available in their homes (61). Therefore, it is critical to understand a comprehensive set of social-contextual influences on children's food purchases in addition to their parent's food purchasing influences.

Focusing on both parents and children in food purchasing influence research is aligned with recommendations for childhood obesity prevention and mitigation efforts that stress the importance of family involvement because families influence food choices, taste preferences, mealtimes, and the food environment (62, 63). Foods and beverages purchased by families make up the home food environment, which has been found to be the largest source of empty calories in children's diets (64). Research also has consistently shown associations between the home food environment and dietary intake (65-72). Additionally, the social ecological framework further specifies social-contextual factors at individual-, interpersonal/family-, and community-dimensions of ecology that each, separately and together, influence human development and behavior (73). Although many possible social-contextual influences on food purchases have been described in the literature, no studies comprehensively operationalize influences on child and parent food

purchases, which may be beneficial to measurement and future programming. Therefore, given obesity prevention recommendations for family involvement, the connections between purchases, home food environment and dietary intake, and the gap in the literature, new measures operationalizing social-contextual influences on food purchases for parents and children are needed.

Thus, the present study aims to (1) develop psychometrically-sound scales, summative indices, and composite items to operationalize social-contextual influences on food purchases for parents and children using exploratory factor analysis (EFA) and test convergent validity of the new measures; and (2) assess for sociodemographic differences in the new measures. Creating new measures of purchasing influences for parents and children will open up opportunities to use measures in future research that may target obesity prevention or mitigation and/or improving dietary intake and the healthfulness of the home food environment. In addition, assessing for sociodemographic differences may indicate if influences are more salient with groups within certain populations.

Method

Sample

This secondary analysis used data from the Healthy Home Offerings via the Mealtime Environment (HOME) Plus study, a healthy eating, family meals, randomized controlled trial conducted in the Minneapolis Metropolitan Area of Hennepin County, Minnesota (74). Participants were recruited in two cohorts, one year apart, with the current analysis using baseline data only from the second cohort. The primary meal-

preparing parent (n=90) and one 8-12 year old child at or above the 50th percentile for age- and gender- adjusted BMI (n=90) were recruited from participating families for data collection; details of recruitment are described elsewhere (75).

Sociodemographic characteristics of the sample for this study are presented in Table 4.2. Children self-reported their sex and their parents reported their children's age and race. Parents also self-reported their sex, education, race, the number of hours worked each week outside of the home, and whether or not their family received free and reduced price lunches or other forms of economic assistance (e.g., food support, WIC, MFIP). In this sample, child sex is balanced between boys (53%) and girls (47%). Women are overrepresented (96%) in the parent sample, as expected due to targeting primary meal-preparing parents for recruitment (who are most often women; 76, 77). Parents were highly educated with 78% having an education level at or above an associate's degree.

Table 4.2 Characteristics of the Study Sample (N=90 parent-child dyads)

Sociodemographic characteristic	mean(SD) or n(%)
Child Age	10 (1.4)
Child Sex	
Female	42 (46.7%)
Male	48 (53.3%)
Child Race	
White	69 (76.7%)
Diverse backgrounds [a]	21 (23.3%)
Parent Education Level	
Some high school (HS), HS diploma, or Some college	19 (22.1%)
Associate's degree or higher	67 (77.9%)
Parent Sex	
Female	86 (95.6%)
Male	4 (4.4%)
Parent Race	
Diverse backgrounds [a]	15 (16.6%)
White	75 (83.3%)
Receives Economic Assistance	
No	59 (65.6%)
Yes	31 (34.4%)
Hours worked outside the home per week	
Not employed outside the home	33 (36.7%)
Part-time (1-34 hours/week)	19 (21.1%)
Full-time (35+ hours/week)	38 (42.2%)

Note.
[a] Diverse backgrounds includes those self-identifying as American Indian or Alaskan Native, Asian, Black or African American, Native Hawaiian or Pacific Islander, and those selecting more than one racial category.

Measures

Purchasing Items. Items were selected from the existing HOME Plus surveys if the item fit within one of the seven purchasing constructs (i.e., Cooking Ability, Concern for Nutrition, Cost, Family Food Preferences, Social Pressure, Store Access, and Time) and the social ecological framework. In addition to those items, we adapted existing items from the literature and also created new items for the HOME Plus purchasing influence questionnaire in order to ensure all purchasing constructs were measured. The new questionnaire underwent expert review to assess content validity, which resulted in minor revisions to enhance face validity, including readability. The new purchasing

questionnaire was then pilot-tested with children and parents using cognitive interviewing techniques. This process ensured questions accurately represented intended content, further supporting face and content validity. Questions that poorly discriminated between pilot respondents were eliminated, as using the full response option range is desired (78). Then, the new purchasing influence questionnaire was administered to Cohort 2 participants during data collection.

Convergent validity measures. It was important to test convergent validity of newly created measures by assessing associations with established scales. Findings from convergent validity tests should be significant, but relationships weaker, as the new measures are intended to capture related but theoretically different constructs than those captured by the established scales (78). Such results would indicate new measures are operationalizing a related but different concept. Table 4.3 contains HOME Plus scales that were paired (when possible) with related purchasing influence constructs to assess convergent validity.

Table 4.3 Established scales used to test convergent validity with the measures developed under each proposed construct

Proposed Constructs	Scale used to test convergent validity, with an example item and source	Reporter	Scale Alpha	Mean (SD)	Range
Cooking Ability	**Parent self-efficacy for cooking** How likely are you to prepare a healthy meal after a tiring day? (Adapted from Beshara et al. 2010 and 79).	Parent	0.82	11.4 (4.0)	4-20
Concern for Nutrition	**Parental role modeling of healthful eating** When you are with your child how often do you eat fruit as a snack? (Adapted from 80).	Parent	0.73	27.5 (3.7)	9-36
Concern for Nutrition	**Parental encouragement of healthful eating** How much do you encourage your child to eat fruit as a snack? (Adapted from 67).	Parent	0.81	29.3 (9.0)	9-50
Cost	**Food insecurity** We worried whether our food would run out before we got the money to buy more. (81).	Parent	NA	12 (13.3%)[a]	NA
Food Preferences	**Food neophobia** I am always trying new and different foods. (82)	Child	0.82	16.9 (4.2)	9-28
Store Access	**Barriers to buying fruit and veggies scale** I don't buy many fruits because they cost too much. (Adapted from 71).	Parent	0.88	6.4 (2.5)	4-16

Notes: These scales were used to measure construct validity of the newly developed scales under the proposed constructs. These convergent validity measures were collected with psychosocial surveys of parent and child. NA=not applicable. [a]Indicates reported as frequency (%).

Analysis Plan

First, the 80 survey items from both parents and children were grouped based on their underlying theoretical purchasing influence construct (i.e., Cooking Ability, Concern for Nutrition, Cost, Family Food Preferences, Social Pressure, Store Access, and Time). All items were transformed into standard normal scores (M=0, SD=1) to account for different response options between variables without loss of generality (83). Although continuous variables are preferred, ordered categorical items (e.g., those with Likert scale responses) are routinely factor analyzed with success (84) and were used in the present study. Additionally, some binary items were included in factor analyses, a practice that has been met with some scrutiny due to the limited range of Pearson's correlations between binary items (85). Because results may be biased and factor loadings attenuated, especially when the proportion of participants answering 1 is extreme (i.e., close to 0 or 1; 85, 86), binary items with extreme probabilities (< 0.11; >0.89) were not included in these analyses. Overall, binary items can be factored, so long as caution is taken with interpretation (84, 85). Correlation matrices were computed for each construct; all items correlated at or above 0.20 with at least one item were retained for EFA within that construct.

Second, EFA was used to ascertain common factor structures within each construct using principal axis factoring. The scree test was used to determine the number of factors extracted (87). Given that survey responses were likely to be related (e.g., parent and child concern for nutrition may be related), promax rotation was utilized, as it

allows for an oblique pattern structure to account for potential relatedness among the factors while also aiming to produce the simplest factor structures possible (88, 89). The factor structures were used to create psychometrically-sound scales, summative indices, or composite items, as appropriate. Although 0.70 is a typical Cronbach's alpha criterion (90, 91), the Cronbach's alpha criterion was set to 0.65, given the exploratory nature of this research. If Cronbach's alpha for items within a factor was at or above 0.65 and there were more than two items on the factor, a psychometrically-sound scale was created. If this threshold was not achieved for a factor, indicating that items were distinct (i.e., not inter-correlated), but the sum of the items defined a theoretically meaningful factor, a summative index was created (e.g., if items on a social pressure factor were individually distinct and had a low scale alpha, but those items, if summed, would still define a theoretical construct, a summative index was created). Scale and index scores were obtained by summing the items on each factor using the original response-option scale if response options for each of the items were identical (e.g., all 4-point never to always responses); if response options varied among items (e.g., 4-point never to always and 5-point strongly disagree to strongly agree) standard normal scores were summed for a total scale or index score. Factors with only two correlated items were averaged for a composite score. Univariate statistical analyses were conducted on all newly created scales, indices, and composite items to obtain descriptive statistics (e.g., mean, standard deviation, range, skewness, kurtosis).

Third, convergent validity with available HOME Plus measures was assessed when possible (see Table 4.3 for proposed tests) with appropriate bivariate statistics given distributional characteristics (e.g., Pearson correlations between continuous variables, t-tests between binary and continuously distributed variables). For example, it was proposed and tested with Pearson's correlations that newly developed measures under the Cooking Ability construct should be related to self-efficacy for cooking. Additionally, if two new measures of a construct operationalized a similar concept but one measure was parent reported and the other child reported, the relationship between the two measures was assessed.

Finally, bivariate relationships between newly developed scales and sociodemographic variables were measured with t-tests, Pearson and Spearman correlations, and Chi square tests, as appropriate. For variables with skewed distributions, sociodemographic differences were also assessed with both Wilcoxon and Kruskal-Wallis non-parametric tests.

Results

Exploratory Factor Analysis Results and Newly Created Measures

To create new purchasing influence measures to be used in future research, EFA was performed. Of the 80 items considered for EFA, few items were excluded from factor analyses, as most were correlated with other items within a purchasing influence construct at the r=0.20 threshold. Table 4.4 provides EFA results by each construct (i.e., Cooking Ability, Concern for Nutrition, Cost, Family Food Preferences, Social Pressure,

Store Access, and Time). For example, EFA yielded a three-factor structure for the first construct, Cooking Ability. The three factors formed two psychometrically-sound scales (*Parent report of child cooking skills* and *Child report of cooking skills*) and one index measure (*Parent and child extra healthful cooking effort*), with the mean, standard deviation and range reported in separate columns on the table. In addition, who reported the item (whether parent or child) is listed in a column next to each item, and corresponding factor loadings are shown in the last columns. In a similar manner, Table 4.4 presents EFA results for all purchasing influence constructs, with the Concern for Nutrition construct resulting in two scales (*Children's nutrition label use frequency*, and *Extra parent effort to select healthful foods*) and an index (*Children as healthful purchasers*). The Cost construct resulted in one scale (*Cost matters*) and one index (*Children think food is expensive*). Family Food Preferences resulted in one scale (*Buying foods we like*). Social Pressure resulted in two scales (*Parent report of child's grocery shopping assistance* and *Child report of grocery shopping assistance*) and a composite item (*TV advertisements: Child requests and parent purchase*). Store Access resulted in two composite items (*Store selection and quality*, and *Access to home or locally grown produce*) and an index (*Store accessibility*). Time resulted in a scale (*Foods need to be quick and easy*), two composite items (*Planning meals in advance* and *Scheduling difficulties around mealtimes*), and an index (*Meal preparation time saving strategies*).

All new scales, indices, and composite items were normally distributed as indicated by skewness or kurtosis scores $|< 1|$ with the exception of two scales: *Cost*

matters and *Buying foods we like*. Two additional exceptions were the composite item, *Store selection and quality*, and index measure, *Children as healthful purchasers,* which were categorical variables with three and four categories, respectively, and were treated as such.

Table 4.4 New measure psychometrics and factor analysis results under each broad purchasing influence construct.

Construct with Final Extracted Factors	M	(SD)	Range	Parent or Child Reported	Items	Factors 1	2	3	4
Cooking Ability[a]									
Factor 1: ***Parent report of child's cooking skills*** (Scale; α = 0.67)	0	3.92	-9.6-7.7	P	• Letting my child make dinner takes too much time	**-0.51**	0.16	-0.12	
				P	• In the past month, my child has prepped fruits/veggies	**0.52**	0.01	0.03	
				P	• In the past month, my child has handled knives properly	**0.56**	0.10	0.11	
				P	• In the past month, my child has followed safe food handling practices	**0.55**	0.12	-0.08	
				P	• In the past month, my child has followed recipe for healthy meal snack	**0.43**	0.18	0.10	
				P	• In the past month, my child has measuring spoons to measure correctly	**0.42**	0.21	-0.06	
				P	• I buy prepackaged foods like boxed foods or frozen meals because they are easy for my child to make	**-0.44**	0.22	0.30	
Factor 2: ***Child report of cooking skills*** (Scale; α = 0.64)	11.2	2.84	3-16	C	• In the past month, I have prepared fruits and vegetables (R)	0.05	**0.45**	0.13	
				C	• In the past month, I have followed safe food handling practices (R)	0.18	**0.65**	-0.06	
				C	• In the past month, I have followed a recipe to prepare a healthy meal or snack (R)	-0.16	**0.79**	-0.03	
				C	• In the past month, I have used measuring cups or spoons to accurately measure correct amounts of ingredients (R)	0.07	**0.42**	0.01	
Factor 3: ***Parent and child extra healthful cooking effort*** (Index)	0	2.61	-6.2-5.0	P	• I know how to cook with low-fat cooking methods (R)	-0.06	-0.15	**0.67**	
				P	• In the past month, I have reduced, substituted, or omitted ingredients in a recipe to make it healthier.	-0.02	0.15	**0.63**	
				C	• I like to eat packaged food (like cookies or crackers) because they are easy to eat (R)	0.16	-0.03	**0.55**	
				P	• We rely on a few key easy-to-prepare meals.	-0.10	-0.14	**-0.38**	

Construct with Final Extracted Factors	M	(SD)	Range	Parent or Child Reported	Items	Factors 1	2	3	4
Concern for Nutrition[b]									
Factor 1: ***Children's nutrition label use frequency*** (Scale; α = 0.78)	7.38	2.57	3-12	C	• How often do you look at food labels to find out if a food is healthy?	**0.65**	0.28	-0.04	
				C	• How often do you look at food labels to find out the serving size?	**0.92**	0.00	-0.10	
				C	• In the past month, I have read a food label for key ingredients like the serving size (R)	**0.68**	-0.13	0.08	
Factor 2: ***Extra parent effort to select healthful foods*** (Scale; α = 0.67)	0	3.22	-10.9-3.9	P	• How healthy foods are is very important to me when buying foods.	0.18	**0.36**	0.10	
				P	• In the past month, I have picked healthy recipes to try or make.	0.12	**0.33**	0.19	
				P	• In the past month, I have read a food label for key items.	-0.02	**0.68**	-0.05	
				P	• How often do you use nutrition information on food labels to help you decide which foods to buy?	-0.03	**0.84**	0.10	
				P	• I can select the healthier option between two foods by comparing the food labels (R)	-0.02	**0.41**	-0.18	
Factor 3: ***Children as healthful purchasers*** (Index)	2.17	0.99	0-3	C	• If given money, I would buy fruits or vegetables.	0.10	-0.10	**0.80**	
				C	• If given money, I would buy baked crackers, pretzels, or nuts (like peanuts).	-0.03	-0.01	**0.50**	
				C	• If given money, I would buy milk or 100% fruit juice.	-0.14	0.16	**0.50**	
Cost[c]									
Factor 1: ***Cost matters*** (Scale; α = 0.74)	0	2.99	-7.4-3	P	• As a parent does the following influence what foods you buy: The food item is on sale.	**0.63**	-0.08		
				P	• As a parent does the following influence what foods you buy: Cost.	**0.78**	0.18		
				P	• My family uses coupons when going to the grocery store to save money.	**0.59**	-0.27		
				P	• Cost is very important to me when buying foods.	**0.62**	0.05		

Construct with Final Extracted Factors	M	(SD)	Range	Parent or Child Reported	Items	Factors 1	2	3	4
Factor 2: ***Children think food is expensive*** (Index)	1.98	1.24	0-5	C	• My parent says fruits and vegetables cost too much to buy a lot of them.	-0.01	**0.40**		
				C	• A fast food value meal (like from McDonalds) costs less than a dinner meal at home.	0.10	**-0.33**		
				C	• My parent says snack foods (like cookies, chips, and candy) cost too much to buy a lot of them.	0.02	**0.70**		
Family Food Preferences									
Factor 1: ***Buying foods we like*** (Scale; α = 0.70)	3.15	1.16	0-4	P	• As a parent does the following influence what foods you buy: I know my family will eat it.	**0.66**			
				P	• As a parent does the following influence what foods you buy: My child requests it.	**0.50**			
				P	• As a parent does the following influence what foods you buy: How the food tastes.	**0.77**			
				P	• As a parent does the following influence what foods you buy: It is in a recipe that I want to use.	**0.53**			
Social Pressure[d]									
Factor 1: ***Parent report of child's grocery shopping assistance*** (Scale α = 0.67)	8.13	1.92	3-12	P	• Come along to the store when you shop for food?	**0.51**	0.01	0.14	
				P	• Help plan the grocery list?	**0.61**	0.05	-0.08	
				P	• Help select fruit and vegetables at the grocery store?	**0.78**	-0.02	-0.04	
Factor 2: ***Child report of grocery shopping assistance*** (Scale; α = 0.64)	0	2.29	-5.2-3.7	C	• In the past month, I have picked out healthy foods and beverages at a store or when making a shopping list (R)	-0.06	**0.70**	-0.05	
				C	• In the past week, did you ask your parents to buy fruits and vegetables?	0.07	**0.72**	0.03	
				C	• I help decide what foods and drinks my family buys by letting my parent know what I like.	0.04	**0.44**	0.06	
Factor 3: ***TV advertisements: child requests and parent purchase*** (Composite item; r = 0.56)	1.78	0.72	1-3.5	C	• How often do you ask your parents to buy foods that you saw on TV commercials?	0.06	-0.09	**0.82**	
				C	• How often do your parents actually buy these foods for you?	-0.06	0.12	**0.72**	

Construct with Final Extracted Factors	M	(SD)	Range	Parent or Child Reported	Items	Factors 1	2	3	4
Store Access[e]									
Factor 1: ***Store selection and quality*** (Composite; r=0.48, p<0.001)	0.29	0.39	0-1	P	• Why do you do most of your shopping at the store you frequent most: It has the best quality of foods.	**0.48**	0.21	0.32	
				P	• Why do you do most of your shopping at the store you frequent most: It has the best selection.	**1.00**	-0.02	-0.13	
Factor 2: ***Access to home or local grown produce*** (Composite; r=0.28, p = 0.009)	0.93	0.53	0-2	P	• My family grows some of the vegetables or fruits that we eat.	-0.01	**0.79**	-0.01	
				P	• My family buys fruits or vegetables at the farmers market, has a farm share, or is in a CSA (community supported agriculture).	0.15	**0.33**	-0.08	
Factor 3: ***Store Accessibility*** (Index)	1.54	1.11	0-4	P	• Why do you do most of your shopping at the store you frequent most: It is on my way home from work.	-0.02	-0.13	**0.35**	
				P	• Why do you do most of your shopping at the store you frequent most: It has the best prices.	-0.10	0.12	**0.42**	
				P	• Why do you do most of your shopping at the store you frequent most: It is easy and convenient to get to.	-0.04	-0.31	**0.43**	
				P	• Why do you do most of your shopping at the store you frequent most: It is conveniently located on my usual route for errands or other activities.	0.22	-0.06	**0.54**	
Time[f]									
Factor 1: ***Foods need to be quick and easy*** (Scale; $\alpha = 0.69$)	0	2.85	-5.3-5.9	P	• How easy and quick a food is to prepare is very important to me when buying foods.	**0.55**	0.01	-0.25	-0.02
				P	• As a parent does the following influence what foods you buy: The food item is quick and easy to make.	**0.48**	0.19	-0.07	0.03
				P	• On busy nights, our family's main meal includes canned or frozen entrees or boxed mixes (i.e. partially prepared meals).	**0.52**	0.11	0.16	0.20
				P	• I buy prepackaged foods like boxed foods and frozen meals because I don't have time to prepare other foods.	**0.67**	-0.06	0.01	-0.03

