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The Relationships between the Home Food Environment and Weight Status among Children and Adolescents, ages 6-17 years

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by

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The home food environment is an important setting in regard to a child's dietary intake and the development of obesity, since 65% to 72% of daily calories are consumed in the home. Research is beginning to explore how the home food environment may influence children's weight status. It is suggested that homes with healthy weight children are more likely to have healthier food options available and limit access to unhealthy foods. Prior research on the influence of the home food environment on children and adolescent's weight status is not clear, as some researchers have found that the home food environment does not influence the weight status of children and adolescents, while other researchers have found conflicting results. The purpose of this study is to 1) to develop and test a parent-friendly home food checklist to assess the availability and visibility of healthy and unhealthy food and beverages in the home; 2) to compare the differences in the availability and visibility of home healthy and unhealthy foods and family meal variables between healthy weight and overweight children; and 3) to explore challenges and strategies in promoting healthy eating in the home among parents of healthy weight and overweight children.

The study found that the home food checklist showed acceptable validity and reliability and can be used independently by parents to assess the foods in the home. Additionally, the study found that overweight children and adolescents had lower scores

of total unhealthy foods and total unhealthy refrigerator foods visible compared to healthy weight children. Overweight among children was inversely associated with refrigerator visibility of unhealthy foods in the home, and children who had family meals more frequently were less likely to be overweight. The study determined that while parents faced numerous challenges in promoting healthy eating in the home, they utilized several strategies in providing healthy foods. The home environment is complex and multifactorial and continues to warrant further research to understand fully the impact of the home environment on a child's weight.

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Introduction

Childhood and adolescent obesity is a major public health concern. Currently, 32.4% of children and adolescents between the ages of 6 and 19 years are overweight, and 16.5% are obese (Ogden et al., 2012). Obese children and adolescents are more likely to become obese adults, which may cause increasing rates of health complications in the future adult population (Dietz, 1998). Therefore, children and adolescents should be considered a priority population in the prevention of obesity (Dehghan et al., 2005).

The home environment is one of the most important settings in regard to a child's dietary intake and the development of obesity (Rosenkranz & Dzewaltoswki, 2008). Research is beginning to explore how factors in the home food environment contribute to children and adolescent obesity (Inhmels et al., 2009; Larson & Story, 2009; McKinnon et al., 2009). Numerous studies have examined the availability and accessibility of foods in a child's home (Ding et al., 2012, Neumark-Sztainer et al., 1999) and limited studies have conducted an in-home assessment of the food environment (Boles et al., 2013; Spurrier et al. 2008). A gap in literature exists that assesses the home food environment between healthy weight and overweight children and adolescents. These topics will be addressed in this study.

Healthy eating behaviors are more likely to occur in a supportive environment where healthier food options are available and provided by the parents (United States Department of Health and Human Services, [USDHHS], 2001). Furthermore, parents play a pivotal role in the development of healthy eating behaviors (Hanson et al., 2004)

and are seen as the nutritional gatekeeper of the home (Wansink, 2006). Parents influence the home food environment through role modeling, providing healthy foods in the home, and policies surrounding family meals (Hanson et al., 2004). Parent's challenges and strategies surrounding what foods are brought into the home and the family's socioeconomic status may also influence a child's eating habits and the potential to develop obesity (Berge et al., 2012; MacFarlane et al., 2007; Neumark-Sztainer et al., 1999; Roos et al., 2012).

A model of the home food environment pertaining to childhood obesity depicts the home food environment as an overlapping and interactive domain that influence a child's dietary habits and obesity development (Rosenkranz & Dzewaltowski, 2008). For example, the economic environment domain influences a child's dietary intake and weight through the parent's socioeconomic status, education level and working status. The sociocultural environment domain influences a child's dietary intake and weight through a parent's role modeling of eating behaviors, rules surrounding food choices, frequency and quality of family meals, and parent's challenges and strategies in providing healthy food in the home. Additionally, the built (home) environment domain influences a child's dietary intake and weight through the availability and visibility of healthy and unhealthy food and beverage. These interlinking domains are important to examine and may elucidate the factors influencing childhood and adolescent obesity (Rosenkranz et al., 2008; Story et al., 2008). Therefore, investigating these influential factors in the home food environment and its effect on a child's weight can guide

researchers in developing intervention strategies to reduce childhood and adolescent obesity.