Construct with Final Extracted Factors	M	(SD)	Range	Parent or Child Reported	Items	Factors 1	2	3	4
Factor 2: ***Planning meals in advance*** (Composite item; r=0.62)	2.49	0.76	1-4	P	• I usually know or plan in advance what we will eat for dinner that night.	-0.03	**1.00**	-0.12	-0.07
				P	• I usually decide at night what we will eat for dinner that night.	-0.14	**-0.59**	-0.15	-0.09
Factor 3: ***Meal preparation time saving strategies*** (Index)	7.07	1.61	3-12	P	• We cook enough on some days/nights so that there will be leftovers for another meal.	-0.20	0.06	**0.57**	0.23
				P	• We try to keep our cupboards well stocked with foods that can be combined easily for a meal.	0.13	0.00	**0.72**	-0.28
				P	• We make food and freeze some of it.	0.00	-0.03	**0.36**	-0.01
Factor 4: ***Scheduling difficulties around mealtimes*** (Composite item; r=0.44)	0	0.84	-1 - 1.92	P	• Fast food and convenience store foods/snacks seem like my only choice when my family is on the go and time is limited by our busy schedules.	0.17	-0.04	-0.04	**0.68**
				P	• We often seem to eat in shifts where we do not all eat at the same time (r)	-0.04	0.03	0.03	**0.63**

Notes. P/C = Reporter of the item, with P=parent and C=Child. (R)=reverse coded. [a] Cooking ability items included or adapted from sources: (29, 80, 92, 93) [b] Concern for Nutrition items included or adapted from sources: (29, 36, 58, 92, 94) [c] Cost items included or adapted from sources: (44, 58). [d] Social Pressure items included or adapted from sources: (39, 74, 92) [e] Store access items included or adapted from sources: (15, 36, 44, 53) [f] Time items included or adapted from sources: (93, 95)

Convergent Validity

The relationships between specified existing HOME Plus scales and new measures were tested to assess convergent validity; results should indicate previously established measures and new measures are related but measure theoretically different concepts. Overall, tests supported content validity of most newly developed scales, indices and composite items (as shown in Table 4.5). In relation to the Cooking Ability construct, the new measure *Parent and child extra healthful cooking effort* was significantly and positively associated with parent self-efficacy for cooking a healthful meal. However, parent self-efficacy for cooking a healthy meal was not significantly correlated with *Child report of cooking skills* or *Parent report of child's cooking skills*, but *Child report of cooking skills* and *Parent report of child's cooking skills* were significantly correlated. *Extra parent effort to select healthful foods* was significantly and positively associated with parental role modeling of healthful eating but not significantly associated with parental encouragement of healthful eating. In addition, with regard to the Concern for Nutrition construct, *Children's nutrition label reading frequency* was significantly and positively associated with both parental role-modeling and parental encouragement of healthy eating. The *Children as healthful purchasers* measure was not significantly associated with either parental role-modeling or parental encouragement of healthy eating. For the Cost construct measures, parent reported *Cost matters* was significantly related to family food insecurity; however, *Children think food is expensive* was not significantly related. The Family Food Preferences construct measure of *Buying*

foods we like was inversely associated with child neophobia (i.e., fear of new foods), although the non-significant association was trending in the expected direction. Finally, the Store Access construct measures, *Store selection and quality, Access to home or locally grown produce,* and *Store accessibility,* were all significantly and inversely related to increased barriers to buying fruits and vegetables.

Table 4.5 Newly developed measures and convergent validity tests

Purchasing Influence Construct	Newly Developed Measures	Convergent validity measures	Statistical Test	p value
Cooking Ability	*Parent and child are willing to make extra effort to cook healthful foods*	Parent self-efficacy for cooking	**r=0.34**	**0.001**
	Child's direct cooking skills	Parent self-efficacy for cooking	r=-0.16	0.13
	Parent's perceptions of their child's direct cooking skills	Parent self-efficacy for cooking	r=0.09	0.38
	Child's direct cooking skills	*'Parent's Perceptions of Their Child's Direct Cooking Skills*	**r=0.26**	**<0.001**
Concern for Nutrition	*Extra parent effort to select healthful foods*	Parental role-modeling of healthy eating at snacks and dinner [a]	**r_s=0.45**	**<0.001**
		Parental encouragement of child to eat and drink healthy foods and snacks at dinner [a]	r_s=0.02	0.81
	Child's label reading frequency	Parental role-modeling of healthy eating at snacks and dinner [a]	**r_s=0.21**	**0.05**
		Parental encouragement of child to eat and drink healthy foods and snacks at dinner [a]	r_s=0.20	0.07
	Children would purchase healthy food and drink types	Parental role-modeling of healthy eating at snacks and dinner [a]	r_s=0.00	0.96
		Parental encouragement of child to eat and drink healthy foods and snacks at dinner [a]	r_s=0.07	0.50
Cost	*Cost matters* [a]	Food insecurity (0 vs 1)	[c]Kruskal-Wallis (χ^2 =3.90) Wilcoxon (statistic=651.5)	**0.05**
	Children think food is expensive	Food insecurity (0 vs 1)	2.03 vs 1.67, (t=-0.35)	0.35
Food Preferences	*Buying foods we like* [a]	Food neophobia	$r_{s=}$ -0.13	0.22
Social Pressure	*Child's report of helping their parent to shop frequency*	*'Parent's report of their child helping to shop frequency'*	**r=0.20**	**0.06**

Purchasing Influence Construct	Newly Developed Measures	Convergent validity measures	Statistical Test	p value
Store Access	*Store selection and quality* [b]	Barriers to buying fruit and veggies scale [a]	**$r_{s=}$ -0.32**	**<0.01**
	Access to home or local grown produce	Barriers to buying fruit and veggies scale [a]	**$r_{s=}$ -0.24**	**0.02**
	Store accessibility	Barriers to buying fruit and veggies scale [a]	**$r_{s=}$ 0.21**	**0.05**

Notes: [a] Variable is skewed or kurtotic. [b] Variable is categorical. [c] Non-parametric tests showed differing results; therefore, only non-parametric tests are reported.

Sociodemographic differences

Most new scales, indices, and composite items did not vary by sociodemographic characteristics. Parent age was only significantly and positively related to one measure: *Extra parent effort to select healthy foods* (r=0.26, p=0.02). Number of hours worked each week was significantly and inversely associated with *Cost matters* (r_s= -0.21, p=0.05) and *Children as healthful purchasers* (r_s= -0.23, p=0.03). Child's age was significantly associated with five measures, *Parent report of child's cooking skills* (r=0.23, p=0.03), *Child report of cooking skills* (r=0.25, p=0.02), *Access to home or locally grown produce* (r= -0.21, p=0.05), *Parent report of child's grocery shopping assistance* (r=0.28, p=0.02), and *Child report of grocery shopping assistance* (r=0.23, p=0.03).

Associations between new measures and sociodemographic characteristics of parent education level, parent race, economic assistance receipt, and child sex are found on Table 4.6. Generally, parent education level was significantly associated with three measures under purchasing constructs of Concern for Nutrition, Social Pressure, and Time. Parent race was significantly associated with four new measures under constructs of Cooking Ability, Family Food Preferences, and Social Pressure. Receipt of economic assistance was significantly associated with five new measures under constructs of Cost, Family Food Preferences, and Social Pressure. Child sex was significantly associated with four measures under Cooking Ability, Cost and Social Pressure.

Table 4.6 Sociodemographic associations* with newly developed scales under each purchasing influence construct.

Purchasing Construct	Education			Parent Race			Economic Assistance			Child Sex		
• *new measures*	<AD	AD+	P	White	Diverse	P	No	Yes	P	Girl	Boy	P
Cooking Ability												
• *Parent's perception of child's direct cooking skills*	1.31 (3.46)	-0.41 (3.82)	0.08	**-0.39 (3.90)**	**1.96 (3.46)**	**0.03**	-0.28 (3.73)	0.53 (4.26)	0.36	**-0.78** (3.85)	**0.88** (3.85)	**0.04**
• *Child's direct cooking skills*	11.42 (2.29)	11.05 (2.96)	0.61	10.99 (2.84)	11.93 (2.79)	0.24	10.90 (2.77)	11.67 (2.94)	0.22	**10.36 (2.88)**	**12.05 (2.53)**	**0.01**
• *Parent willing to make extra cooking effort*	0.13 (2.78)	-0.10 (2.59)	0.73	0.04 (2.61)	-0.19 (2.71)	0.76	0.09 (2.52)	-0.17 (2.80)	0.67	0.20 (2.67)	0.23 (2.56)	0.43
Concern for Nutrition												
• *Frequency of children's use of nutritional labels*	7.42 (2.52)	7.33 (2.56)	0.90	7.26 (2.63)	8.00 (2.24)	0.31	7.15 (2.74)	7.83 (2.17)	0.24	7.09 (2.42)	7.71 (2.72)	0.25
• *Parent willing to make the extra effort to select healthy foods*	**-1.19 (3.80)**	**0.44 (2.96)**	**0.05**	0.15 (3.35)	-0.73 (2.40)	0.34	0.31 (3.16)	-0.60 (3.28)	0.20	0.22 (3.14)	-0.25 (3.32)	0.50
• *Children would purchase healthy food and drink types* [a]	$\chi^2 = 5.50$		0.14	$\chi^2 = 0.69$		0.87	$\chi^2 = 1.39$		0.71	$\chi^2 = 0.18$		0.98
Cost												
• *Cost matters* [b]	0.88 (1.95)	-0.29 (3.24)	0.15 [c]	-0.10 (3.13)	0.51 (2.14)	0.49[c]			0.16 [d]	0.44 (2.43)	-0.49 (3.48)	0.15[c]
• *Children think food is expensive*	2.32 (1.20)	1.90 (1.26)	0.20	1.92 (1.27)	2.27 (1.03)	0.32	**1.76 (1.18)**	**2.39 (1.26)**	**0.02**	**2.22 (1.26)**	**1.69 (1.16)**	**0.04**
Family Food Preferences												
• *Buying foods we like* [b]	2.89 (1.34)	3.27 (1.05)	0.21[c]	**3.32 (1.00)**	**2.21 (1.53)**	**<0.01**[c]	**3.34 (0.98)**	**2.77 (1.41)**	**0.03**[c]	3.28 (1.04)	3.00 (1.29)	0.27 [c]
Social Pressure												
• *Parent report of child's grocery shopping assistance*	8.79 (2.07)	7.91 (1.86)	0.08	**7.92 (1.90)**	**9.20 (1.74)**	**0.02**	**7.68 (1.91)**	**9.00 (1.65)**	**<0.01**	7.90 (1.93)	8.40 (1.90)	0.21
• *Child report of helping with grocery shopping*	0.47 (2.14)	-0.19 (2.28)	0.27	0.06 (2.30)	-0.29 (2.30)	0.59	-0.15 (2.29)	0.28 (2.29)	0.40	**-0.66 (2.27)**	**0.76 (2.09)**	**<0.01**

Purchasing Construct	**Education**			**Parent Race**			**Economic Assistance**			**Child Sex**		
• *new measures*	**<AD**	**AD+**	**P**	**White**	**Diverse**	**P**	**No**	**Yes**	**P**	**Girl**	**Boy**	**P**
• *TV advertisements and child requests and parent purchase*	**2.05 (0.69)**	**1.66 (0.68)**	**0.03**	**1.66 (0.66)**	**2.40 (0.69)**	**<0.001**	**1.64 (0.68)**	**2.05 (0.73)**	**0.01**	1.78 (0.70)	1.79 (0.75)	0.98
Store Access												
• *Store Selection and Quality* [a]	$\chi^2 = 1.75$		0.42	$\chi^2 = 2.35$		0.31	$\chi^2 = 4.32$		0.12	$\chi^2 = 4.45$		0.11
• *Access to home or local grown produce*	0.94 (0.54)	0.94 (0.54)	0.98	0.95 (0.53)	0.86 (0.53)	0.54	0.97 (0.55)	0.87 (0.49)	0.37	0.86 (0.52)	1.01 (0.54)	0.18
• *Store Accessibility*	1.28 (1.78)	1.57 (1.06)	0.32	1.54 (1.04)	1.50 (1.45)	0.88	1.47 (1.01)	1.67 (1.30)	0.44	1.59 (1.27)	1.49 (0.95)	0.66
Time												
• *Foods need to be quick and easy*	-0.79 (2.70)	0.12 (2.88)	0.22	0.03 (2.84)	-0.17 (3.01)	0.81	-0.24 (2.74)	0.45 (3.05)	0.28	-0.04 (2.98)	0.05 (2.74)	0.88
• *We plan ahead for meals*	2.40 (0.91)	2.49 (0.73)	0.65	2.47 (0.78)	2.57 (0.65)	0.67	2.59 (0.75)	2.29 (0.76)	0.07	2.48 (0.80)	2.50 (0.72)	0.90
• *Meal preparation time saving strategies*	7.26 (1.82)	7.07 (1.53)	0.65	7.07 (1.54)	7.07 (1.98)	1.00	7.15 (1.42)	6.90 (1.92)	0.49	7.14 (1.49)	6.98 (1.75)	0.62
• *Scheduling difficulties around mealtimes*	**0.36 (0.85)**	**-0.13 (0.80)**	**0.02**	-0.08 (0.83)	0.38 (0.83)	0.06	**-0.17 (0.80)**	**0.32 (0.83)**	**<0.01**	0.00 (0.84)	0.00 (0.85)	0.97

Notes. *T-test results are reported mean (SD) unless otherwise noted. <AD = no high school diploma, high school diploma, or some college. AD+ = Associate's degree or higher. [a] Indicates variable is categorical with three categories; chi square analyses were used to assess sociodemographic differences. [b] Indicates variable has a skewed distribution. [c] Indicates no difference between nonparametric tests and t-tests and therefore t-tests are reported. [d] Differences between t-tests and nonparametric tests (Kruskal-Wallis and Wilcoxon) were observed; therefore, given variable distribution as skewed only nonparametric tests results are listed.

Discussion

Seven, important, broad purchasing influence constructs (i.e., Cooking Ability, Concern for Nutrition, Cost, Family Food Preferences, Social Pressure, Store Access, and Time) exist in the research literature and fit in the social ecological framework. A comprehensive set of items capturing the seven constructs for parents and their 8-12 year old children were factor analyzed to develop new purchasing influence measures for research, which resulted in the creation of 9 scales, 5 indices, and 4 composite items. With these measures, social-contextual food purchasing influences for parents and children were operationalized and provide researchers a future opportunity to assess how these food purchasing influences associate with outcomes of interest. More specifically, in future research, understanding the relationships between purchasing influences and home food environment, dietary intake and weight outcomes may lead to innovative interventions addressing purchasing influences significantly associated with these outcomes.

When testing was possible, many convergent validity tests supported validity of the new measures with few exceptions noted here. Parent self-efficacy for cooking was not significantly related to *Child report of cooking skills* or *Parent report of child's cooking skills.* However, it is possible that parent self-efficacy is not significantly related to their child's cooking skills, and because *Child report of cooking skills* and *Parent report of child's cooking skills* were correlated significantly, these two measures likely are operationalizing children's cooking skills. Although parental encouragement of healthful eating was not significantly related to *Extra parent effort to select healthful*

foods and *Children's nutrition label reading frequency*, both these measures were significantly related to parental role-modeling of healthful eating; role-modeling has been associated with healthier eating behavior (96, 97). Neither parental encouragement or role-modeling were significantly related to *Children as healthful purchasers;* this lack of significant association is possible, as regardless of a parent's role modeling or encouragement, children still may not choose to purchase healthy foods, especially if a parent is not present during purchase. Food insecurity was not significantly associated with the child measure of *Children think food is expensive.* However, it is plausible that *Children think food is expensive* was not significantly related to food insecurity as originally hypothesized, as children may be buffered from the effects of food insecurity by their parent(s) or meals provided at school. Additionally, *Children think food is expensive* was significantly related to family receipt of economic assistance. Children's food neophobia (i.e., fear of new foods) was not significantly associated with *Buying foods we like,* although results trended in the right direction. This lack of association is also plausible, as children do not necessarily have to fear new foods in order to have strong food preferences that influence families to buy foods they like. Given these plausible explanations of non-significant findings, results of significant convergent validity tests, and the rigorous methods used to adapt and develop new survey items and conduct EFA, it is likely the new measures meaningfully operationalize social-contextual food purchasing influences of children and parents.

The measures created with this research may be important for future research aiming to improve the healthfulness of foods purchased and consumed, as understanding

which purchasing influence measures associate with home food environment, dietary intake and weight outcomes will provide potential targets for intervention development. However, it is important to first understand how these new measures differ by sociodemographic characteristics, as differences may imply which influences are most salient for intervention in different populations. Overall, few sociodemographic differences existed among the new measures. However, understanding the existing differences highlights the importance of tailoring interventions. For example, if researchers do not consider addressing a social-contextual influence (e.g., store access) significantly important in the target-population (e.g., low-income families), a dynamic, innovative behavioral intervention to change a health behavior (e.g., increasing healthful food purchases) may not be effective.

Strengths and Limitations

Study strengths include careful selection and development of items grounded in the literature and theory for each purchasing influence construct, which included expert review and pilot testing with cognitive interviews. Additionally, EFA was consistently performed for each construct to develop new theoretically meaningful measures, and convergent validity was tested when possible. The new measures operationalized a host of important food purchasing influences for parents and children; however, the new measures could not capture all possible purchasing influences and were created with self-reported data, as opposed to directly observed data, data collected immediately following a food shopping trip, or geographical information system (GIS) data. Additionally, the sample in this study is smaller than most samples used in EFA; however, Monte Carlo

research simulations suggest sample sizes of 50-100 are sufficient for defining social constructs (98). The study sample has limited generalizability, as participants were recruited for the HOME Plus trial, a healthful eating, family meals study. Yet, study findings provide valuable new measures on the influences of food purchases for parents and their school-age children and should be tested in a larger, more generalizable sample.

Conclusion

If found to be valid and reliable in future research, the new measures created with EFA will be important for better operationalizing and understanding the impact of social-contextual influences on parent and child food purchases. With most new measures demonstrating convergent validity (when it was possible to test), the new measures may be potential focus areas and new measures for intervention. For example, if *Access to home or locally grown produce* was associated with a healthier home food environment, interventions could be developed to target and measure change in the influence (e.g., increasing access to home gardens, community gardens, farmer's markets, and community supported agriculture programs) and resulting impact on the home food environment. Therefore, future research should assess associations between the new measures and home food environment, dietary intake, and weight outcomes for families; findings may generate a better understanding about which food-purchasing influences are most important to intervene on and with whom, thus, providing novel avenues for future obesity prevention research with children and their parents.

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Chapter 5: Manuscript Three

This chapter is written in manuscript form for a journal with Uniform Requirements for Manuscripts for Biomedical Journals. It has yet to be submitted for publication.

Social-Contextual Food Purchasing Influences of Parents and Children: Associations with Home Food Environment, Dietary and Weight outcomes

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Overview

Objective: Obesity has been associated with dietary intake and home food environments, which consist of foods purchased by families. Research has identified many social-contextual influences on food purchases for adults and children (e.g., cooking ability, concern for nutrition, cost, family food preferences, social pressure, store access, and time). However, this research has not investigated how a set of social-contextual purchasing influences relates to home food environment, dietary intake, and weight outcomes, a gap the present study aims to fill. Findings may help inform future research and intervention to positively impact home food environments, dietary intake, and ultimately obesity for children and their parents.

Methods: The present study uses baseline HOME Plus study data from the second cohort of parents (n=90) and children (n=90). Pearson correlations, general linear models, and hierarchical blocked regression models were used to assess relationships between food purchasing influence measures and home food environment, dietary, and weight outcomes.

Results: Bivariate and multivariate results suggested many (between 5 and 11) social-contextual purchasing influences measures from the cooking ability, concern for nutrition, store access and time constructs were significantly associated with home food environment *and* dietary outcomes; few measures were significantly associated with weight outcomes. Hierarchical models suggested blocks of purchasing influences (i.e.,

time, cooking ability, store access, and concern for nutrition) were more robust at explaining significant additional variability of home food environment outcomes than of dietary or weight outcomes.

Conclusions: Findings indicated many social-contextual food purchasing influences are significantly associated with home food environments and dietary intake. Hierarchical model findings suggested interventions should consider focusing on multiple food-purchasing influences/constructs to positively impact home food environments. Future, more highly powered research should validate findings and evaluate longitudinal relationships in a more generalizable sample.

Background

Obesity is highly prevalent (1) and associated with many chronic conditions. These conditions include heart disease, cancers, stroke, type 2 diabetes, hyperlipidemia, hypertension, and psychosocial problems (2, 3) with the first four listed as the first, second, fourth and seventh leading causes of death in the United States (4). As a result, healthful dietary intake has been emphasized in campaigns (e.g., 5), programming (e.g., 6), and research (e.g., 7), because healthful eating is an important factor in preventing chronic disease, maintaining a healthy weight, and mitigating the impact of obesity for children and adults alike (8). Similarly, home food environments have received increasing attention, as children and adults consume most foods at home (9), and research shows direct associations between home food availability and dietary intake (10-17). However, in spite of increased attention on programming promoting healthful dietary intake and home food environments, obesity rates remain high for school-age children and adults (1). Therefore, it is imperative for researchers to continue to investigate novel areas that may be targeted with intervention to positively influence home food environments, healthful dietary intake, and ultimately, obesity.

Because home food environments are comprised of foods purchased from stores, one particularly salient area for study is investigating what influences children's and parents' food purchases and how these influences impact home food environments, dietary intake, and weight outcomes (18, 19). Findings from such research may highlight important influences on food purchases that interventions could target or address. To date, most research studies examining factors influencing food purchases focus primarily

on cost, location of purchase, and sociodemographic differences (20-33). Additional research studies have identified many social-contextual factors influencing food purchases of parents and their children; these factors include cooking and meal preparation skills (34, 35), overall concern for nutrition (36-40), family food preferences (35, 36, 39, 41-44), and time (37, 39, 40, 42-46). Social pressures, including children's requests for foods, who is going shopping with parents, and the role of media also are described as important purchasing influences (38, 40, 44, 47). Additionally, store access, including store features and food selection and quality, have received significant attention (37, 39, 42, 43, 45, 48, 49). Some quantitative research studies have explored individual associations between these social-contextual influences and purchasing outcomes. However, no quantitative research has yet assessed how a comprehensive set of influential factors simultaneously associates with home food environment, dietary and weight outcomes of parents and their children.

In order to fill this gap, a recent study (Horning dissertation Manuscript 2, Chapter 4) outlined food purchasing influences identified in the research literature along with the social ecological framework, which outlines social-contextual influences important for all aspects of community health promotion, research, and intervention (50). Selected, social-contextual purchasing influences were theoretically grouped by underlying purchasing influence construct (i.e., cooking ability, concern for nutrition, cost, family food preferences, social pressure, and time; as shown in ovals on Figure 5.1). These constructs were operationalized with a total of 19 new measures (Horning dissertation Manuscript 2, Chapter 4). These measures were aligned with recent

childhood obesity prevention and mitigation recommendations to involve families, not just children or their parents (51, 52), as both school-age children and their primary meal-preparing parents provided data used in purchasing influence measure development. However, the measure development study stopped short of assessing associations between the newly created measures and outcomes important to obesity, which could inform future community health promotion work for children and parents.

Therefore, the goals of the present study are to: (a) estimate relationships between each purchasing influence measure and each home food environment, child dietary, and parent and child weight outcome with and without adjustment for sociodemographic characteristics; and (b) assess whether groups of purchasing influence measures help to explain additional variance in outcomes beyond that explained by sociodemographic characteristics (for home food environment, dietary, and weight outcomes) and home food environment variables (for dietary and weight outcomes). For example, results will suggest whether purchasing influences explain additional variance in children's fruit and vegetable intake beyond what is explained by sociodemographic characteristics and home food environment variables. Results of this study may provide the scientific foundation to inform and personalize innovative interventions and research to improve healthfulness of home food environments, children's dietary intake, and parent and child weight status by addressing salient food purchasing influences.

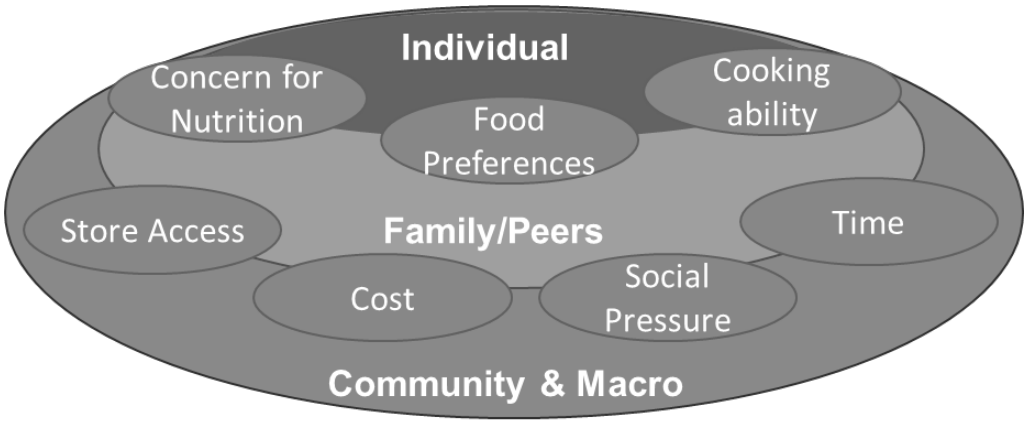

Figure 5.1 Purchasing influence constructs within the social ecological framework.

Method

The present study uses baseline parent and child participant data from the Healthy Home Offerings via the Mealtime Environment (HOME) Plus trial. HOME Plus was a community-based, family meals, and healthful eating intervention study for families in the Minneapolis, Minnesota Metropolitan area. Eligible families with one 8-12 year old child and their primary meal-preparing parent were recruited in two cohorts in summers 2011 and 2012 to participate in HOME Plus; trial details are published elsewhere (53). Additional purchasing influence questions were asked of the second cohort on their baseline surveys; combined with other HOME Plus survey data, the new items were used to develop the food purchasing influence measures. Therefore, the present secondary analysis uses only data from the second cohort, consisting of n=90 parents and n=90 children. All HOME Plus processes and procedures and the present dissertation study were approved by the University of Minnesota's Institutional Review Board.

Study Sample

Sociodemographic characteristics were self-reported by parent and child. In this sample, child sex is balanced between boys (53%) and girls (47%). Parents identified 77% of children as being white and 23% as being from diverse backgrounds (i.e., including those identifying their child with one or more of the following racial/ethnic categories: American Indian or Alaskan Native, Asian, Black or African American, Native Hawaiian or Pacific Islander, Other). Eighty-three percent of parents identified themselves as white and 17% identified themselves as diverse. Parents were highly educated with 78% having an associate's degree or higher and were 96% women (primary meal-preparing parents are most often women; 54, 55). Nearly half (42%) of parents reported full-time employment (i.e., ≥35 hours per week), 21% reported part-time employment (i.e., 1-34 hours per week), and 37% reported no outside employment. Thirty-four percent of families reported receiving economic assistance (e.g., free- and reduced-priced lunches at school or other forms of public assistance).

Measures

Following informed parental consent and child assent, trained study staff collected survey and anthropometric data. The measures used in the present study are briefly outlined below. More specific examples are detailed in Table 5.1, which includes psychometric properties of the measures.

Purchasing Influences. Exploratory factor analysis was used to operationalize the purchasing influence constructs (i.e., cooking ability, concern for nutrition, family food preferences, social pressures, store access, and time; Horning dissertation

Manuscript 2, Chapter 4). Measures include *summative scales* (i.e., with scale alphas at or above 0.65, given the exploratory nature of this work), *summative indices* (i.e., the sum of items that are not intercorrelated but explain common variance of a theoretically meaningful construct), and *composite items* (i.e., two correlated items explaining common variance, summed and averaged).

Cooking ability was operationalized with three measures: *Parent report of child's cooking skills, Child report of cooking skills*, and *Parent and child extra healthful cooking effort.* ***Concern for nutrition*** was also operationalized with three measures including *Children's nutrition label use frequency, Extra parent effort to select healthful foods*, and *Children as healthful purchasers*. ***Cost*** was measured with *Cost matters* and *Children think food is expensive*. The construct, ***family food preferences,*** was measured with *Buying foods we like*. ***Social pressure*** was operationalized with three measures, *Parent report of child's grocery shopping assistance, Child report of grocery shopping assistance,* and *TV advertisements: Child requests and parent purchase*. ***Store access*** was measured with 3 measures, *Store selection and quality, Access to home or locally grown produce*, and *Store accessibility*. ***Time*** was operationalized with four measures including: *Foods need to be quick and easy, Planning meals in advance, Meal preparation time saving strategies,* and *Scheduling difficulties around mealtimes*. All purchasing influence measures (see Table 1) were scored such that higher scores indicate higher underlying traits (e.g., higher cooking skill, higher effort, etc.)

Outcome measures. Table 5.1 also lists psychometric properties for all outcome measures. Each is briefly outlined below.

Home food environment outcomes were collected with the validated Home Food Inventory (HFI; 56). The HFI was used to count the different types of foods available in the home; outcomes in the present study are the number of fruits, vegetables, and obesogenic foods available in the home. Obesogenic foods are those that may contribute to obesity (e.g., frozen or prepared desserts, savory snacks, added fats, and sugar-sweetened beverages).

Child's dietary intake outcomes were collected using an average of three, 24-hour dietary recall interviews (2 weekdays and 1 weekend day). Recall interviews were completed with child participants by research staff, trained and certified in Nutrition Data System for Research software (versions 2011 and 2012 were used for data collection; final calculations were completed with the 2012 version); recalls are considered a gold standard measure of dietary intake (57). For this study, children's dietary intake outcomes are average daily servings of fruits and vegetables and total dietary quality, the latter of which was calculated with the recall data using the validated Healthy Eating Index (higher scores indicate higher dietary quality; 58, 59).

Parent and child weight. Using standardized protocols and procedures (60), trained staff measured parents' and children's height (cm) and weight (kg). These data were used to calculate parent body mass index (BMI) and child age- and gender-adjusted BMI z-scores using CDC Guidelines and Growth Chart LMS Parameters (61).

Table 5.1 Purchasing influence and outcome measures used in the present study

Content	• Measures - Example item	Mean	SD	No. of items in measure	Range	Psychometrics
PURCHASING INFLUENCES						
Cooking Ability	• Parent report of child's cooking skills - In the past month, my child has prepped fruits/veggies	0	3.92	7	-9.6-7.7	$\alpha = 0.67$
	• Child report of cooking skills - In the past month, I have prepared fruits and vegetables	11.2	2.84	4	3-16	$\alpha = 0.64$
	• Parent and child extra healthful cooking effort - In the past month, I have reduced, substituted, or omitted ingredients in a recipe to make it healthier	0	2.61	4	-6.2-5.0	Summative index
Concern for Nutrition	• Children's nutrition label use frequency - How often do you look at food labels to find out if a food is healthy	7.38	2.57	3	3-12	$\alpha = 0.78$
	• Extra parent effort to select healthful foods - How healthy foods are is very important to me when buying foods	0	3.22	5	-10.9-3.9	$\alpha = 0.67$
	• Children as healthful purchasers - If given money, I would buy fruits or vegetables	2.17	0.99	3	0-3	Summative index

Content	• Measures - Example item	Mean	SD	No. of items in measure	Range	Psychometrics
Cost	• Cost matters - My family uses coupons when going to the grocery store to save money	0	2.99	4	-7.4-3	α = 0.74
	• Children think food is expensive - My parent says fruits and vegetables cost too much to buy a lot of them	1.98	1.24	3	0-5	Summative index
Food Preferences	• Buying foods we like - As a parent does the following influence what foods you buy: My child requests it	3.15	1.16	4	0-4	α = 0.70
Social Pressure	• Parent report of child's grocery shopping assistance - How often does your child come along to the store when I shop for food	8.13	1.92	3	3-12	α = 0.67
	• Child report of grocery shopping assistance - I help decide what foods and drinks my family buys by letting my parent know what I like	0	2.29	3	-5.2-3.7	α = 0.64
	• TV advertisements: child requests and parent purchase - How often do you ask your parents to buy foods that you saw on TV commercials	1.78	0.72	2	1-3.5	Composite item; $r = 0.56$, $p < 0.0001$

Content	• Measures - Example item	Mean	SD	No. of items in measure	Range	Psychometrics
Store Access	• Store selection and quality - Why do you do most of your shopping at the store you frequent most: It has the best quality of foods	0.29	0.39	2	0-1	Composite item; $r = 0.48$, $p < 0.0001$
	• Access to home or locally grown produce - My family grows some of the vegetables or fruits that we eat	0.93	0.53	2	0-2	Composite item; $r = 0.28$, $p = 0.009$
	• Store accessibility - Why do you do most of your shopping at the store you frequent most: It is on my way home from work	1.54	1.11	4	0-4	Summative index
Time	• Foods need to be quick and easy - How easy and quick a food is to prepare is very important to me when buying foods.	0	2.85	4	-5.3-5.9	$\alpha = 0.69$
	• Planning meals in advance - I usually know or plan in advance what we will eat for dinner that night.	2.49	0.76	2	1-4	Composite item; $r = 0.62$, $p < 0.0001$
	• Meal preparation time saving strategies - We cook enough on some days/nights so that there will be leftovers for another meal.	7.07	1.61	3	3-12	Summative index

Content	• Measures - Example item	Mean	SD	No. of items in measure	Range	Psychometrics
	• Scheduling difficulties around mealtimes - Fast food and convenience store foods/snacks seem like my only choice when my family is on the go and time is limited by our busy schedules.	0	0.84	2	-1 - 1.92	Composite item; r = 0.44, p < 0.0001
OUTCOME MEASURES						
Home Environment Outcomes	• Fruit Availability - Please check whether each fruit present is fresh, canned, frozen, or dried (mark all that apply).	10.0	4.7	26	0-26	Kappa = 0.83* Sensitivity = 0.87* Specificity = 0.95* r_s=0.37 (with fruit servings)*
	• Vegetable Availability - Please mark whether each vegetable present is fresh, canned or frozen (mark all that apply).	10.3	3.6	20	0-20	Kappa = 0.80* Sensitivity = 0.89* Specificity = 0.90* r_s =0.34 (with veg servings)*
	• Obesogenic Food Availability - Check "yes" to a product/item/category if it is present anywhere in your home/where you live (opened or unopened) as you are completing this form. Check "no" to a product/item/category if it is not present anywhere in your home/where you live as you are completing this form.	26.9	8.7	77	0-77	Kappa = 0.79* Sensitivity = 0.83* Specificity = 0.91* r_s =0.16 (with kcal food)*
Child Dietary Outcomes	• Average daily servings of fruits and vegetables • Total dietary quality	2.5 53.4	1.6 11.4		0-7.5 29.4-82.2	

Content	• Measures - Example item	Mean	SD	No. of items in measure	Range	Psychometrics
Weight Outcomes	• Child age and gender adjusted BMI-z score	0.94	0.75		-0.22-2.57	
	• Parent BMI	28.20	7.36		18.92-50.34	

Notes. Measures with means of zero and ranges that span both negative and positive values indicate that the items responses of those measures were standardized (as item response options differed, e.g., from 4-point to 5-point) and then summed. *as reported in (56).

Missing data

Data for the home food environment outcome variables of fruit, vegetable, and obesogenic food availability were respectively missing from 8.9%, 6.7%, and 6.7% of participants. Participants with missing data were significantly more likely to be (a) receiving economic assistance than those not receiving economic assistance, (b) be parents from diverse backgrounds than parents who identified as white, and (c) have lower levels of education (i.e., some high school, high school diploma or some college) than those with higher education levels (i.e., an associate's degree or higher). All other variables were missing less than 5% of data. Each statistical model used all available data (i.e., listwise deletion; for example, if a family was missing the home fruit environment variable but was not missing any other data, the family would be excluded from statistical models containing fruit availability but the family would be included in all other models).

Analysis Plan

There were four steps in the research analysis plan. First, to examine relationships between food-purchasing influence measures and outcomes, bivariate associations between each food-purchasing influence measure and outcome were estimated using Pearson correlations or general linear models with categorical predictors, as appropriate by each variable's level of measurement and distribution. Two purchasing influence measures were skewed, *Cost matters* and *Buying foods we like*. Both were analyzed as square-root transformed and non-transformed variables; no differences in results were noted, so non-transformed measures were used for all subsequent analyses.

Second, general linear models were used to assess relationships between each food purchasing influence measure and each outcome, while controlling for potentially confounding sociodemographic characteristics (i.e., parent education, race, and hours worked outside of the home, child sex and age, and family economic assistance use). Only food purchasing influence measures significantly associated with at least two outcomes were retained for the hierarchical blocked regression models (steps 3 and 4 below).

Third, hierarchical blocked regression models were used to assess the strength of the retained purchasing influence measures in explaining outcome variability, while continuing to account sociodemographic characteristics. Particularly useful in studies with small samples, hierarchical blocked models allowed measures to be grouped together in a block and entered into the model as one set (62). This process increased power in estimating variance explained in the outcomes by each block of variables (R^2 and R^2 change). Because measures can be and were entered together as a block into the regression model, measures within each block may be correlated (62); therefore, measures (retained during step two of the analysis) were grouped into blocks based on their underlying theoretical construct. Within each block, the total number of significant associations between the retained measures and outcomes was summed; blocks were then ordered from highest to lowest number of significant associations with outcomes and entered into models in that order.

Specifically, each home food environment, dietary intake, and weight outcome was regressed on Block 1 (sociodemographic characteristics) and four blocks of food

purchasing influence constructs: Block A (Time measures); Block B (Ability measures); Block C (Store Access measures); and Block D (Concern for Nutrition measures; see Column 1 of Tables 5.4 and 5.5). This analysis highlighted the amount of variance explained in each outcome by each block of purchasing influences that was above what was explained by the sociodemographic characteristics. This process allowed for assessment of the robustness of each block of purchasing influence measures.

Fourth, final hierarchical blocked regression models for dietary and weight outcomes were conducted. These final models contained an extra block of variables, Block 2. Block 2 contained home food environment variables (i.e., home fruit, vegetable, and obesogenic food availability) shown in previous research to associate with dietary intake and weight status. Block 2 was entered into models after Block 1, but before Blocks A-D (See Column 1 on Table 5.6) in order to allow results to indicate the explained variance in dietary and weight outcomes by the purchasing influence blocks that is above and beyond what is explained by sociodemographic characteristics and the home food environment.

The first two steps of analysis were conducted with SAS software version 9.3 (SAS Inc., Cary, NC USA) and steps three and four were conducted with IBM SPSS Statistics for Windows, Version 22.0 released 2013 (IBM Corp. Armonk, NY). The alpha level (p-value) was set to 0.05; no adjustments were performed for multiple comparisons due to the exploratory nature of the study and results will be interpreted cautiously.

Results

Unadjusted Bivariate and Adjusted Multivariate Results

Bivariate and multivariate results are organized below by food purchasing influence construct; unadjusted results are presented in Table 5.2, and results adjusted for sociodemographic characteristics are presented in Table 5.3. Patterns of statistically significant findings are described in text and numerical results are provided on Tables 5.2 and 5.3.