Limited studies have been conducted using an in-home assessment of the food environment among preschoolers and children (Boles et al., 2013; Spurrier et al., 2008), and numerous studies have examined the availability and accessibility of foods in a child's home (Ding et al., 2012, Neumark-Sztainer et al., 1999). Few instruments have been developed to assess the home environment, and no studies have compared the availability and visibility of the foods in the home environment between healthy weight and overweight children and adolescents. Furthermore, few studies have compared and explored parent's views of their challenges and strategies in promoting healthy eating in the home environment between healthy weight and overweight children and adolescents, which will provide further understanding of these perceptions to enhance obesity prevention strategies.

 The purpose of this study is to examine and explore the home food environment between healthy weight and overweight/obese children, ages 6-17 years and is divided in three separate studies with the following primary objectives:

1. To develop a valid and reliable parent-friendly home food checklist to assess the availability and visibility of healthy and unhealthy food and beverages in the home.

2. To compare the availability and visibility of healthy and unhealthy food and beverages and family meal variables in the home food environment between healthy weight and overweight/obese children;

3. To explore challenges and strategies in promoting healthy eating in the home among parents of healthy weight and overweight children.

The *long-term* goal of this study is to further research regarding the influence of the home food environment on childhood obesity and to enhance obesity prevention strategies.

Literature Review

I.Conceptual framework for understanding the Home Food Environment

The Ecological Systems Theory serves as a theoretical foundation for this study and was developed by Brofenbrenner (1989), which divides environmental influences into four interacting levels: microsystems, mesosystems, exosystems, and macrosystems. Microsystems refer to an individual's contact with family, peers, and schools and its influences. Mesosystems refers to the organizations that the individual is involved with, such as work, school, and church, which are linked to exosystems, which are the larger social system in which individuals can exist.. Finally, the macrosystem is the individual's culturally beliefs and attitudes. The ecological systems are a reciprocal determinism, in which the environment shapes and maintains our behavior, but that a person can change their environment. This framework emphasizes the interaction of factors that may influence obesity.

The Model of the Home Food Environment pertaining to Childhood Obesity has been developed based on this theory and depicts the home food environment as an overlapping and interactive domain that influences children's and adolescents' eating

behaviors and potential for obesity (Rosenkranz & Dzewaltowski, 2008)). The model depicts the home food environment as overlapping and interactive domains composed of built and natural environments, political and economic environments, and socio-cultural environments, with each level having micro-level and macro-level factors that influence the home food environment and the development of a child's dietary habits and potential obesity. For example, the economic environment may influence a child's weight through parent's socioeconomic status and education. Further, the built environment may influence a child's weight through the availability of foods in the home, while the socio-cultural environment may influence a child's weight through parent's feeding practices. This study will use the model depicted in Figure 1 and includes the sociocultural, economic and built environment that influences the home food environment (micro and macro-level influences) and it potential impact on a child's weight status.

II. Factors influencing the Home Food Environment

Influence of the Economic Environment on the Home Food Environment

Family socioeconomic status. Considering the socioeconomic status on the dietary intake and obesity risk among children and adolescents is important when evaluating the home food environment. Maternal education is a strong predictor of socioeconomic status (SES) and is a commonly used indicator of SES in home food environment studies and its influence on dietary intake and obesity among children and adolescents (Campbell et al., 2002). Evidence suggests that adolescents who have less educated parents and have a lower SES have unhealthier diets when compared to adolescents with more educated parents and from a higher SES (MacFarlane et al., 2007).

For example, in a survey study of 2,301 adolescents, parents with a higher education level were more likely to have adolescents who meet the recommendations of dairy foods, fruits, and vegetables (Xie et al., 2002). Similarly, in a study examining the dietary intake of 2,149 nine- and ten-year-old girls, parents with a higher education level had girls who ate less dietary fat, and ate more foods high in Vitamin C, calcium and potassium (Crawford et al., 1995).

The dietary intake of adolescents with a lower SES may be influenced by the type of food available in the home. In a cross-sectional, self-reported survey completed by 3,264 adolescents, the researchers found that adolescents from a lower SES were more likely to watch TV during meals and had unhealthier foods available in the home (MacFarlane et al., 2007). Determining the impact of SES on the home food environment is an important consideration when developing interventions aimed at reducing obesity risk among adolescents.