Table 5.2 Pearson correlations between purchasing influence measures and outcomes of interest

	Home Availability of			Servings of Fruits & Veggies	Total Dietary Quality	Child BMIz	Parent BMI
	Fruits	Veg	Obesogenic foods				
COOKING ABILITY							
• Parent report of child's cooking skills	**0.36** **<0.001**	**0.30** **<0.01**	-0.11 0.32	0.20 0.07	0.14 0.19	0.13 0.23	0.05 0.64
• Child report of cooking skills	0.14 0.23	**0.26** **0.02**	-0.11 0.31	0.13 0.22	0.07 0.55	0.15 0.15	0.09 0.38
• Parent and child extra healthful cooking effort	**0.24** **0.03**	**0.25** **0.02**	**-0.44** **<0.001**	**0.25** **0.02**	**0.23** **0.03**	-0.03 0.77	**-0.23** **0.03**
CONCERN FOR NUTRITION							
• Children's nutrition label use frequency	0.13 0.25	**0.29** **0.01**	-0.05 0.65	0.17 0.12	0.15 0.16	0.16 0.14	-0.02 0.86
• Extra parent effort to select healthful foods	**0.39** **<0.001**	**0.32** **<0.01**	**-0.26** **0.02**	**0.37** **<0.001**	**0.31** **<0.01**	-0.12 0.26	**-0.20** **0.05**
• Children as healthful purchasers [a]	2.4% 0.60	**8.9%** **0.01**	2.1% 0.64	2.5% 0.54	**6.2%** **0.04**	0.3% 0.43	3.2% 0.15
COST							
• Cost matters [b]	0.01 0.96	0.10 0.36	0.11 0.30	-0.07 0.49	-0.01 0.91	0.03 0.76	**0.22** **0.04**
• Children think food is expensive	0.00 0.97	0.11 0.31	0.02 0.89	-0.09 0.39	-0.13 0.23	0.09 0.41	0.11 0.28
FAMILY FOOD PREFERNCES							
• Buying foods we like [b]	0.04 0.73	0.08 0.49	0.01 0.92	0.03 0.77	-0.06 0.60	-0.05 0.61	-0.14 0.18

	Home Availability of			Servings of Fruits & Veggies	Total Dietary Quality	Child BMIz	Parent BMI
	Fruits	Veg	Obesogenic foods				
SOCIAL PRESSURE							
• Parent report of child's grocery shopping assistance	-0.09 0.40	-0.08 0.45	**-0.29** **0.01**	0.11 0.29	0.01 0.94	0.19 0.07	0.15 0.15
• Child report of grocery shopping assistance	0.13 0.24	0.07 0.54	-0.07 0.54	0.17 0.12	0.16 0.14	0.14 0.19	-0.03 0.76
• TV advertisements: child requests and parent purchase	**-0.27** **0.02**	-0.14 0.19	**0.25** **0.02**	-0.11 0.28	**-0.20** **0.05**	0.11 0.29	0.10 0.36
STORE ACCESS							
• Store selection and quality [a]	4.8% 0.15	4.0% 0.19	1.2% 0.62	**13.0%** **<0.01**	**13.0%** **<0.01**	1.1% 0.62	3.6% 0.21
• Access to home or locally grown produce	**0.31** **<0.01**	**0.53** **<0.001**	**-0.28** **0.01**	**0.22** **0.04**	**0.27** **0.01**	0.01 0.94	-0.07 0.50
• Store Accessibility	-0.16 0.14	-0.17 0.11	0.05 0.64	0.02 0.86	0.06 0.55	0.00 0.98	0.00 0.97
TIME							
• Foods need to be quick and easy	**-0.27** **0.01**	**-0.26** **0.02**	0.16 0.15	**-0.27** **0.01**	**-0.28** **0.01**	0.17 0.12	0.13 0.23
• Planning meals in advance	0.17 0.14	0.11 0.30	-0.12 0.27	**0.27** **0.01**	**0.24** **0.02**	-0.18 0.08	-0.10 0.35
• Meal preparation time saving strategies	**0.30** **0.01**	**0.29** **0.01**	0.06 0.59	0.11 0.32	0.11 0.29	0.06 0.59	0.06 0.58
• Scheduling difficulties around mealtimes	**-0.36** **0.001**	**-0.33** **<0.01**	0.20 0.07	**-0.35** **<0.001**	**-0.36** **<0.001**	**0.21** **0.05**	**0.20** **0.05**

Notes. Each cell reports Pearson correlation in the first line and p value in the second line unless otherwise indicated. [a]Variable was categorical and a general linear model was used to analyze associations between the categorical predictor and outcome variables results are reported as r^2 and p values. [b]Variable is skewed; minimal differences were found when using a square root transformation, thus non-transformed results are presented.

Table 5.3 Explained variance and regression coefficients of multivariate analyses (adjusted for sociodemographic characteristics) of each purchasing influence measure regressed on each outcome

		Home availability			Servings of Fruits & Veggies	Total Dietary Quality	Child BMIz	Parent BMI
		Fruit	Vegetables	Obesogenic foods				
Sociodemographics only	r^2	**10.6%**	**14.9%**	**11.5%**	**5.4%**	**11.6%**	**11.5%**	**18.7%**
COOKING ABILITY								
• Parent report of child's cooking skills	r^2	**32.2%**	**30.1%**	12.1%	**11.1%**	13.6%	12.9%	19.0%
	β	**0.62**	**0.40**	-0.20	**0.11**	0.46	0.03	0.12
	SE	**0.13**	**0.10**	0.28	**0.05**	0.34	0.02	0.22
	p	**<0.001**	**<0.001**	0.47	**0.03**	0.18	0.27	0.58
• Child report of cooking skills	r^2	**16.1%**	**32.9%**	11.5%	6.7%	12.3%	13.0%	18.9%
	β	**0.44**	**0.58**	-0.11	0.07	0.42	0.04	0.23
	SE	**0.19**	**0.13**	0.38	0.07	0.47	0.03	0.30
	p	**0.03**	**<0.001**	0.77	0.32	0.38	0.24	0.44
• Parent and child extra healthful cooking effort	r^2	**15.7%**	**20.4%**	**31.0%**	**10.8%**	**17.3%**	11.6%	21.8%
	β	**0.42**	**0.33**	**-1.53**	**0.14**	**1.07**	-0.01	-0.52
	SE	**0.21**	**0.15**	**0.34**	**0.07**	**0.46**	0.03	0.29
	p	**0.04**	**0.03**	**<0.001**	**0.04**	**0.02**	0.80	0.08
CONCERN NUTRITION								
• Children's nutrition label use frequency	r^2	14.0%	**28.6%**	11.5%	7.9%	13.8%	13.4%	18.6%
	β	0.37	**0.53**	0.04	0.10	0.69	0.04	-0.07
	SE	0.21	**0.14**	0.40	0.07	0.49	0.03	0.31
	P	0.07	**<0.001**	0.93	0.16	0.16	0.19	0.83
• Extra parent effort to select healthful foods	r^2	**27.2%**	**23.9%**	**16.5%**	**17.2%**	**19.2%**	12.0%	20.2%
	β	**0.64**	**0.36**	**-0.67**	**0.18**	**1.05**	-0.02	-0.30
	SE	**0.16**	**0.12**	**0.32**	**0.05**	**0.39**	0.03	0.25
	p	**<0.001**	**<0.01**	**0.04**	**<0.01**	**<0.01**	0.52	0.24

		Home availability			Servings of Fruits & Veggies	Total Dietary Quality	Child BMIz	Parent BMI
		Fruit	Vegetables	Obesogenic foods				
Sociodemographics only	r^2	**10.6%**	**14.9%**	**11.5%**	**5.4%**	**11.6%**	**11.5%**	**18.7%**
• Children as healthful purchasers [a]	r^2	13.5%	**26.7%**	14.4%	9.8%	17.2%	12.7%	20.2
•Category 0	β0(SE)	-1.32(1.85)	**-1.82(1.24)**	1.08(3.29)	-0.49(0.61)	-2.60(4.17)	-0.83(0.29)	1.61(2.67)
•Category 1	β1(SE)	-1.51(1.73)	**-1.58(1.21)**	-4.05(3.21)	0.21(0.59)	-5.91(4.07)	0.03(0.28)	-0.49(2.60)
•Category 2	β2(SE)	-1.84(1.73)	**-2.90(0.89)**	1.07(2.37)	-0.76(0.42)	-5.91(2.87)	-0.18(0.20)	2.01(1.83)
•Category 3 (ref)	β3(ref)	0	**0**	0	0	0	0	0
	p	0.51	**0.02**	0.48	0.33	0.18	0.81	0.64
COST								
• Cost matters [b]	r^2	10.9%	16.6%	11.9%	6.8%	12.3%	9.8%	18.7%
	β	0.08	0.15	0.21	-0.06	-0.22	0.01	0.36
	SE	0.18	0.13	0.34	0.06	0.43	0.03	0.26
	p	0.65	0.26	0.54	0.32	0.60	0.78	0.18
• Children think food is expensive	r^2	10.6%	14.9%	11.5%	6.2%	12.3%	11.5%	18.8%
	β	-0.07	0.01	-0.12	-0.11	-0.83	0	0.22
	SE	0.46	0.33	0.83	0.15	1.05	0.07	0.66
	p	0.88	0.98	0.88	0.45	0.43	0.99	0.74
FAMILY FOOD PREFERENCES								
• Buying foods we like	r^2	10.6%	14.9%	12.4%	5.8%	12.0%	9.8%	16.7%
	β	-0.05	0.02	-0.85	0.06	-0.08	-0.02	-0.10
	SE	0.52	0.38	0.96	0.17	1.17	0.08	0.73
	p	0.93	0.96	0.38	0.73	0.94	0.75	0.90
SOCIAL PRESSURE								
• Parent report of child's grocery shopping assistance	r^2	10.6%	14.9%	**18.5%**	7.3%	12.6%	12.3%	19.3%
	β	0.03	0.03	**-1.34**	0.12	0.65	0.04	0.33
	SE	0.30	0.22	**0.54**	0.10	0.69	0.05	0.43
	p	0.93	0.91	**0.01**	0.23	0.35	0.40	0.44

		Home availability			Servings of Fruits & Veggies	Total Dietary Quality	Child BMIz	Parent BMI
		Fruit	Vegetables	Obesogenic foods				
Sociodemographics only	r^2	**10.6%**	**14.9%**	**11.5%**	**5.4%**	**11.6%**	**11.5%**	**18.7%**
• Child report of grocery shopping assistance	r^2	15.0%	18.6%	11.5%	6.9%	**16.1%**	13.0%	18.9%
	β	0.47	0.33	-0.04	0.09	**1.17**	0.05	-0.14
	SE	0.24	0.18	0.47	0.08	**0.58**	0.04	0.37
	p	0.06	0.07	0.93	0.28	**0.05**	0.25	0.70
• TV advertisements: child requests and parent purchase	r^2	14.3%	16.5%	**19.6%**	6.2%	13.9%	11.5%	18.8%
	β	-1.37	-0.69	**3.85**	-0.21	-2.66	0.00	-0.39
	SE	0.79	0.58	**1.42**	0.27	1.85	0.13	1.17
	p	0.09	0.24	**<0.01**	0.44	0.15	1.00	0.74
STORE ACCESS								
• Store selection and quality [a]	r^2	**17.1%**	**19.7%**	12.2%	**14.1%**	**21.3%**	12.2%	19.4%
•Category 1	β1(SE)	**3.04(1.50)**	**2.22(1.12)**	-2.17(2.90)	**1.34(0.49)**	**8.74(3.39)**	0.23(0.24)	3.41(2.19)
•Category 0.5	β0.5(SE)	**2.20(1.33)**	**1.07(0.99)**	-0.18(2.58)	**0.33(0.44)**	**6.44(3.06)**	-0.17(0.22)	-0.22(1.98)
•Category 0 (ref)	β0(ref)	**0**	**0**	0	**0**	**0**	0	0
	p	**0.05**	**0.05**	0.75	**<0.01**	**0.01**	0.35	0.29
• Access to home or locally grown produce	r^2	**16.6%**	**34.3%**	**23.9%**	**11.2%**	**20.1%**	6.4%	17.4%
	β	**2.16**	**3.01**	**-5.97**	**0.74**	**6.57**	-0.01	-1.21
	SE	**0.97**	**0.65**	**1.74**	**0.34**	**2.29**	0.16	1.49
	p	**0.03**	**<0.001**	**0.001**	**0.03**	**<0.01**	0.94	0.42
• Store accessibility	r^2	12.1%	16.4%	12.3%	5.7%	12.7%	9.8%	16.7%
	β	-0.54	-0.42	0.78	-0.03	0.90	0.02	-0.06
	SE	0.49	0.36	0.93	0.17	1.17	0.08	0.73
	p	0.28	0.25	0.40	0.86	0.44	0.84	0.93

		Home availability			Servings of Fruits & Veggies	Total Dietary Quality	Child BMIz	Parent BMI
		Fruit	Vegetables	Obesogenic foods				
Sociodemographics only	r^2	**10.6%**	**14.9%**	**11.5%**	**5.4%**	**11.6%**	**11.5%**	**18.7%**
• Foods need to be quick and easy								
	r^2	**18.7%**	**21.1%**	14.8%	**13.0%**	**17.9%**	14.2%	20.3%
	β	**-0.48**	**-0.32**	0.58	**-0.16**	**-1.05**	0.05	0.35
	SE	**0.18**	**0.13**	0.35	**0.06**	**0.43**	0.03	0.27
	p	**0.01**	**0.02**	0.10	**0.01**	**0.02**	0.13	0.21
• Planning meals in advance	r^2	13.5%	16.1%	12.6%	**12.7%**	**16.3%**	13.4%	19.0%
	β	1.05	0.54	-1.29	**0.58**	**3.36**	-0.14	-0.58
	SE	0.69	0.52	1.31	**0.23**	**1.62**	0.11	1.04
	p	0.13	0.30	0.33	**0.01**	**0.04**	0.21	0.58
• Meal preparation time saving strategies	r^2	**17.2%**	**19.8%**	**11.5%**	7.6%	12.2%	7.9%	19.3%
	β	**0.76**	**0.5**	**0.11**	0.15	-0.58	0.04	0.38
	SE	**0.32**	**0.24**	**0.63**	0.11	0.78	0.05	0.49
	p	**0.0213**	**0.04**	**0.04**	0.18	0.46	0.48	0.43
• Scheduling difficulties around mealtimes	r^2	**29.4%**	**31.9%**	14.0%	**14.6%**	**16.3%**	12.2%	19.0%
	β	**-2.74**	**-1.98**	1.89	**-0.65**	**-3.34**	0.08	0.56
	SE	**0.64**	**0.47**	1.3	**0.23**	**1.60**	0.11	1.03
	p	**<0.001**	**<0.001**	0.15	**<0.01**	**0.04**	0.46	0.59

Notes. All models were controlled for the following sociodemographic characteristics: parent education level, race, and hours worked outside of the home, child sex and age, and family economic assistance use.

[a]Variable was categorical and treated as such in the general linear model; the beta value (SE) was provided for each of the variable categories

[b]Variable is skewed; however, no differences in results were found when using a square root transformation; therefore, non-transformed results are presented.

Home food environment outcomes. As shown in Table 5.2, in bivariate analyses, eight purchasing influence measures significantly related to fruit availability, ten measures significantly related to vegetable availability, and only five measures significantly related to obesogenic food availability. In multivariate models (see Table 5.3), most relationships found in bivariate analyses held and a few additional relationships were found; a total of nine, eleven and six purchasing influence measures were respectively and significantly related to fruit, vegetable and obesogenic food availability. In both bivariate and multivariate analyses, the purchasing influence measures significantly associated with the fruit and vegetable availability outcomes were from the cooking ability, concern for nutrition, store access and time constructs. The purchasing influence measures that were significantly associated with obesogenic food availability were from the cooking ability, concern for nutrition, social pressure, and store access constructs. No measures within the blocks of cost or family food preferences were significantly related to any home food environment outcome.

Dietary outcomes. Significant bivariate associations were found between seven purchasing influence measures and children's average daily servings of fruits and vegetables; nine measures were significantly associated with children's total dietary quality. Multivariate analyses again showed most bivariate relationships remained significant when adjusting for sociodemographic characteristics and a few additional significant relationships were found; a total of eight purchasing influence measures were significantly associated with children's average daily servings of fruits and vegetables and eight measures were significantly associated with children's total dietary quality.

Purchasing influence measures from the cooking ability, concern for nutrition, store access and time constructs were significantly associated with both dietary outcomes in bivariate and multivariate analyses, whereas measures from the social pressure construct were only significantly related to children's total dietary quality. Again, no measures within the blocks of cost or family food preferences were significantly related to either outcome.

Weight outcomes. In bivariate analyses, four purchasing influence measures were significantly associated with parent BMI and no measures were significantly related to child BMIz. No significant relationships remained in multivariate analyses.

Measures retained for hierarchical models. The measures retained for hierarchical blocked models (i.e., those with at least two significant associations with outcomes in adjusted multivariate models) were grouped into blocks based on the underlying purchasing influence construct. Block order was set by the number of total outcomes significantly associated with the retained measures. The time construct had 4 retained measures with 13 significant associations with outcomes. Three measures from the cooking ability construct were retained with 10 significant associations with outcomes. Store access had two measures retained with 9 significant associations with outcomes. Finally, only one measure from the concern for nutrition construct was retained, with 5 significant associations with outcomes. No measures from the cost, family food preferences, or social pressure constructs were retained for hierarchical models.

Hierarchical Blocked Models

Home food environment outcomes. In hierarchical blocked models, Block A (Time measures) significantly explained additional variance beyond that provided by Block 1 (Sociodemographic Characteristics) in both fruit and vegetable availability (See Table 5.4). Specifically, one measure within Block A, *Scheduling difficulties around mealtimes*, was significantly and inversely associated with both of these home availability outcomes.

Block B (Cooking ability measures) explained significant additional variance for all three home food availability outcomes. In Block B, the measure, *Parent report of child's cooking skills*, was significantly and positively associated with both fruit and vegetable availability, but *Child report of cooking skills* was only significantly and positively associated with vegetable availability; *Parent and child extra healthful cooking effort* was significantly and inversely associated with obesogenic food availability.

Block C (Access measures) also contributed significant additional explained variance of vegetable availability, with the measure of *Access to home or locally grown produce* significantly and positively associated with this outcome.

Finally, Block D (Concern for nutrition measures) only explained significant additional variance in fruit availability, with the measure *Extra parent effort to select healthful foods* being significantly and positively associated with the outcome.

Overall in the blocked models, compared to the explained variance in home availability of obesogenic foods (r^2=0.39), the variance explained in home availability of fruits and vegetables was higher (r^2=0.55 and 0.60, respectively).

Table 5.4 Standardized regression coefficients and variance explained in home food environment outcomes by purchasing influence blocks from hierarchical blocked regression models

	Home Availability of											
	Fruits				Vegetables				Obesogenic foods			
Adjusted for:	Δr^2	β	**SE**	**p**	Δr^2	β	**SE**	**p**	Δr^2	β	**SE**	**p**
Block 1: Sociodemographics	0.10			0.39	0.15			0.12	0.11			0.26
Block A: Time	**0.25**			**<0.001**	**0.22**			**<0.001**	0.05			0.42
• Foods need to be quick and easy		-0.22	-1.91	0.06		-0.17	-1.59	0.12		-0.02	-0.14	0.89
• Meal preparation time saving strategies		0.03	0.30	0.77		-0.01	-0.12	0.91		0.11	0.91	0.37
• Scheduling difficulties around mealtimes		**-0.30**	**-2.60**	**0.01**		**-0.23**	**-2.16**	**0.04**		0.02	0.15	0.88
• Planning meals in advance		-0.07	-0.58	0.56		-0.14	-1.29	0.20		0.01	0.05	0.96
Block B: Ability	**0.13**			**<0.01**	**0.17**			**<0.001**	**0.15**			**0.01**
• Parent report of child's cooking skills		**0.39**	**3.46**	**<0.01**		**0.25**	**2.43**	**0.02**		0.06	0.48	0.64
• Child report of cooking skills		0.09	0.88	0.38		**0.29**	**2.99**	**<0.01**		0.05	0.41	0.69
• Parent and child extra healthful cooking effort		-0.09	-0.74	0.46		-0.04	-0.37	0.71		**-0.40**	**-3.13**	**<0.01**
Block C: Store Access	0.01			0.78	**0.06**			**0.04**	0.08			0.06
• Access to home or locally grown produce		-0.09	-0.75	0.46		**0.26**	**2.47**	**0.02**		**-0.31**	**-2.38**	**0.02**
• Store Selection and Quality [a]												
•Category 1		0.02	0.15	0.88		0.05	0.46	0.65		-0.03	-0.20	0.84
•Category 0.5		0.05	0.51	0.61		-0.01	-0.14	0.89		0.11	0.96	0.34
•Category 0 (ref)												
Block D: Nutrition Concern	**0.06**			**0.01**	0.01			0.38	0.00			0.88
• Extra parent effort to select healthful foods		**0.32**	**2.70**	**<0.01**		0.10	0.88	0.38		-0.02	-0.16	0.88
TOTAL VARIANCE	0.55				0.60				0.39			

Notes. Sociodemographic characteristics used in Block 1 include: parent education level, race, and hours worked outside of the home, child sex and age, and family economic assistance use. Δr^2 =Change in r^2 from the addition of that block into the model; associated significance tests indicate whether the change is significant. Beta values are standardized and are only provided for the full hierarchical model with all the blocks.