Influence of the Sociocultural Environment on the Home Food Environment

Role of parenting on the home food environment. Parents are considered the nutritional gatekeepers of the home and directly influence what types of foods are brought into the home (Wansink, 2006). More importantly, parent's role modeling of healthy eating is pivotal for children and adolescents' eating habits, since 65% of their calories are consumed at home (Hanson et al., 2004; Poti & Popkin, 2011; Story et al., 2008). Parents and caregivers are encouraged to role model healthy eating and exercise behaviors to prevent childhood obesity (Ritchie et al., 2005). For instance, in a study examining weight resilient parenting skills among preschoolers, parents who had higher

fruit and vegetable and lower SSB intake were more likely to have healthy weight

children (Lim et al., 2011). Also, it is suggested that children were more likely to

consume fruits and vegetables when parents purchased fruits and vegetables or took their

children grocery shopping for these foods (Gross et al., 2010).

In a cross-sectional study of 347 adolescents, ages 12-13 years, Campbell et al.

(2007) found that parents' eating habits impacted adolescents' food intake. Specifically,

the mothers' intake of high-energy fluids, sweet and savory snacks, and take-out foods

were positively associated with boys' intake of these foods. In a similar study, teenage

daughters were more likely to consume sweet snacks if their mothers consumed such

foods at home (Bauer et al., 2011). Evidence also supports positive correlations of fruit

and vegetable intake (Bauer et al., 2011; Hanson et al., 2004; Pearson et al., 2008; Wyse

et al., 2011) and soft drink consumption (Bauer et al., 2011) between parents and children

and between parents and adolescent girls, respectively.

Furthermore, in a qualitative study, 27 parents of overweight adolescents, ages

12-19 years, were asked what advice they had for parents of overweight adolescents.

Parents stated that role modeling of healthful behaviors and providing a healthy home

food environment was very important in helping their adolescents eat healthier (Boutelle

et al., 2012). Therefore, continuing to understand the role of parents on the home food

environment is critical in the development of intervention strategies.

Parental views of challenges in promoting healthy eating in the home. Limited

research has been conducted on the challenges parents face in providing healthful food

choices in the home. One study found that parents who perceived their kitchens as poorly

set up for meal preparation were more likely to have adolescent boys who ate more savory snacks (e.g., potato chips) (Campbell et al., 2007). Additionally, food insecurity and decreased nutritional quality of meals was seen in households with preschool children who had fewer kitchen appliances available and parents with poor cooking skills (Broughton et al., 2006).

In a focus group study examining the perceptions of risk and protective factors for healthful eating in the home among 102 family members (age 8-61 years), time constraints and increased cost in preparing healthy meals was seen as barriers for a healthy home food environment. Also, family members stated that working long hours, children's schedules, and the time it takes to prepare a healthy meal were barriers in eating healthy foods in the home, as well as not sure how to prepare, buy and introduce healthy foods to their children (Berge et al., 2012; Birkett et al., 2004). Furthermore, parents perceived cost as a barrier in providing fruits and vegetables to their children (Mushi-Brunt et al., 2007) and wasting food when serving fruits and vegetables and not being able to get their children to eat vegetables (Cullen et al., 2004).

Similarly, several studies among low-income adults found that lack of time and money to prepare and purchase healthy foods, family taste preferences, and the lack of access to healthy foods were barriers to healthful eating (Davis et al., 2012; Eikenberry & Smith, 2004). Furthermore, parents who experienced higher levels of work-life stress, increased depressive symptoms, and lower levels of family functioning were more likely to serve unhealthier foods at family meals (Neumark-Sztainer et al., 2012). Similarly, parents with overweight children in treatment weight program stated in focus groups that

often a spouse or another family member would sabotaged healthy eating efforts at home, by either bringing in unwanted or unhealthy food into the home or take their child out to eat at restaurants serving unhealthy food choices (Lyles et al., 2012), Therefore, understanding the challenges to healthful eating for families can lead to the development of interventions and strategies to improve the home food environment.