[a]Variable was categorical and treated as such in the general linear model; beta values are provided were for each category.

Dietary Intake and Weight Outcomes (without adjustment for home food environment variables). Block A (Time measures) explained significant additional variance in children's dietary intake of fruit and vegetables, although within this block, no individual measures were significantly related to dietary intake of fruits and vegetables (See Table 5.5).

Block C (Store Access measures) contributed significant additional explained variance in total dietary quality, but again no individual measures within this block were significantly associated with dietary quality.

No other blocks significantly contributed to explaining variability in dietary or weight outcomes. Overall variance explained in the final models for dietary intake of fruits and vegetable servings, total dietary quality, child BMIz and parent BMI was 0.32, 0.35, 0.21 and 0.27, respectively.

Dietary Intake and Weight Outcomes (with adjustment for home food environment variables). As shown in Table 5.6, Block 2 (Home food environment variables) contributed to significant additional explained variance in two outcomes: children's dietary intake of fruits and vegetables and total dietary quality. However, no individual measures were significant. Additionally, home food environment measures did not contribute to significant additional explained variance in child or parent weight outcomes.

Only one purchasing influence block, Block C (Store Access), contributed to significant, additional explained variance in children's total dietary quality, with the

measure, *Store selection and quality*, significantly and positively associated with children's total dietary quality.

No other blocks of purchasing influence measures contributed to significant additional explained variance of the dietary or weight outcomes. Overall variance explained by the blocked models for dietary intake of fruits and vegetables was 0.42, total dietary quality was 0.40, child BMIz was 0.27, and parent BMI was 0.43.

Table 5.5 Standardized regression coefficients and variance explained in dietary and weight outcomes by purchasing influence blocks from hierarchical blocked regression models

	Fruit and Vegetable Servings				Total Dietary Quality				Child BMIz				Parent BMI			
Adjusted for:	Δr^2	β	**SE**	**p**	Δr^2	β	**SE**	**p**	Δr^2	β	**SE**	**p**	Δr^2	β	**SE**	**p**
Block 1: Sociodemographics	0.06			0.73	0.12			0.20	0.10			0.35	0.16			0.06
Block A: Time	**0.15**			**0.02**	0.11			0.06	0.04			0.50	0.03			0.59
• Foods need to be quick and easy		-0.15	-1.18	0.24		-0.16	-1.29	0.20		0.17	1.24	0.22		0.10	0.76	0.45
• Meal preparation time saving strategies		-0.07	-0.59	0.56		-0.08	-0.65	0.52		0.11	0.87	0.39		0.15	1.23	0.22
• Scheduling difficulties around mealtimes		-0.12	-0.92	0.36		-0.05	-0.34	0.74		0.10	0.67	0.51		-0.04	-0.26	0.79
• Planning meals in advance		0.15	1.18	0.24		0.06	0.50	0.62		-0.02	-0.11	0.92		0.00	-0.01	0.99
Block B: Ability	0.03			0.40	0.02			0.64	0.03			0.55	0.04			0.38
• Parent report of child's cooking skills		0.16	1.29	0.20		0.02	0.17	0.87		0.09	0.71	0.48		0.07	0.57	0.57
• Child report of cooking skills		0.05	0.42	0.68		0.03	0.28	0.78		0.20	1.53	0.13		0.09	0.67	0.51
• Parent and child extra healthful cooking effort		0.01	0.11	0.91		0.05	0.38	0.70		0.12	0.82	0.41		-0.16	-1.20	0.23
Block C: Store Access	0.06			0.13	**0.09**			**0.04**	0.03			0.55	0.04			0.39
• Access to home or locally grown produce		-0.01	-0.09	0.93		0.14	1.11	0.27		-0.05	-0.37	0.71		-0.06	-0.44	0.66
• Store Selection and Quality [a]																
•Category 1		0.21	1.68	0.10		0.20	1.59	0.12		0.20	1.46	0.15		-0.17	-1.27	0.21
•Category 0.5		0.01	0.06	0.95		0.19	1.69	0.10		-0.08	-0.62	0.54		0.00	-0.01	0.99
•Category 0 (ref)																
Block D: Nutrition Concern	0.02			0.15	0.01			0.27	0.02			0.18	0.00			0.68
• Extra parent effort to select healthful foods		0.20	1.48	0.15		0.15	1.10	0.27		-0.20	-1.36	0.18		-0.06	-0.41	0.68
TOTAL VARIANCE	0.32				0.35				0.21				0.27			

Notes. Sociodemographic characteristics in Block 1 included: parent education level, race, and hours worked outside of the home, child sex and age, and family economic assistance use. Δr^2 =Change in r^2 from the addition of that block into the model; associated significance tests indicate whether the change is significant. Beta values are standardized and are only provided for the full hierarchical model with all the blocks. [a]Variable was categorical and treated as such in the general linear model; beta values are provided for each category.

Table 5.6 Standardized regression coefficients and variance explained in dietary and weight outcomes by purchasing influence blocks from hierarchical blocked regression models that include the home food environment

	Fruit and Vegetable Servings				Total Dietary Quality				Child BMIz				Parent BMI			
Adjusted for:	Δr^2	β	**SE**	**p**	Δr^2	β	**SE**	**p**	Δr^2	β	**SE**	**p**	Δr^2	β	**SE**	**p**
Block 1: Sociodemographics	0.13			0.20	0.16			0.08	0.12			0.26	0.22			0.01
Block 2: Home Food Environment	**0.17**			**<0.01**	**0.11**			**0.03**	0.02			0.68	0.05			0.20
• Home fruit availability		0.29	1.75	0.09		0.08	0.48	0.64		-0.05	-0.27	0.79		0.15	0.92	0.36
• Home vegetable availability		-0.26	-1.41	0.17		-0.01	-0.06	0.95		0.13	0.62	0.54		-0.09	-0.52	0.60
• Home obesogenic food availability		-0.13	-0.98	0.33		-0.09	-0.67	0.50		-0.14	-0.93	0.36		**-0.45**	**-3.35**	**<0.01**
Block A: Time	0.04			0.51	0.03			0.63	0.04			0.63	0.03			0.62
• Foods need to be quick and easy		-0.05	-0.40	0.69		-0.11	-0.76	0.45		0.07	0.49	0.63		0.09	0.67	0.50
• Meal preparation time saving strategies		-0.04	-0.30	0.77		-0.06	-0.49	0.63		0.08	0.60	0.55		0.20	1.62	0.11
• Scheduling difficulties around mealtimes		-0.10	-0.68	0.50		-0.04	-0.27	0.79		0.11	0.71	0.48		-0.05	-0.37	0.71
• Meal planning in advance		0.15	1.12	0.27		0.05	0.39	0.70		-0.02	-0.14	0.89		0.05	0.34	0.74
Block B: Ability	0.01			0.90	0.00			0.98	0.03			0.47	0.05			0.20
• Parent report of child's cooking skills		0.06	0.42	0.68		-0.02	-0.11	0.91		0.17	1.08	0.29		0.08	0.55	0.58
• Child report of cooking skills		0.07	0.52	0.61		-0.02	-0.14	0.89		0.23	1.53	0.13		0.14	1.04	0.31
• Parent and child make extra healthful cooking effort		-0.05	-0.34	0.74		0.01	0.05	0.96		0.08	0.49	0.62		-0.23	-1.62	0.11
Block C: Store Access	0.07			0.09	**0.09**			**0.04**	0.05			0.30	0.07			0.08
• Access to home or locally grown produce		0.11	0.70	0.49		0.18	1.12	0.27		-0.22	-1.23	0.22		-0.29	-1.86	0.07
• Store Selection and Quality [a]																
•Category 1		**0.27**	**2.03**	**0.05**		0.21	1.61	0.11		0.14	0.95	0.34		-0.16	-1.22	0.23
•Category 0.5		0.07	0.54	0.59		**0.25**	**2.02**	**0.05**		-0.14	-0.99	0.33		0.00	0.01	0.99
•Category 0 (ref)																
Block D: Nutrition Concern	0.00			0.57	0.00			0.64	0.01			0.39	0.00			0.59
• Extra parent effort to select healthful foods		0.09	0.58	0.57		0.07	0.47	0.64		-0.14	-0.88	0.39		-0.08	-0.54	0.59
TOTAL VARIANCE	0.42				0.40				0.27				0.43			

Notes. Sociodemographic characteristics in Block 1 included: parent education level, race, and hours worked outside of the home, child sex and age, and family economic assistance use. Δr^2 =Change in r^2 from the addition of that block into the model; associated significance tests indicate whether the change is significant. Beta values are standardized and are only provided for the full hierarchical model with all the blocks. [a]Variable was categorical and treated as such in the general linear model; beta values are provided for each category.

Discussion

This research study assessed relationships between 19 food purchasing influence measures and outcomes related to the home food environment, child dietary intake, and child and parent weight status. There were few significant relationships between the purchasing influence measures and weight outcomes, none of which held when accounting for potentially confounding sociodemographic characteristics. However, bivariate and multivariate models indicated many significant relationships between purchasing influence measures and home food environment and dietary outcomes. Therefore, the possibility of intervening on food purchasing influence constructs should be explored to improve the home food environment and dietary intake, which, in turn, may influence weight.

Additionally, results from hierarchical blocked models with home food environment outcomes may help narrow the scope on which interventions could focus. Results from these models suggest more specific targets of the purchasing influence constructs of time, cooking ability, store access, and concern for nutrition, as these constructs significantly explain additional variability in home food environment outcomes. Therefore, it may be important to consider working with families to balance time constraints, which is aligned with previous research on time constraints limiting food purchases and mealtimes (46, 63-66). Additionally, increasing cooking ability and concern for nutrition may also be explored to increase healthful purchasing (e.g., fruits and vegetables may be purchased more often, if parents/children are able and willing to

prep the vegetables and fruits). Another potential strategy to consider is helping families to access healthful foods (e.g., by growing produce at home or in community gardens or accessing locally grown produce through farmer's markets). These notions are also supported by recent literature reviews and research that have found children's and adults' cooking skills (67, 68) and access to farmer's markets/stands (48, 69, 70) are associated with better dietary intake.

Although these potential focus areas may be helpful for conceptualizing an intervention and are consistent with other research literature findings and recommendations, a critical study finding suggests that intervening on only one purchasing construct (e.g., time, cooking ability, concern for nutrition *or* access) may limit the impact of an intervention. Hierarchical models with home environment outcomes suggested that multiple purchasing influence constructs were contributing to the variability of home food environments. Therefore, exploring a multi-pronged intervention using a social-contextual approach that addresses multiple purchasing influences should be considered. Future food purchasing influence research and intervention work should be grounded in the social ecological context, as this context considers how aspects within individuals, families, and communities/systems influence health behaviors (e.g., food purchases). This research recommendation based on study findings is consistent with recommendations for improving healthfulness of food environments and dietary intake and preventing obesity (8, 71).

It is important to note that only two purchasing influence constructs (time and store access) were helpful in explaining variability of dietary outcomes in hierarchical models, and no blocks were helpful in final models, which included the home food environment as a covariate. However, in these final models, the home food environment was linked to dietary outcomes, consistent with previous research (10-17). Therefore, it is plausible purchasing influence measures may be distally related to dietary intake through associations with the home food environment, which should be evaluated with longitudinal research. More specifically, structural equation models would help to tease out specific relationships between purchasing influence measures, and home food environment, dietary and weight outcomes, and ideally, this research would include actual food purchases (e.g., data from grocery store receipts) as well. Informed by the present study findings, this future research would provide significant further direction for development of purchasing influence intervention research that aims to work with families and communities to promote healthful home food environments and dietary and weight-related behaviors.

Strengths and Limitations

The strengths of this study include the use of child and parent data and novel measures grounded in the literature and theory to provide a comprehensive assessment of relationships between children's and parent's food-purchasing influences and home food environment, dietary, and weight outcomes. However, this study is limited given its cross-sectional nature, so temporality of relationships cannot be determined.

Additionally, the sample does not represent all families, as participant families self-selected to enroll in the healthful eating, family meals, HOME Plus study, and families with missing data were significantly more likely to be receiving economic assistance, be from diverse backgrounds, and be less educated.

Other study strengths included selecting hierarchical blocked modeling and only purchasing influence measures that significantly related to two or more outcomes to intentionally increase parsimony and power in explaining changes in variance, given the small sample size. However, power remains limited in assessing significance of the individual purchasing influence measures (as shown in Tables 4-6); beta values for these individual measures may also be influenced by possible collinearity between measures within each block. Additionally, block order for hierarchical blocked models influences results, which is why the blocks were entered into the model based on the overall number of significant associations with outcomes in multivariate models. Purchasing influence measures are yet to be validated in a second sample, and no direct measures of food purchases (e.g., grocery store receipts) were available for the present research. Many significance tests were necessary in the present research and multiple comparisons were not adjusted for due to the exploratory nature of the study. As a result of study limitations, a more highly powered study is warranted, ideally with longitudinal data, structural equation modeling, and a more generalizable sample. Meanwhile, these findings provide important insights for future longitudinal and intervention research

designed to influence the home food environment, and through the home food environment, dietary intake and weight status.

Conclusion

The present study identified a variety of food-purchasing influences significantly related to the availability of fruits, vegetables, and obesogenic foods within the home. Specifically, these relationships demonstrate how purchasing influences, grounded in the social ecological model, should be explored in future work aiming to impact the home food environment. The purchasing influence constructs of time, cooking ability, concern for nutrition, and store access may be particularly salient to consider. Using of a social-contextual approach to focus intervention and future research on multiple food purchasing influences and constructs (rather than just one) may be important to impact home food environments, which could in turn improve dietary intake and weight status.

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Chapter 6: Discussion

This dissertation research closely examined affordability of healthful diets and operationalized a set of social-contextual influences on food purchases of parents and children. These new measures captured the broad purchasing influence constructs described in the literature that fit within the social ecological framework (i.e., cooking ability, concern for nutrition, cost, family food preferences, social pressure, store access and time). The description and analysis of relationships between the newly-operationalized food purchasing influence measures, sociodemographic characteristics, and home food environment, child dietary intake, and child and parent weight outcomes provide direction for future research and practice. Findings will be summarized, synthesized, and discussed below.

The affordability of healthful diets for low-income families receiving Supplemental Nutrition Assistance Program (SNAP) benefits was assessed with a systematic review of Market Basket Survey (MBS) research (Horning & Fulkerson, 2015). MBS research calculates the cost of a diet meeting minimum daily dietary requirements for a family of four, using food prices found in actual grocery stores. Sixteen MBS studies met inclusion criteria; methods and results were analyzed. Methods were inconsistent across MBS research and affordability of diets meeting minimum dietary requirements was called into question. More specifically, healthful diets were unaffordable in 90% of small/medium-sized stores surveyed and in over 50% supermarkets surveyed. In addition to affordability, the MBS research literature pointed

to a new direction needed in research, namely to understand how food purchasing influences intersect with the healthfulness of home food environment, dietary intake, and weight outcomes (Beaulac, Kristjansson, & Cummins, 2009; Fulp, McManus, & Johnson, 2009; Gustafson, Hankins, & Jilcott, 2012; Robert Wood Johnson Foundation Working Group on In-Store Marketing, 2014).

This research direction propelled measurement development for the food purchasing influence constructs. Using items from existing HOME Plus surveys and new items created or adapted from the literature and social ecological framework, nineteen new measures were created with exploratory factor analysis. In general, the new measures were supported with convergent validity tests and varied minimally by sociodemographic characteristics. Minimal variation by sociodemographic characteristics suggests influences on food purchases similarly resonated with those in this study sample, regardless of background. Associations between purchasing influence measures and sociodemographic characteristics should be validated in future research with a more generalizable sample of parents and children; if measures and findings are validated, exploration of future interventions to address purchasing influences may be applicable to all parents and children, regardless of background.

To explore whether intervention on food purchasing influences may be warranted, relationships between food purchasing influence measures and home food environment, child dietary, and child and parent weight outcomes were measured. Many purchasing influence measures (especially within the constructs of cooking ability, concern for

nutrition, store access, and time) associated with home availability of fruits, vegetables and obesogenic foods, as well as, children's dietary intake of fruits and vegetables and total dietary quality. When accounting for sociodemographic characteristics, most relationships between purchasing influence measures and outcomes remained and a few additional relationships emerged. These significant findings indicated that purchasing influences may be in fact important to consider targeting with future intervention.

Results of the hierarchical analyses provided further support for the consideration of future intervention to address purchasing influences. Results indicated that constructs of time, cooking ability, store access, and concern for nutrition were robust in explaining the variability of home food environment outcomes. For example, sociodemographic characteristics explained 10% of the variance of home fruit availability. Time, cooking ability, and concern for nutrition, significantly explained additional variance beyond that of sociodemographic characteristics (i.e., 25%, 15%, and 6%, respectively) for a total of 55% of variance in home fruit availability explained. Similarly, sociodemographic characteristics explained 15% of the variance of vegetable availability. Beyond sociodemographic characteristics, time, cooking ability, and store access each, respectively, contributed significant additional explained variance of 22%, 17% and 6%, for a total of 60% of variance in home vegetable availability explained. As demonstrated by each of these examples, several constructs of purchasing influence measures (i.e., time, cooking ability, store access, concern for nutrition) are helping to explain the variability in home food environment outcomes, which suggests exploring an

intervention to address multiple purchasing influences ought to be considered. For example, interventions on the home food environment may be more efficacious if they would focus on addressing time barriers, cooking ability, concern for nutrition, *and* store access than if the intervention was just focused on one area.

It should be noted that blocks of purchasing influence measures explained minimal significant additional variance in dietary and weight outcomes, with only the time and store access blocks, respectively and significantly, explaining additional variance in dietary intake of fruits and vegetables and total dietary quality. The block of store access continued to meaningfully explain additional variance in the final hierarchical model for total dietary quality. In the final hierarchical models, consistent with previous research, the home food environment block explained significant variability in the dietary outcomes for children. Therefore, it is possible that purchasing influences measures could be distally related to dietary outcomes through the home food environment. Future research should consider investigating longitudinal relationships.

Results from the systematic review on MBS research highlighted how low-income families receiving SNAP benefits may likely encounter difficulties affording healthful diets. In the purchasing influence research conducted in the present study, the two new measures developed within the cost construct (*Cost Matters* and *Children think food is expensive)* were significantly associated with food insecurity or receipt of economic assistance but were not significantly associated with home food environment, dietary or weight outcomes, with the exception of parent BMI, a relationship that did not

hold when adjusting for sociodemographic characteristics. These discrepant findings may be the result of (a) different study designs (i.e., MBS research of food prices from stores vs. cross-sectional analysis using parent- and child-reported data); (b) the cost measures were not measuring what they were intended to measure, in spite of careful attention to quality measurement development; (c) different income levels of interest (i.e., MBS research was targeted for low-income families whereas the participants in sample of the purchasing influence research had incomes that spanned all levels); and/or (d) study participants, regardless of income level, do not outwardly perceive cost as an influencing factor. Although findings may be discrepant, the systematic review findings within this dissertation support that it is critical to be able to afford healthful diets and the purchasing influence research findings suggest purchasing influences for parents and children are complex, with many social-contextual factors influencing their food purchases.

A literature review and dimensions of the social ecological model informed the selection and creation of items that were used to operationalize the measures quantifying the social-contextual food purchasing influences of parents and children in the present study. Given that the items were all parent- or child-reported, evaluating the influence of the dimensions of the ecological model did not prove to be possible, because self-report is in fact impacted by all dimensions (e.g., individual, family/social, and community/structural) of the model. For example, the cost construct was measured by three parent- and child- reported measures; however, a host of structural factors (e.g., store pricing structures and cost of living) were not include in this purchasing influence

research but may have been extremely influential on the parent- and child-reported measures of food costs. As a further example, the four parent- and child-reported measures within the time construct may have also been impacted by family involvement in activities outside of work and school, the social pressures to participate in such extra-curricular activities, family structure and cohesiveness (e.g., two-parent households, one-parent households, number/age of children, extended family involvement), parental hours worked per week outside of the home (e.g., full-time hours, part-time hours, two jobs, contract work, etc.), and time of day at which those hours are worked (e.g., rotating shifts, regular business hours, flexibility in scheduling). Multilevel research using data from individuals, from families, and of structural environments would be helpful to understand how the dimensions of the social ecological framework impact food purchasing influences and ultimately associations with home food environment, dietary, and weight outcomes.

Limitations

Aim 1 Limitations.

Although the literature search for the systematic review attempted to exhaust all possible data sources, grey literature (e.g., commissioned reports, white papers), and studies with non-significant findings remain difficult to locate, and therefore, may be underrepresented in the systematic review. Additionally, all studies, except one (Morris, Neuhauser, & Campbell, 1992), were limited primarily to one geographic location thereby decreasing generalizability of findings. Still the studies, holistically, do represent

geographic locations from across the country, but this does not mean affordability issues are the same in all locations (Horning & Fulkerson, 2015).

Caution was taken to report the differences in quality, methodology and reporting methods of MBS; however, the studies included in this review were of varying quality, used different methodologies, and had different reporting methods, which limit the findings of this review. This review also was not able to consider affordability issues for families who do not qualify or are ineligible for SNAP benefits, like undocumented immigrants or those who are not defined as low-income but struggle to afford healthful foods (e.g., a result of the recent economic downturn). Finally, the systematic review was unable to assess how other national, state, and local food support programs/organizations, like the National School Lunch Program, Women, Infants, and Children (WIC), food shelves, and soup kitchens, help families meet their dietary requirements (Horning & Fulkerson, 2015).

Aim 2-5 Limitations

Sample limitations. Sample generalizability in the purchasing influence research is limited by the recruitment criteria of the larger HOME Plus trial. Recruitment criteria excluded children with severe medical conditions that would prevent full participation in the RCT (e.g., life-threatening dietary allergies), parents and children who did not read, write or speak English, or families planning to move in the next six months. Therefore, the study population and findings do not represent families with these characteristics. For example, families with children with severe life-threatening dietary allergies may have

different influences on food purchases (e.g., related to the allergies) than families who do not have children with severe life-threatening allergies; as a result, findings from the present purchasing influence research should not be generalized to families with children with severe medical conditions, like severe life-threatening allergies, as they were not represented in the study sample.

Recruitment criteria also required the 8-12 year old child participant to have an age- and gender- adjusted BMI at or above the 50th percentile. It is important to note that proportionally more than 50% of children locally and nationally exceed the 50th percentile (Freedman et al., 2005; Harnack et al., 2009; Harrington, Staiano, Broyles, Gupta, & Katzmarzyk, 2013), which means the BMI exclusion criterion does not systematically exclude 50% of children in this age-range. However, the sample and findings do not represent families with children below the 50th BMI percentile, and it is possible that families with children above the 50th BMI percentile have different influences on their food purchases than families than with children below the 50th percentile. Therefore, findings may not be applicable families with children below the 50th BMI percentile.

Additionally, because the trial was held in the Minneapolis Metropolitan area of Minnesota, the sample and findings do not represent families who live in rural areas or necessarily represent families in other metropolitan areas. For example, families who live in rural areas may have different influences on food purchases given the differences

within community structure (e.g., corner stores may not exist or have rules requiring stocking of healthful foods, and access to larger stores may require significant travel).

Self-selection bias further limits generalizability of findings, as families self-selected to enroll in the HOME Plus, healthful eating, family meals, obesity prevention RCT. Families who chose to enroll in the study are inherently different than families who did not enroll for a variety of possible reasons (e.g., more personal interest/priority in healthful eating/family meals, and having more resources, like time/support, to be able to commit to an intervention activity). Therefore, self-selection bias means that findings do not necessarily represent parents and children who were not interested in enrolling in the study.

It is also important to note that while overall missing data were low for variables used in the present dissertation study (i.e., less than 5%), the home food environment outcomes of fruit, vegetable and obesogenic food availability were, respectively, missing for 8.9%, 6.7%, and 6.7% of the sample. Individuals with missing data were significantly more likely to be receiving economic assistance, be from diverse backgrounds, and have less education compared to those who completed the HFI survey. Thus, this missing data also reduces generalizability, as individuals who received economic assistance, who were more diverse, and who had less education were less likely to be included in analyses with home food environment outcomes.

As noted above, given the types of families not represented in the purchasing influence research (e.g., families who do not read, write or speak English; those with

children with severe medical conditions; those with children under the 50th BMI percentile; those with missing data; those not interested in participating in the healthful eating, family meals study), findings should not be extrapolated to apply to these types of families. Future research should test to see if study findings are similar or different in a more generalizable population of parents and their 8-12 year old children.

Study design limitations. The purchasing influence study is a secondary data analysis of cross-sectional data collected at the baseline phase of the HOME Plus RCT; thus, it is not possible to draw causal inferences or understand longitudinal relationships between purchasing influence measures and outcomes. However, the present study does suggest significant cross-sectional associations between food purchasing influences, supporting consideration of further longitudinal study. Also, as a secondary analysis, additional data that may have helped to evaluate social-contextual purchasing influences (e.g., geographical information systems (GIS) data, directly observed data during a shopping trip with families, or data collected immediately following a shopping trip) was not available, nor was data on actual food purchases (e.g., grocery store receipts).

Conceptual limitations. Although a review of the literature and social ecological framework were used to conceptualize purchasing influence items and constructs, measures could not and did not capture all possible food purchasing influences. Influences not included in this study involve shopping enjoyment, ability to shop/compare prices (Putrevu & Ratchford, 1997), perceived value of products, quality of staff and service within the store, in-store layout, reliability of transportation, cultural

traditions (Freedman, Blake, & Liese, 2013), use of shopping lists (Block & Morwitz, 1999; Hersey et al., 2001; Peterson, Dodd, Kim, & Roth, 2010; Putrevu & Ratchford, 1997), portability of food products (Hughner & Maher, 2006); or food products and packaging to prevent waste (Wingert, Zachary, Fox, Gittelsohn, & Surkan, 2014). Although these additional influences may be important to consider for inclusion in future food purchasing influence research, the present research still identifies and operationalizes a host of important social-contextual food purchasing influence measures.

Methodological limitations. The sample in this study is smaller than most samples used in factor analysis; however, Monte Carlo research simulations suggest that samples of 50-100 are sufficient for defining social constructs (Sapnas & Zeller, 2002). Additionally, because the range of Pearson's correlations between binary items is limited, inclusion of binary items in factor analysis has been debated because it can result in bias and attenuated factor loadings, especially when the proportion of participants answering 1 is extreme (i.e., close to 0 or 1; Muthen, 1989; Parry & McArdle, 1991). Overall, binary items can be factored, as long as caution is taken with interpretation (Floyd & Widaman, 1995; Muthen, 1989). Therefore, binary items with extreme probabilities (< 0.11; >0.89) were not included in analysis and results were cautiously interpreted.

Additionally, quality measure development recommendations include testing convergent validity of all new measures and assessing for validity and reliability of the measures in a second sample (DeVellis, 2012). In the present dissertation study, convergent validity was tested when it was possible to do so with existing HOME Plus

data; it was, however, not possible to test all measures for convergent validity (e.g., no measures were collected with HOME Plus that would allow for testing convergent validity of measures in the time construct). New measure confirmation in a second sample was not proposed as a part of this dissertation study; therefore, measures need to be confirmed in a more generalizable sample before widespread use.

The sample in the present research was also not specifically powered to detect statistical significance of analyses. For example, study sample size was not selected to be able to determine a significant change in the ratio of variance (i.e., the F^2 effect size; Cohen, 1983; Cohen 1992) in the outcomes explained by each block of purchasing influence measures within the hierarchical models at 80% power with an alpha set to 0.05; rather, the sample size was determined by the number of participants available in the second cohort of the HOME Plus data set. Not being specifically powered to determine change in variance increases the probability of Type I and II errors (Cohen, 1983). In addition, many significance tests were conducted with the proposed analyses, which means 1 of 20 significant associations found in the present research could be a result of chance. However, statistical adjustments for multiple comparisons were not conducted due to the exploratory nature of the study. Future studies should consider making adjustments (e.g., Bonferroni, Tukey, adjusting the alpha) to account for multiple comparisons and be appropriately powered.

Hierarchical blocked regression models were purposefully selected to increase model power given the small sample size of the purchasing influence dissertation

research. Hierarchical blocked modeling allowed purchasing influence measures to be grouped into blocks; blocks were then entered into the hierarchical blocked regression models (versus all measures individually as would be done in a general linear model, for example). The process of using blocks versus individual measures increased the power to estimate the variance explained in outcomes by each block. Additionally, for parsimony, only purchasing influence measures significantly associated with at least two outcomes were retained for hierarchical analyses. (For example, each of the four time measures was significantly associated with at least two outcomes; therefore, the four, time measures were grouped together in a block; these measures were entered into models together as a block versus individually, which increased power in explaining changes in variance). However, the power to interpret the beta values and significance of each measure (within the blocks) remained constrained by the total number of variables in the hierarchical model and small sample size; therefore, beta values in the present study should be interpreted very cautiously due to limited power.

Because the primary outcome of hierarchical blocked modeling is the change of explained variance by each block, measures within each block are allowed to be related (Cohen, 1983). Allowing for relatedness among measures within each block is critical in the present study, as measures were intentionally created with promax rotation and parent and child measures may be related. However, in hierarchical models, even though measures within a block are allowed to be related, beta values generated still need to be interpreted extremely cautiously because (a) potential collinearity between measures may

influence the beta values and (b) the model is underpowered to assess individual beta values as discussed above.

Additionally, the order in which blocks were entered into the hierarchical blocked models influences results. Therefore, careful attention was paid to the ordering of blocks, as blocks are to be ordered according to the "logic of the research" (Cohen, 1983, p. 120). Therefore, sociodemographic characteristics were entered into models first, as the goal of the study was to assess whether purchasing influence blocks explained variance in outcomes beyond what was explained by sociodemographic characteristics. Also, sociodemographic characteristics are nonmalleable, thus, by adding them into the model first and then additional blocks, it is possible to see what might be able to changed. Then after the block of sociodemographic characteristics, blocks of purchasing influences were ordered and entered into the models based on the number of overall significant associations with outcomes (in the multivariate models), as it was hypothesized that the number of significant associations may indicate the relevance of a construct, and this ordering of blocks is considered acceptable (Cohen, 1983, p. 123). Using causal theory is an alternative way in which to order blocks (Cohen, 1983) but was not applied to the purchasing-influence block order, as there was no possible way to tease out which purchasing influence block was antecedent to another (e.g., do time barriers precede cooking ability or does limited cooking ability influence how time barriers are perceived?).

In final hierarchical models, the block of home food environment variables was added. The home food environment block was entered into the model as the second block (after the block of sociodemographics but before blocks of purchasing influences). This order was also purposefully chosen, as it allowed results to indicate whether the blocks of purchasing influence measures explained variance above and beyond what was already explained by sociodemographic characteristics (block 1) and the home food environment (block 2), which have been associated with dietary and weight outcomes in past research. However, again, if thinking about a causal path, purchasing influences, in theory, should influence home food environments, which would then influence dietary intake and obesity. Therefore, entering the home food environment block into the model before blocks of purchasing influences could be disputed for this reason; however, it is important to note that causality and/or temporality cannot be assessed in the present study given use of only baseline data. Ultimately, a more highly-powered study on food purchasing influences of parents and children is warranted with both longitudinal data (to help understand temporality and causality) and structural equation modeling (to help understand potential collinearity between measures).

Strengths

In spite of these study limitations, this dissertation has many strengths. In particular, the systematic review on the affordability of a healthful diet (Chapter 2: manuscript one) was conducted according to PRISMA guidelines (quality guidelines for conducting and reporting a systematic review; Moher, Liberati, Tetzlaff, Altman, & The

PRISMA Group, 2009) and included a systematic data search and data extraction, an assessment of the quality of each MBS, a thorough review and report of findings, and development of a novel measure to compare affordability findings across studies.

The purchasing influence research for manuscripts two and three (Chapters 4 and 5) was a secondary analysis, which made this study feasible and efficient to create new measures and investigate a new potential avenue for research. Additional strengths of the purchasing influence research include high quality measurement of (a) home food environment outcomes, (b) dietary outcomes derived from dietary-recall data collected by trained study staff for three days (two week days and one weekend day), and (c) anthropometric outcomes directly measured by trained study staff. In addition, the development and testing of innovative survey items was rigorous and included a literature review, use of a theoretical model, expert review and revision, and pilot-testing with cognitive interviews. Exploratory factor analysis was completed with extensive thought and consideration of methodological variation and choice points. As a result of exploratory factor analysis, new important food purchasing influence scales, indices, and composite items were developed. Convergent validity was tested when it was possible to do so. Careful attention was paid to the distributional properties of measures used in the present research and steps were taken to account for these properties (e.g., skewed purchasing influence measures were analyzed as both square-root transformed and non-transformed variables).

The thorough analysis plan allowed for assessment of sociodemographic differences in the new measures. Unadjusted bivariate and adjusted (i.e., for sociodemographic characteristics) multivariate associations between purchasing influence measures and home food environment, dietary, and weight outcomes were analyzed, and as described above, hierarchical models were purposefully selected, as they were particularly useful in this small study sample and when measures within blocks may be related. Findings provide important insights, that even with cautious interpretation, indicate potentially significant avenues to be explored with future research and intervention that could eventually influence home food environments, dietary intake and weight outcomes for youth and their parents.

Implications for Research

The systematic review on the affordability of healthful diets for low-income families in the United States has important future research recommendations. In particular, to improve MBS research quality, more consistent methods and reporting of findings is needed. For example, MBS researchers should report many important aspects of their studies; these are outlined in manuscript one (Chapter 2) and include reporting the sampling method used to select stores for surveying, number of stores sampled, how minimum daily dietary requirements were calculated, and data collection method, to name a few (Horning & Fulkerson, 2015).

In addition, few studies included market baskets with healthier options to meet dietary requirements (e.g., white rice was used to meet a carbohydrate requirement

instead of brown rice). Future MBS researchers need to update the food items in market baskets to reflect the latest dietary guidelines (e.g., “make at least half your grains whole” USDA, 2011). This future research will allow for a better comparison of SNAP benefits and the price of diets meeting dietary requirements for families; such findings could play an important role in shaping future policy on SNAP benefits. Research is also needed to understand how other national, state and local resources (e.g., National School Lunch program, WIC, food shelves) assist low-income families in meeting dietary requirements if/when SNAP benefits are not sufficient. Also, research is needed to assess how affordability differs by region and location (urban vs. rural).

Related to food purchasing influences, the most important next step for research is validating the purchasing influences measures and findings. To do this, measures should be confirmed in a second sample; this ideally would be done with a more highly powered, generalizable sample and include a two-week test-retest to assess reliability of the measures and replication of dissertation study findings; for example, do relationships between the outcomes and blocks of purchasing influence constructs of time, cooking ability, store access, and concern for nutrition hold?

If measures are found to be valid and reliable and similar associations are found with the outcomes, conducting a longitudinal study to look at the temporality of these influences would be warranted. Given measures were created with promax rotation and parent and child measures may be related, this longitudinal work would ideally occur with structure equation modeling to be able to tease out the associations between

purchasing influences and home food environment, dietary and weight outcomes for children and their parents.

The measures also suggest potential areas to explore as targets for intervention. For example, the constructs of time, cooking ability, store access, and concern for nutrition explained significant variability in home food environment outcomes. Therefore, exploring development of an intervention to target these influences, which should include pilot work with parents and children, should be considered; such work may have the potential to impact the home food environment, and through the home food environment, dietary intake, and weight outcomes of parents and children.

Additional research should also consider further exploring the purchasing influence constructs, as these constructs are in fact representing complex social-contextual aspects of life, which are likely impacted by each of the dimensions of the social ecological model. In particular, the measures within the time construct explained a large amount of significant variance in home food environment outcomes; these results indicate time may be an especially important influence, which is consistent with previous research (Bava et al., 2008; Fulkerson et al., 2011; Horning et al., under review; McIntosh et al. 2010; Share our Strengths Cooking Matters, 2012). Time is also likely impacted by hosts of social and structural factors (e.g., as described above including hours and shifts worked, support at home, social pressure for child involvement in activities), which could be explored in future studies. It is also possible that the time construct could also moderate or mediate other purchasing influences (e.g., if one

perceives there is enough time, parents and children may feel they have the time to make extra healthful cooking effort). Given the particularly complex nature of time and the associations found between time measures and the home food environment, further investigation is recommended.

It is also important to consider use of additional measures in future food purchasing influence research. Specifically, further development of new measures to capture purchasing influences not studied in the present research (e.g., store pricing strategies and product placement within stores). Additionally, while one social pressure measure, *TV advertisements: Child request and parent purchase,* attempted to quantify the influence of marketing, additional measures around marketing and advertisements through various forms of media (e.g., TV, computer, games) are also likely important to incorporate into future research. In addition, GIS data may be useful to help capture objective proximity to stores and farmer's markets. However, GIS data does not capture whether families are grocery shopping at stores or markets in close proximity, and therefore, a thorough measurement and assessment of where and why families shop at the locations that they do may enhance future research. Future research should also consider using food receipt data collected over a period of time as another potential outcome.

Implications for Nursing Practice

Regardless of the settings in which nurses work (e.g., communities, schools, clinics, places of worship, or hospitals), nurses inevitably have a multitude of opportunities to work with families to improve healthful eating and weight status, which

is within the scope of nursing practice (Bulechek, Butcher, Dochterman, & Wagner 2013; Doenges, Moorhouse, & Murr, 2013; Moorhead, Johnson, Maas, & Swanson, 2013). When working with families to improve the healthfulness of eating and weight, it is important for nurses to assess a family's ability to afford a healthful diet. Results from the systematic review indicate, specifically for low-income families, affordability may be a significant barrier to purchasing healthful foods. However, many families who are not considered low-income may also struggle with affordability of healthful foods; therefore, in practice, affordability should be considered for all families. If families are unable to afford healthful diets, intervention and education should be adapted and tailored to meet families' needs and these families should also be connected to resources within the community to help them gain access to healthful diets. If nurses fail to address affordability of healthful foods when it is of concern, interventions and education are likely to be ineffective and inappropriate. However, if nurses help families to resolve affordability issues, it may help establish rapport and trust, which means nurses have potentially increased their ability and credibility to work with these families on improving the healthfulness of their food purchases, the foods in their home, and the foods they provide to their families at mealtimes. In conjunction with work at the individual/family level, nurses should also advocate for increased access to and affordability of healthful diets, especially around legislation and policies to maintain or increase funding for SNAP benefits.

In addition to assessing, intervening, and advocating on and for food affordability issues, when working with families on improving the healthfulness of dietary intake, nurses should comprehensively assess what parents and children feel are the influences on their food purchases, home food environments, and eating patterns. This assessment may shed light on important aspects for the nurse and family to work together to address, which may lead to the shared goal of healthier dietary intake (e.g., if cooking ability is identified by a parent and child as a major influencer on the foods that are purchased, the nurse could work with them to address that particular issue or help them find the resources to do so, which in turn, may help the family feel more confident to purchase healthful foods, cook healthful foods, and try and eat healthful foods). Assessing, understanding, and working together with families to identify and address factors which contribute to their dietary intake patterns, including influences on food purchases, may help nurses to tailor interventions to be appropriate, more effective, and families to be engaged in behavior change.

Ultimately, these types of nursing activities are important to improving overall healthfulness of dietary intake and obesity in our youth and their parents. However, it will take multidisciplinary collaboration and teamwork with nurses, dieticians, medical professionals, social workers, public health professionals, community organizations and partners (e.g., grocery stores, farmer's markets, food pantries, hospital systems), policy makers, teachers, and our youth and their parents to improve dietary intake and prevent and reduce the impact of obesity.