Parental views of strategies to promote healthy eating in the home. Parents' views of their strategies to promote healthy eating in the home are important to examine, because it directly influences the availability of foods in the home and the types of foods that parents purchase for their children (Roos et al. 2012). In a study of 57 parents of young children, parents reported that encouraging their child to eat a small amount of a healthy food and being persistent were effective strategies in promoting healthy eating in the home (Russell et al., 2015). Further, parental role modeling of healthy eating, encouraging their child to eat breakfast, increase the availability of healthy foods in the home and decrease unhealthy food options in the home are seen as effective strategies to promote healthy eating (Gross et al., 2010; O'Dea, 2003, Ritchie et al., 2005).

Family meals. Evidence indicates that eating family meals encourages healthy eating habits and promotes a healthy weight among children and adolescents (Larson et al., 2013). For example, numerous studies suggest that having frequent family meals is associated with an increased intake of fruits, vegetables, and dairy products, the likelihood of eating breakfast, and drinking less SSB (Videon & Manning, 2003; Welsh et al., 2011).

Utter et al. (2008) surveyed 3,245 adolescents regarding their eating behaviors. They found that 42% of adolescents had eaten a family meal on all of the previous school nights before the survey was taken. Furthermore, having family meals was associated with parental support of healthy eating, eating more fruits and vegetables, having more fruit in the home, eating breakfast, and bringing lunch from home. However, the adolescents who had frequent family meals were more likely to have unhealthy snacks at home (e.g. chips, candy, soft drinks) when compared to the adolescents who did not have frequent family meals. Interestingly, the study concluded that having frequent family meals had no effect on adolescents' BMI.

On the other hand, Taveras et al. (2005) examined the effects of family meals on weight of adolescents and found that eating together most days of the week decreased adolescents' BMI. However, there was no association between the likelihood of becoming overweight and the frequency of family meals longitudinally. In a review of family meal frequencies on children's weight status, researchers suggested a positive, but weak, correlation between being obese and eating together as a family (Valdes et al., 2012). Similarly, Goldfield et al. (2010) found that a higher frequency of family meals was associated with a lower BMI in girls, but not in boys.

Types of foods served at family meals may affect the dietary quality and weight status of children and adolescents. In a study of 1,923 families with children and adolescents, researchers examined the type of foods that were usually or always served at dinner. Seventy percent of families served vegetables (besides potatoes), 28% served green salads, 33% served fruit or 100% fruit juice, 50% served milk, and 33% served

SSB (Neumark-Sztainer et al., 2012). In a study examining type and quality of home meals, Fulkerson et al. (2012) observed 51 parents preparing an evening meal in their homes. When comparing family meals with the Food Guide Pyramid categories (e. g., meat or other protein, milk, vegetables, fruit and grains), 18% served food from all five of the food groups, 37% from four groups; 27% from three groups; 12% from two groups; 4% from one group; and 2% did not serve any of the five food groups. The most frequently served food group at the home evening meals was meat or other protein and vegetables. However, less than one-half served fruit and over one-half served dessert as part of the family meal.

Furthermore, a study examining the effect of away-from-home meal sources on weight status determined that 723 families with adolescents who purchased weekly fast-food or take-out foods for their home evening meals had children and adolescents with higher percent body fat and undesirable metabolic risk factors (e.g. elevated cholesterol, fasting blood glucose, LDL, triglycerides, and HDL). Also, both adolescents' and parents' weight was significantly higher in the fast-food and take-out dinner meals at home group compared to the group who did not purchase fast-food for home meals (Fulkerson et al., 2011). A similar study was conducted with 902 middle-school and high-school adolescents and their families. Families who purchased fast-food for home meals at least 3 times per week were less likely to have vegetables and milk served with the meal, more likely to have a higher intake of salty snack foods, and have SSB and chips available in the home, as well as a higher weight among parents (Boutelle et al., 2007).

Interestingly, a recent cross-sectional study examined the association between children's BMI and dietary intake with the structure of a family meal (e.g., length of meal, type of foods served), and interpersonal characteristics (e.g., communications, emotion/affect management) during the family meals. Researchers found that positive interpersonal dynamics during mealtime (e.g., overall family functioning) was associated with higher vegetable intake and a lower weight in children (Berge et al., 2013). Therefore, learning what types of foods are served at family meals can help guide strategies to improve the home food environment.