Conclusion

As a whole, this dissertation provided an analysis of both the affordability of a healthful diet and social-contextual influences on food purchases for children and their parents. The findings of the systematic review highlight how healthful diets for low-income American families may not be affordable when compared to SNAP benefits, which significantly could impact food purchases made by families. The purchasing influence research identified and operationalized 19 social-contextual influences on the food purchases of parents and their children. Many individual measures and groups of measures, especially those related to the time, cooking ability, concern for nutrition, and store access constructs, were significantly associated with home food environment outcomes, and home food environment outcomes were significantly related to dietary intake.

These findings highlight the need for measure confirmation and validation as well as potential longitudinal work. Longitudinal research would better assess temporality and relationships between food purchasing influences, home food environment, dietary, and weight outcomes in a more highly powered, generalizable sample of parents and their children. Additionally, if validated, the new measures could be used to guide development and measurement of interventions aiming to improve the healthfulness of home food environments through targeting food purchasing influences of children and their parents. Such future intervention work should consider focusing on more than one purchasing influence/construct, as the influences on food purchases of youth and their

parents are complex with multiple purchasing influences related to the healthfulness of home food environments; addressing these influences may lead to healthier home food environments and in turn, to healthier dietary intake and weight outcomes for children and their parents.

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Appendix A. Copyright Permission for Manuscript 1 (Chapter 2)

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My name is Melissa Horning, and I am very excited about getting my article published. I am currently a PhD Candidate in the School of Nursing at the University of Minnesota. I want to inquire about my ability to use this published article in my dissertation, which I will defend in approximately the next year. Post-graduation, my dissertation/thesis would go into a digital conservancy.

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Thank you for your information and your time!

Kind regards,

Melissa

Melissa Horning, BSN, PHN

PhD Candidate and Research Assistant, School of Nursing

Interdisciplinary Research Training in Child and Adolescent Health Fellow, Department of Pediatrics

University of Minnesota

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From: <PHN@wiley.com>
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Subject: Your article to be published in Public Health Nursing - PHN12145
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Journal: Public Health Nursing

Article title: "A Systematic Review on the Affordability of a Healthful Diet for Families in the United States"

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Your article has been received by our production department. Please log into Author Services and sign your licence agreement. Failure to do so may result in a delay of your article's publication.

Note to Contributors on Deposit of Accepted Version:
Certain funders, including the NIH, members of the Research Councils UK (RCUK) and Wellcome Trust, require deposit of the Accepted Version in a repository after an embargo period.

Appendix B. HOME Plus IRB Approval

1003S78592 - PI Fulkerson - IRB - APVD Continuing Review
1 message

irb@umn.edu <irb@umn.edu> Thu, Oct 16, 2014 at 11:16 PM
To: adki0032@umn.edu

TO : garwi001@umn.edu, story001@umn.edu, neuma011@umn.edu, fulke001@umn.edu, kubik002@umn.edu, adki0032@umn.edu, ogurvich@umn.edu,

The IRB: Human Subjects Committee renewed its approval of the referenced study listed below:

Study Number: 1003S78592

Principal Investigator: Jayne Fulkerson

Expiration Date: 10/14/2015

Approval Date: 10/15/2014

Title(s):
Healthy Home Offerings via the MealTime Environment (HOME) Plus

This e-mail confirmation is your official University of Minnesota HRPP notification of continuing review approval. You will not receive a hard copy or letter. This secure electronic notification between password protected authentications has been deemed by the University of Minnesota to constitute a legal signature.

You may go to the View Completed section of http://eresearch.umn.edu/ to view or print your continuing review submission.

For grant certification purposes you will need this date and the Assurance of Compliance number, which is FWA00000312 (Fairview Health Systems Research FWA00000325, Gillette Childrens Specialty Healthcare FWA00004003). Approval will expire one year from that date. You will receive a report form two months before the expiration date.

In the event that you submitted a consent document with the continuing review form, it has also been reviewed and approved. If you provided a summary of subjects' experience to include non-UPIRTSO events, these are hereby acknowledged.

Appendix C. HOME Plus IRB Approval of Purchasing Influence Research Questions

UNIVERSITY OF MINNESOTA
Change In Protocol Request

Route this form to: See instructions below. | Rev: Aug 2011

Instructions:
Use this form when submitting change requests on IRB protocols. This form is for use when the changes are initiated by the PI. Do not use this form to respond when changes are requested by the IRB. Please do not use this form when responding to changes requested in a stipulation letter.

Submit this form to the Human Research Protection Program:

U.S. Mail Address: or
Human Research Protection Program
MMC 820
420 Delaware St. SE
Minneapolis, MN 55455-0392

Electronic Submission:
Submit to: irb@umn.edu
PI must submit request using University of Minnesota e-mail Account.

The UMN IRB reviewed and APPROVED this submission including all attachments listed on this form by expedited review.
9:13 am, May 31, 2012
By perke001

IRB Protocol Information

IRB Study Number:	**1003S78592**
Principal Investigator:	**Jayne Fulkerson**
Primary StudyTitle:	Healthy Home Offerings via the Mealtime Environment (HOME) Plus
Date of this Submission	May 21, 2012
Study Includes	☐ Drug(s) / Biologic(s) ☐ Device(s)

Indicate the type of change: :
☐ Protocol Amendment: Version , Dated
☐ Revised Investigator Brochure: Version , Dated
☐ Recruitment Changes/Advertisements
☐ Notice of Closure to Accrual
☒ Change(s) to Study Procedures
☐ Other:

1. **Briefly summarize the change(s). For protocol amendments, do not say "See summary of changes provided with amendment." Rather, summarize the nature of the significant revisions.**

As part of the study, we ask parents and 8-12 year old children to complete data collection forms and surveys that have been approved by the IRB in June of 2011. We are requesting approval of a minor addition to the parent and child data collection forms that we feel will allow us to better evaluate food purchasing behaviors and attitudes. This minor addition, which consists of an additional page of questions for each the parents and the children, will allow us to better evaluate these outcomes without significantly increasing the burden to participants.

2. **Describe the rationale for the change(s):**

All of the content is consistent with what was approved in the initial IRB application (2010). The additional questions were added to the surveys after a further literature search on the impact of food shopping behaviors of parents and children. The questions remain consistent with the focus of the study as proposed in the initial IRB application, specifically to the focus area of parent and children shopping but allow us to examine (1) what influences food purchases, and (2) how the intervention influences these behaviors for the second cohort of participants.

3. **In your opinion as principal investigator, how will these changes affect the overall risk to subjects in this study?**

We have included additional survey questions for the parent and child that do not affect the overall risk to participants. As with all of our forms, participants can choose to not fill out the forms if desired.

4. **Do the changes to the study prompt changes to the consent form(s)?**

☒No. ☐ Yes. **If yes:**

- **Attach a copy of the revised consent form(s) with changes tracked or highlighted as well as a clean copy.**
- **Confirm whether currently enrolled subjects will notified of the changes and how they will be notified (i.e. subjects will be re-consented with the updated form once approved, subjects will be provided with an information sheet, subjects will be told of changes at next study visit, etc.).**

5. List and attach all documents included with this request, including version dates:

5.17.2012 - Parent purchasing questions 5.17.2012 - Child purchasing questions

Principal Investigator's Signature **Date**

Appendix D. Purchasing Influence Research IRB Approval

The purchasing influence research study originally underwent exempt review with the IRB, which was granted. The NIH then requested for my grant that the name of my study was changed. This change in protocol was submitted and approved. Then, the NIH requested the purchasing influence research study undergo expedited review, which was also approved. The approval of each of these steps is attached.

Melissa Horning <horn0199@umn.edu>

1403E49083 - PI Horning - IRB - Exempt Study Notification

irb@umn.edu <irb@umn.edu> Tue, Apr 8, 2014 at 11:18 AM
To: horn0199@umn.edu

TO : fulke001@umn.edu, horn0199@umn.edu,

The IRB: Human Subjects Committee determined that the referenced study is exempt from review under federal guidelines 45 CFR Part 46.101(b) category #4 EXISTING DATA; RECORDS REVIEW; PATHOLOGICAL SPECIMENS.

Study Number: 1403E49083

Principal Investigator: Melissa Horning

Title(s):
Child and Parent Influences on Food Purchasing (CAPIP): Contributions to Obesity

---

This e-mail confirmation is your official University of Minnesota HRPP notification of exemption from full committee review. You will not receive a hard copy or letter. This secure electronic notification between password protected authentications has been deemed by the University of Minnesota to constitute a legal signature.

The study number above is assigned to your research. That number and the title of your study must be used in all communication with the IRB office.

If you requested a waiver of HIPAA Authorization and received this e-mail, the waiver was granted. Please note that under a waiver of the HIPAA Authorization, the HIPAA regulation [164.528] states that the subject has the right to request and receive an accounting of Disclosures of PHI made by the covered entity in the six years prior to the date on which the accounting is requested.

If you are accessing a limited Data Set and received this email, receipt of the Data Use Agreement is acknowledged.

This exemption is valid for five years from the date of this correspondence and will be filed inactive at that time. You will receive a notification prior to inactivation. If this research will extend beyond five years, you must submit a new application to the IRB before the study's expiration date.

Upon receipt of this email, you may begin your research. If you have questions, please call the IRB office at (612) 626-5654.

You may go to the View Completed section of eResearch Central at http://eresearch.umn.edu/ to view further details on your study.

The IRB wishes you success with this research.

We value your feedback. We have created a short survey that will only take a couple of minutes to complete. The questions are basic, but your responses will provide us with insight regarding what we do well and areas that may need improvement.

Melissa Horning <horn0199@umn.edu>

1403P49083 - PI Horning - IRB - APVD Add Title

1 message

irb@umn.edu <irb@umn.edu> Tue, May 20, 2014 at 5:30 PM
To: horn0199@umn.edu

TO : horn0199@umn.edu,

IRB approval has been recorded for the additional title for the study listed below:

Study Number: 1403P49083

Principal Investigator: Melissa Horning

Expiration Date:

Title(s):
Child and Parent Food Choices and Purchases: Contributions to Obesity

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You may go to the View Completed section of eResearch Central at http://eresearch.umn.edu/ to view your additional title request submission.

This action was based on your assurance that the research is the same project as that currently approved. If this new title results in a funded project, please provide the face page of this grant application along with the methods section of your grant.

All protocol titles will have the same approval date, 04/08/2014, and continuing review schedule.

You are reminded that the addition of a title to this file does NOT reflect IRB approval for any changes in protocol or additional subjects. If any changes are planned for this research or if the new grant submission will mean an increase in the subject accrual goal, you must submit a request for a change in protocol for review.

We will be happy to notify your funding agency of approval of this title. If you would like us to do this, please send us the name and address of your contact person at the agency.

Thank you for keeping the IRB informed of the status of your research.

As principal investigator for this research you are required by federal regulations to inform the IRB of any proposed changes to your research that involve human subjects. Changes should be reviewed and approved by the IRB before they are initiated. Unanticipated problems and adverse events should be reported to the IRB as they occur. Research projects are subject to continuing review and approval.

If you have any questions, call the IRB office at 612-626-5654.

UNIVERSITY OF MINNESOTA

Twin Cities Campus

Human Research Protection Program
Office of the Vice President for Research

D528 Mayo Memorial Building
420 Delaware Street S.E.
MMC 820
Minneapolis, MN 55455

Office: 612-626-5654
Fax: 612-626-6061
E-mail: irb@umn.edu or ibc@umn.edu
Website: http://research.umn.edu/subjects/

May 21, 2014

Melissa L Horning
Pediatrics & Adolescent Health
Room 353
1932K
717 Delaware St SE
Minneapolis, MN 55414

RE: "Child and Parent Food Choices and Purchases: Contributions to Obesity"
IRB Code Number: **1403P49083**

Dear Ms. Horning

The referenced study was reviewed by expedited review procedures and approved on May 20, 2014. If you have applied for a grant, this date is required for certification purposes as well as the Assurance of Compliance number which is FWA00000312 (Fairview Health Systems Research FWA00000325, Gillette Children's Specialty Healthcare FWA 00004003). Approval for the study will expire one year from that date. A report form will be sent out two months before the expiration date.

The IRB would like to stress that subjects who go through the consent process are considered enrolled participants and are counted toward the total number of subjects, even if they have no further participation in the study. Please keep this in mind when calculating the number of subjects you request. This study is currently approved for 180 subjects. If you desire an increase in the number of approved subjects, you will need to make a formal request to the IRB.

The code number above is assigned to your research. That number and the title of your study must be used in all communication with the IRB office.

As the Principal Investigator of this project, you are required by federal regulations to inform the IRB of any proposed changes in your research that will affect human subjects. Changes should not be initiated until written IRB approval is received. Unanticipated problems and adverse events should be reported to the IRB as they occur. Research projects are subject to continuing review and renewal. If you have any questions, call the IRB office at 612-626-5654.

On behalf of the IRB, I wish you success with your research.

Sincerely,

Christina Dobrovolny, CIP
Research Compliance Supervisor
CD/bw

CC: Jayne Fulkerson

Appendix E. Parent HOME Plus Purchasing Influence Questions

ID #: _____ Cohort: 2

Visit #:_____ Date: _____
(MM/DD/YYYY)

Parent: New Home Plus Purchase Items

The questions we ask you on this survey are about costs of foods. We also ask about where you might buy them. There are no right or wrong answers. We just want your honest opinion.

Answer how much you, as a parent, agree or disagree with each of the statements by marking **one** box for each statement.

		Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
1	Cost is very important to me when buying foods.	☐1	☐2	☐3	☐4	☐5
2	How healthy foods are is very important to me when buying foods.	☐1	☐2	☐3	☐4	☐5
3	How easy and quick a food is to prepare is very important to me when buying foods.	☐1	☐2	☐3	☐4	☐5
4	A fast food value meal (like from McDonald's) costs less than a dinner meal at home.	☐1	☐2	☐3	☐4	☐5
5	I think snack foods (like cookies, chips, candy) cost too much to buy a lot of them.	☐1	☐2	☐3	☐4	☐5
6	Generally, fruits and vegetables cost the same all year round. For example, strawberries in the winter cost the same as they do in the summer.	☐1	☐2	☐3	☐4	☐5
7	Fast food and convenience store foods/snacks seem like my only choice when my family is on the go and time is limited by our busy schedules.	☐1	☐2	☐3	☐4	☐5

Please mark one box for each statement.

		Always	Sometimes	Never
8	My family grows some of the vegetables or fruits that we eat.	☐2	☐1	☐0
9	My family buys fruits or vegetables at the farmer's market, has a farm share, or is in a CSA (community supported agriculture).	☐2	☐1	☐0
10	My family uses coupons when going to the grocery store to save money.	☐2	☐1	☐0

11. Do you have a set amount of money that you spend on food per month?
    - 0☐ No
    - 1☐ Yes, the amount is about $_____

12. How do you go grocery shopping most of the time? *(Mark **one** box)*
    - 1☐ a. In my car
    - 2☐ b. With a friend in friend's car
    - 3☐ c. Borrow a car
    - 4☐ d. On the bus
    - 5☐ e. Bike or walk

Questions continued on the back…

13. As a parent, which of the following influence what foods you buy? *(Mark **all** that apply)*

- 1☐ a. The food item is on sale.
- 1☐ b. The food item is available in bulk.
- 1☐ c. The food item is at the grocery store I go to.
- 1☐ d. The food item is healthy.
- 1☐ e. The food item has a long shelf life.
- 1☐ f. I know my family will eat it.
- 1☐ g. Cost.
- 1☐ h. The food item is quick and easy to make.
- 1☐ i. It's a brand name I trust.
- 1☐ j. My child requests it.
- 1☐ k. How the food tastes.
- 1☐ l. It is in a recipe that I want to use.
- 1☐ m. Other:_____

14. Which of the <u>two things you checked in question #13</u> influence your food purchases the **most**: *(Mark only **two**)*

- 1☐ a. The food item is on sale.
- 1☐ b. The food item is available in bulk.
- 1☐ c. The food item is at the grocery store I go to.
- 1☐ d. The food item is healthy.
- 1☐ e. The food item has a long shelf life.
- 1☐ f. I know my family will eat it.
- 1☐ g. Cost.
- 1☐ h. The food item is quick and easy to make.
- 1☐ i. It's a brand name I trust.
- 1☐ j. My child requests it.
- 1☐ k. How the food tastes.
- 1☐ l. It is in a recipe that I want to use.
- 1☐ m. Other:_____

15. Where do you do **most** of your grocery shopping? *(Mark **one** box)*

- 1☐ a. Small store, like a corner store, convenience store
- 2☐ b. Large grocery store
- 3☐ c. Bulk grocery store like Sam's Club or Costco
- 4☐ d. Farmer's market
- 5☐ e. Other:_____

16. Why do you do **most** of your grocery shopping there? *(Check **all** that apply)*

- 1☐ a. It is on my way home from work.
- 1☐ b. It has the best prices.
- 1☐ c. It is easy and convenient to get to.
- 1☐ d. It has the best selection.
- 1☐ e. It has the best quality of foods.
- 1☐ f. It is conveniently located on my usual route for errands or other activities.
- 1☐ g. Other:_____

Appendix F. Child HOME Plus Purchasing Influence Questions

ID #: _____ Cohort: 2

Visit #:_____ Date: _____ (MM/DD/YYYY)

Child: New HOME Plus Purchase Items

The questions we ask you on this survey are about costs of foods. We also ask about where you might buy them. There are no right or wrong answers. We just want your honest opinion.

For each question, mark **one** box to show how much you think the statement is true.

1	A fast food value meal (like from McDonald's) costs less than a dinner meal at home.	No, Never ☐0	Yes, sometimes ☐1	Yes, always ☐2
2	My parent says fruits and vegetables cost too much to buy a lot of them.	No, Never ☐0	Yes, sometimes ☐1	Yes, always ☐2
3	My parent says snack foods (like cookies, chips, and candy) cost too much to buy a lot of them.	No, Never ☐0	Yes, sometimes ☐1	Yes, always ☐2
4	Healthy foods cost more than unhealthy foods.	No, Never ☐0	Yes, sometimes ☐1	Yes, always ☐2

For each question mark **one** box.

5	I help decide what foods and drinks my family buys by letting my parent know what I like.	No, Never ☐0	Yes, sometimes ☐1	Yes, always ☐2
6	I like to eat packaged food (like cookies or crackers) because they are easy to eat.	No, Never ☐0	Yes, sometimes ☐1	Yes, always ☐2
7	I don't like to eat fruits and vegetables because I don't like to peel and cut them up.	No, Never ☐0	Yes, sometimes ☐1	Yes, always ☐2
8	I can easily get to places to buy foods or drinks with my own money by myself (like by walking or riding my bike).	No, Never ☐0	Yes, sometimes ☐1	Yes, always ☐2

If we gave you money to spend on foods or drinks, what would you buy? Mark **one** box for each question.

9	If given money, I would buy *treats (like ice cream, a cookie, chips, fries).*	No ☐0	Yes ☐1
10	If given money, I would buy a *fast food meal.*	No ☐0	Yes ☐1
11	If given money, I would buy *fruits or vegetables.*	No ☐0	Yes ☐1
12	If given money, I would buy *baked crackers, pretzels, or nuts (like peanuts).*	No ☐0	Yes ☐1
13	If given money, I would buy pop *(like Mountain Dew or Sprite) or sports drinks (like Gatorade or Powerade).*	No ☐0	Yes ☐1
14	If given money, I would buy *milk or 100% fruit juice.*	No ☐0	Yes ☐1
15	I buy food or drinks with my own money.	No ☐0	Yes ☐1

If you checked 'yes' on question 15, continue answering the questions below.
If you checked 'no' on question 15, you are done!

Mark **one** box for each question.

16	I buy more healthy foods and drinks when I am with my parent than when I am by myself.	No, Never ☐0	Yes, sometimes ☐1	Yes, always ☐2

Mark **one** box for each question.

17	I buy more healthy foods and drinks when I am with my friends than when I am by myself.	No, Never ☐0	Yes, sometimes ☐1	Yes, always ☐2
18	I buy foods and drinks based on how much they cost.	No, Never ☐0	Yes, sometimes ☐1	Yes, always ☐2
19	I buy foods and drinks that are shown on TV.	No, Never ☐0	Yes, sometimes ☐1	Yes, always ☐2
20	I buy foods that are easy to make and easy to eat.	No, Never ☐0	Yes, sometimes ☐1	Yes, always ☐2

The next questions are fill in the blank:

21 How much of your own money do you spend each week on foods and drinks?

I spend _____ dollars on foods and drinks each week.

22 What are the two foods or drinks you buy the most with your own money?

1._____

2._____

23 How much of the money you spend on food and drinks each week is spent on ***healthy*** foods or drinks?

I spend _____ dollars on ***healthy*** foods and drinks each week.

Think about where you bought food or drinks from in the **past year.** Mark one box for each question:

24	With my own money, I bought foods or drinks from my *school's cafeteria.*	No ☐0	Yes ☐1
25	With my own money, I bought foods or drinks from my *school's store.*	No ☐0	Yes ☐1
26	With my own money, I bought foods or drinks from my *school's vending machine.*	No ☐0	Yes ☐1
27	With my own money, I bought foods or drinks from a *vending machine in the community.*	No ☐0	Yes ☐1
28	With my own money, I bought foods or drinks from a *small store near school or home.*	No ☐0	Yes ☐1
29	With my own money, I bought foods or drinks from *a big grocery store.*	No ☐0	Yes ☐1
30	With my own money, I bought foods or drinks from a *fast food restaurant.*	No ☐0	Yes ☐1
31	With my own money, I bought foods or drinks from a *farmer's market.*	No ☐0	Yes ☐1

Appendix G. Descriptive statistics of HOME Plus and new HOME Plus purchase items used in the present research

Reporter & Instrument	Question	Mean	SD	RO	Proposed Scale	Level of measure
Child HP*	In the past month, I have picked out healthy foods and beverages at a store or when making a shopping list?	2.71	0.87	a	Social Pressure	Family
Child HP	In the past week, did you ask your parents to buy fruits and vegetables?	0.57^		b	Social Pressure	Family
Child new HPPI**	I help decide what foods and drinks my family buys by letting my parent know what I like.	1.14	0.57	c	Social Pressure	Family
Parent HP	In the last month, how often your child come along to the store when you shop for food?	2.92	0.78	b	Social Pressure	Family
Parent HP	In the last month, how often your child help plan the grocery list?	2.39	0.88	b	Social Pressure	Family
Parent HP	In the last month, how often your child help select fruit and vegetables at the grocery store?	2.82	0.82	b	Social Pressure	Family
Child HP	How often do you ask your parents to buy foods that you saw on TV commercials?	1.87	0.82	b	Social Pressure	Community
Child HP	How often do your parents actually buy these foods for you?	1.73	0.81	b	Social Pressure	Community
Parent new HPPI	(As a parent, which of the following influence what foods you buy?) It's a brand name I trust.	0.51^		d	Social Pressure	Community
Parent HP	I know how to cook with low-fat cooking methods.	1.96	0.72	a	Ability	Individual
Parent HP	Reduced, substituted, or omitted ingredients in a recipe to make it healthier.	0.57^		d	Ability	Individual
Parent HP	Relied less on mainly boxed or frozen meals (e.g. macaroni and cheese) when planning and preparing meals.	0.64^		d	Ability	Individual
ParentHP	They are easy for my child to prepare.	0.27^		d	Ability	Individual
Child new HPPI	I like to eat packaged food (like cookies or crackers) because they are easy to eat.	1.01	0.51	c	Ability	Individual
Child new HPPI	I don't like to eat fruits and vegetables because I don't like to peel and cut them up.	0.26	0.51	c	Ability	Individual
Child HP	In the past month, I have prepared fruits and vegetables.	2.30	0.56	a	Ability	Individual
Child HP	In the past month, I have followed safe food handling practices.	1.78	0.11	a	Ability	Individual
Child HP	In the past month, I have followed a recipe to prepare a healthy meal or snack.	2.51	0.34	a	Ability	Individual
Child HP	In the past month, I have used measuring cups and spoons to accurately measure correct amounts of ingredients	2.90	0.92	a	Ability	Individual
Parent HP	In the past month, my child has prepared fruits and vegetables (e.g. washed, peeled, chopped) in the past month.	0.64^		e	Ability	Individual
Parent HP	In the past month, my child has handled knives properly in the past month.	0.68^		e	Ability	Individual
Parent HP	In the past month, my child has followed a recipe to prepare a healthy meal or snack in the past month.	0.36^		e	Ability	Individual
Parent HP	In the past month, my child has used measuring cups and spoons to accurately measure correct amounts of ingredients.	0.57^		e	Ability	Individual

Reporter & Instrument	Question	Mean	SD	RO	Proposed Scale	Level of measure
Parent HP	In the past month, my child has followed safe food handling practices, (e.g., washed hands, wiped off counters)	0.83^		e	Ability	Individual
Parent new HPPI	How easy and quick a food is to prepare is very important to me when buying foods.	3.63	1.17	f	Time	Family
Parent new HPPI	Fast food and convenience store foods/snacks seem like my only choice when my family is on the go and time is limited by our busy schedules.	2.27	1.34	f	Time	Family
Parent new HPPI	(As a parent, which of the following influence what foods you buy?) The food item is quick and easy to make.	0.42^		d	Time	Family
Parent HP	On busy nights, our family's main meal includes canned or frozen entrees or boxed mixes (i.e. partially prepared meals).	1.87	0.81	b	Time	Family
Parent HP	I don't have time to prepare other foods.	0.56^		d	Time	Family
Child HP	Do your parents work schedules sometimes make it hard for your family to have dinner together?	0.37^		d	Time	Family
Child HP	Is your family too busy to eat dinner together most nights?	0.17^		d	Time	Family
Parent HP	I usually know or plan in advance what we will eat for dinner that night	2.36	0.83	a	Time	Parent
Parent HP	I usually decide at night what we will eat for dinner that night (r)	2.33	0.86	a	Time	Parent
Parent HP	We often seem to eat in shifts where we do not all eat at the same time (r)	1.87	0.84	a	Time	Family
Parent HP	We cook enough on some days/nights so that there will be leftovers for another meal.	2.33	0.69	b	Time	Parent
Parent HP	We try to keep our cupboards well stocked with foods that can be combined easily for a meal.	2.91	0.74	b	Time	Parent
Parent HP	We make food and freeze some of it	1.82	0.76	b	Time	Parent
Parent new HPPI	How healthy foods are is very important to me when buying foods.	4.44	0.75	f	Nutrition concern	Individual
Parent new HPPI	(As a parent, which of the following influence what foods you buy?) The food item is healthy.	0.88^		d	Nutrition concern	Individual
Parent HP	In the past month, I have picked healthy recipes to try or make.	0.83^		d	Nutrition concern	Individual
Parent HP	In the past month, I have read a food label for key items.	0.79^		d	Nutrition concern	Individual
Parent HP	How often do you use nutrition information on food labels to help you decide which foods to buy	3.09	0.76	b	Nutrition concern	Individual
Parent HP	I can select the healthier option between two foods by comparing the food labels.	1.66	0.64	a	Nutrition concern	Individual
Child HP	In the past month, I have read a food label for key ingredients like the serving size?	2.42	0.92	a	Nutrition concern	Individual
Child HP	How often do you look at food labels to find out if a food is healthy?	2.67	0.99	b	Nutrition concern	Individual
Child HP	How often do you look at food labels to find out the serving size?	2.31	1.00	b	Nutrition concern	Individual
Child new HPPI	If given money, I would buy treats (like ice cream, a cookie, chips, fries).	0.58^		d	Nutrition concern	Individual
Child new HPPI	If given money, I would buy a fast food meal.	0.20^		d	Nutrition concern	Individual
Child new HPPI	If given money, I would buy fruits or vegetables.	0.80^		d	Nutrition concern	Individual
Child new HPPI	If given money, I would buy baked crackers, pretzels, or nuts (like peanuts).	0.64^		d	Nutrition concern	Individual

Reporter & Instrument	Question	Mean	SD	RO	Proposed Scale	Level of measure
Child new HPPI	If given money, I would buy pop (like Mountain Dew or Sprite) or sports drinks (like Gatorade or Powerade).	0.54^		d	Nutrition concern	Individual
Child new HPPI	If given money, I would buy milk or 100% fruit juice.	0.73^		d	Nutrition concern	Individual
Parent HP	On average, about how often does your family shop for groceries?	1.86	0.95	h	Access	Community
Parent new HPPI	My family grows some of the vegetables or fruits that we eat.	0.84	0.75	g	Access	Community
Parent new HPPI	My family buys fruits or vegetables at the farmers market, has a farm share, or is in a CSA (community supported agriculture).	1.03	0.57	g	Access	Community
Parent new HPPI	(As a parent, which of the following influence what foods you buy?) The food item is available in bulk.	0.30^		d	Access	Community
Parent new HPPI	(As a parent, which of the following influence what foods you buy?) The food item is at the grocery store I go to.	0.71^		d	Access	Community
Parent new HPPI	(Why do you do most of your grocery shopping there?) It is on my way home from work.	0.11^		d	Access	Community
Parent new HPPI	(Why do you do most of your grocery shopping there?) It has the best prices.	0.44^		d	Access	Community
Parent new HPPI	(Why do you do most of your grocery shopping there?) It is easy and convenient to get to.	0.66^		d	Access	Community
Parent new HPPI	(Why do you do most of your grocery shopping there?) It has the best selection.	0.29^		d	Access	Community
Parent new HPPI	(Why do you do most of your grocery shopping there?) It has the best quality of foods.	0.28^		d	Access	Community
Parent new HPPI	(Why do you do most of your grocery shopping there?) It is conveniently located on my usual route for errands or other activities.	0.33^		d	Access	Community
Child new HPPI	I can easily get to places to buy foods or drinks with my own money by myself (like by walking or riding my bike).	0.54^	0.69	c	Access	Community
Child new HPPI	My parent says fruits and vegetables cost too much to buy a lot of them.	0.24	0.46	c	Cost	Family
Child new HPPI	My parent says snack foods (like cookies, chips, and candy) cost too much to buy a lot of them.	0.89	0.64	c	Cost	Family
Parent HP	In the past month, I have planned several healthy meals that fit into our family's grocery budget.	0.70^		d	Cost	Family
Parent new HPPI	Cost is very important to me when buying foods.	4.02	1.03	f	Cost	Family
Parent new HPPI	I think snack foods (like cookies, chips, candy) cost too much to buy a lot of them.	3.37	1.08	f	Cost	Family
Parent new HPPI	My family uses coupons when going to the grocery store to save money.	0.99	0.63	g	Cost	Family
Parent new HPPI	Do you have a set amount of money that you spend on food per month?	0.29^		d	Cost	Family
Child new HPPI	A fast food value meal (like from McDonalds) costs less than a dinner meal at home.	1.15	0.70	c	Cost	Community
Child new HPPI	Healthy foods cost more than unhealthy foods.	0.94	0.62	c	Cost	Community
Parent new HPPI	A fast food value meal (like from McDonalds) costs less than a dinner meal at home.	2.42	1.28	f	Cost	Community
Parent new HPPI	(As a parent, which of the following influence what foods you buy?) The food item is on sale.	0.82^		d	Cost	Community

Reporter & Instrument	Question	Mean	SD	RO	Proposed Scale	Level of measure
Parent new HPPI	(As a parent, which of the following influence what foods you buy?) Cost.	0.75^		d	Cost	Community
Parent new HPPI	(As a parent, which of the following influence what foods you buy?) I know my family will eat it	0.87^		d	Preferences	Family
Parent new HPPI	(As a parent, which of the following influence what foods you buy?) My child requests it.	0.67^		d	Preferences	Family
Parent new HPPI	(As a parent, which of the following influence what foods you buy?) How the food tastes.	0.84^		d	Preferences	Family
Parent new HPPI	(As a parent, which of the following influence what foods you buy?) It is in a recipe I want to use	0.76^		d	Preferences	Family

Notes: HP= HOME Plus psychosocial survey. New HPPI = new HOME Plus purchase items; these items were adapted from previously existing literature or newly developed to either provide greater specificity for the listed scale or to measure the construct for the first time. RO = response option. Sources for the questions/items listed above can be found in Chapters 3 and 4.

^Values are proportions of participants answering yes.

a = Agree-disagree 4 point.

b = Never-always 4 point.

c = Never-Always 3 point.

d = Binary (yes/ I don't no).

e = Yes, no, or t know. (Proportion responding yes was calculated out of those responding yes or no).

f = Disagree-agree 5 point.

g = Always-Never 3 point.

h = categorical frequency options.

All response options will be considered and standardized where appropriate. Reverse coding will also be utilized to assure constructs are being measured in the same direction.

Appendix H. Detailed documentation of the results of steps 1-4 of Aim 2 by construct of interest

Cooking ability. The correlation matrix of the 17 items thought to be related to cooking ability indicated that all items should undergo factor analysis (all items related to at least one other item at $r \geq 0.20$, $p \leq 0.05$. Factor analysis proceeded with one item not loading on any factors and another item loading equally on all three factors (I don't like to eat fruits and vegetables because I don't like to peel and cut them up; In the past month, I have relied less on mainly boxed or frozen meals for example macaroni and cheese, when planning and preparing meals), so these items were removed. The Kaiser-Guttman Eigenvalue greater than 1 rule suggested four factors, whereas the scree plot, Montanelli and Humphreys, and Maximum Likelihood approaches suggested three factors. The three factor solutions made the most theoretical sense and were qualitatively similar. Three factors were extracted with principal factor analysis with seven items loading on the first factor and four items loading on each of the second and third factors. Qualitatively, the factors remained (albeit in a different order) when the tetrachoric correlation matrix was factored with principal axis factoring and the scree plot was used to determine the number of factors.

Cost. Twelve items were thought to be related to the cost contruct. The correlation matrix of these 12 items indicated that nine items should be included in analysis and three items excluded at $r \geq 0.20$, $p \leq 0.05$.The excluded items were: In the past month, I have planned several healthy meals that fit into our family's grocery budget;

Healthy foods cost more than unhealthy foods; A fast food value meal, like from McDonalds, costs less than a dinner meal at home.

Factor analysis of these nine items was completed. The Kaiser-Guttman Eigenvalue Greater than 1 Rule suggested a three factor solution with Montanelli and Humphreys suggesting at least a three factor solution. Both maximum likelihood and the scree plot suggested a two factor solution. The two factor solution made the most theoretical sense. Two parent-reported items (I think snack foods like cookies, chips and candy cost too much to buy a lot of them; Do you have a set amount of money that you spend on food per month) did not load on any factors and were removed. Factor analysis was repeated.

This time, the Kaiser-Guttman Eigenvalue Greater than 1 rule, scree plot, and maximum likelihood suggested a two factor solution and Montanelli and Humphreys suggested at least two factors should be extracted. The two factor solution made theoretical sense and was retained. Four items loaded on factor one and three items loaded on factor two. Qualitatively, these factor structures remained when the tetrachoric correlation matrix was used for factor analysis and the scree plot was used to determine the number of factors.

Concern for Nutrition. The correlation matrix of the 15 items thought to be related to concern for nutrition indicated that all items should undergo factor analysis (all items related to at least one other item at $r \geq 0.20$, $p \leq 0.05$). The Kaiser-Guttman Eigenvalue greater than 1 rule suggested a five factor solution, whereas the scree plot,

Montanelli and Humphreys, and Maximum Likelihood approaches suggested four factor structures. In the four factor structure, two child-reported items (If given money, I would buy treats, like ice cream, a cookies, chips, fries; If given money I would buy a fast food meal) did not load on any factors and were removed.

Factor analysis was repeated. A three factor solution was now suggested by the scree plot and maximum likelihood approaches. This three factor solution made more theoretical sense than the five factor and four factor solutions suggested by Kaiser-Guttman Eigenvalue Greater than 1 Rule and Montanelli and Humphreys, respectively. In the three factor solution, another item (As a parent does the following influence what foods you buy: The food item is healthy) did not load on any factors and was thus removed from the model. In addition, one child item (If given money, I would buy pop, like Mountain Dew or Sprite, or sports drinks, like Gatorade or Powerade) loaded with healthful purchases, likely as a result of sports drinks being included in the item stem, as often children perceive sports drinks to be healthful; given this, the item was removed from the analysis as well.

Factor analysis was repeated. The Kaiser-Guttman Eigenvalue Greater than 1 Rule suggested a 4 factor solution, Montanelli and Humphreys suggested at least 4 factors and the scree plot and Maximum Likelihood approaches continued to suggest a 3 factor solution. The three factor solutions continued to make the most theoretical sense and were qualitatively resulting in the same factor structures. Using principal axis factoring with the three factor solution, three items loaded on the first factor, five items

loaded on the second factor, and three items loaded on the third factor. Qualitatively, the factor structures remained (albeit in a different order) when the tetrachoric correlation matrix was factored with principal axis factoring and the scree plot was used to determine the number of factors.

Family Food Preferences. The correlation matrix of the 4 items thought to be related to food preferences indicated that all items should undergo factor analysis (all items related to at least one other item at $r \geq 0.20$, $p \leq 0.05$). The items all loaded on one factor, regardless of extraction technique. In addition, qualitatively, this factor structure remained when the tetrachoric correlation matrix was factor analyzed and the scree plot was used to determine the number of factors.

Time. The correlation matrix of the 13 items thought to be related to the time construct indicated that all but one item (Do your parent's work skechedules sometime make it hard for your family to have dinner together?) should undergo factor analysis (e.g., $r \geq 0.20$, $p \leq 0.05$). The Kaiser-Guttman Eigenvalue Greater than 1 Rule, scree plot, Maximum Likelihood, and Montanelli and Humphreys approaches suggested a 4 factor solution. This factor solution made theoretical sense; however, one item (Is your family too busy to eat dinner together on <u>most</u> nights?) did not load well on any factors.

In rerunning factor analysis without this item, the factor structure remained with the four factor solution theoretically interpretable, regardless of the extraction technique used. All methods were in agreement on the number of factors to be extracted with the exception being that Montanelli and Humphreys suggested at least four factors. The first

factor had four items, second had two items, third had three items, and fourth had two items. In addition, qualitatively the factor structure remained (albeit in a different factor order) as well when the tetrachoric correlation matrix was factor analyzed and the scree plot was used to determine the number of factors.

Social Pressure. The correlation matrix of the nine items thought to be related to social pressure indicated all but one item (As a parent does the following influence what foods you buy: It's a brand name I trust) should undergo factor analysis (e.g., $r \geq 0.20$, $p \leq 0.05$). The Kaiser-Guttman Eigenvalue Greater than 1 Rule and scree plot approaches suggested three factor solutions, Montanelli and Humphreys approach suggested at least three factors and Maximum Likelihood suggested a two factor solution. The three factor solution was the most theoretically plausible. The first two factors each had three items loading on them and the last factor had two items loading on it. These factor structures were replicated with factor analysis using tetrachoric correlations.

Store Access. The correlation matrix of the 12 items thought to be related to store access indicated that all but one child-reported item (I can easily get to places by myself to buy foods or drinks with my own money by myself, like by walking or riding my bike) should undergo factor analysis (e.g., $r \geq 0.20$, $p \leq 0.05$). In addition, one item (As a parent does the following influence what foods you buy: The food item is available in bulk) had two theoretical interpretations, one of which could mean buying from large bins at a food coop location and another meaning, buying bulk quantities at a big box retailer (e.g., Costco, Sam's Club, etc). Therefore, this item was also removed. The Kaiser-Guttman

Eigenvalue Greater than 1 Rule suggested a 4 factor solution, the scree plot approach suggested a 2 to 4 factor solution, Maximum Likelihood approach 2 factors, and Montanelli and Humphreys approach suggested at least a 4 factor solution. The two factor solution made the most theoretical sense. One parent-reported item (On average, how often does your family shop for groceries) did not load on any factors and was thus removed.

Repeated factor analysis showed one item (As a parent does the following influence what foods you buy: The food item is at the grocery store I go to) did not load on any factors. It was then removed. The resulting factor structures suggested a 3 factor solution according to the Kaiser-Guttman Eigenvalue Greater than 1 Rule, and scree plot approaches. Maximum Likelihood did suggest a 2 factor solution, and Montanelli and Humphreys approach suggested at least a three factor solution. The three factor solution was retained. The first two factors each had 2 items load on them and the third factor had four items load on it. Qualitatively, these factor structures were replicated with factor analysis using tetrachoric correlations (albeit in a different order).