Family support for healthy eating in the home. Family support of healthy eating is an important factor to consider when examining the types of foods in the home. For example, family members stated that when others emphasized the importance of investing in a health behavior at a family level, such as being supportive when trying new foods, the entire family ate healthier (Berge et al., 2012). Further, adults reported that their grandchildren and children are influential when eating healthy foods (Eikenberry & Smith, 2004). Families participating in the Supplemental Nutrition Program for Women, Infants and Children (WIC) stated that the key motivators for positive health behaviors are the feeling of responsibility, concern for children's health and development, and positive social support (Birkett et al., 2004).

Other factors that positively influence a healthier home food environment are: (1) children requesting their parents to purchase healthy foods; (2) children going to the grocery store with their parents to purchase healthy foods; and (3) children who asked

their parents to reduce the amount of "junk food" in the home (Neumark-Sztainer et al., 1999; O'Dea, 2003; Sylvetsky et al., 2013).

Fruit and vegetable intake among children and adolescents. Fruits and vegetables are nutrient-rich, low in calories, and can be an important part of weight management (Rolls et al., 2004). Despite the importance of including fruits and vegetables in a healthy diet, a large proportion of children and adolescents do not consume the recommended amounts of fruits and vegetables (Epstein et al., 2001). Studies examining the relationship between children and adolescent's fruit and vegetable intake and weight have yielded inconsistent findings. For example, using data from the Continuing Survey of Food Intakes by Individuals (CSFII), Lin and Morrison (2002) reported that obese boys ate fewer vegetables and less fruit than did healthy weight and overweight boys, and healthy weight girls consumed more fruit than did overweight girls. In addition, in a three-year study examining fruit, vegetable and fruit juice intake and weight status, the researchers found no significant changes in BMI among boys and girls (Field et al., 2003).

Interestingly, Tohill et al., (2004) found that eating more vegetables and less fruit lowered the risk of developing obesity. In addition, Cutler et al. (2011) found that a higher intake of vegetables and sweet/salty snacks was associated with a lower risk of obesity. Similarly, Nicklas et al. (2003) examined rates of obesity and eating patterns among 1,562 children who participated in the Bogalusa Heart Study. Rates of obesity were significantly lower for African-American girls who consumed more fruits and vegetables compared to other ethnicities and gender. Additionally, researchers surveyed

681 adolescents regarding their dietary patterns and measured their BMI and waist circumference and found that fruit and vegetable intake was not associated with BMI or waist circumference (Howe et al., 2013).

In two international studies, researchers concluded that overweight adolescents had lower intake of fruits and vegetables (Al-Hazzaa et al., 2012), and fat intake was higher and fiber intake was lower in overweight compared to healthy weight girls (Garaulet et al., 2000). However, as the researchers noted, the findings may be influenced by the fact that adolescents may have underreported their dietary intake. Further understanding of the relationship between fruit and vegetable intake and children and adolescents' BMI is essential in formulating intervention strategies.

Sugar-sweetened beverages (SSB) intake by children and adolescents. Several studies find that SSB (e.g., soft drinks, fruit flavor drinks, sweetened tea, and sweetened coffee drinks) contributes a significant amount of calories in children and adolescents' diet (Slining et al., 2013) and has a negative impact on the diet quality of children and adolescents (Frary et al., 2004). When assessing the SSB intake of 95 low-income parent-child dyads, Pinard et al. (2011) found that parents and children consumed more SSB and less nutrient-dense beverages (e. g., low-fat dairy) than current recommendations. NHANES 1999 to 2008 data reports that even though soda intake of children and adolescents has decreased during the past decade, adolescents' intake of sports and energy drinks has tripled (4% to 12%) (Han & Powell, 2013). Similarly, Iannotti and Wang (2013) found that SSB intake decreased from 2001 to 2009 after examining the trends in dietary intake and BMI among U.S. children and adolescents.

Nicklas et al. (2011) found that overweight and obese children and adolescents did not have higher intakes of added sugars in their diet compared to their normal-weight peers. However, in a long-term epidemiological study examining the risk of heart disease, drinking SSB was associated with increased risk of obesity in children (Nicklas et al., 2003). Similarly, researchers examining SSB intake and obesity among 548 ethnically diverse schoolchildren found that for each additional serving of SSB consumed, BMI increased (Ludwig et al., 2001). Researchers state that considerable improvement is needed to reduce children and adolescents' non-nutritious beverage intake (Iannotti & Wang, 2013).

Snacking among children and adolescents. Calories from snacks are contributing to energy increases in children and adolescents (Piernas & Poplin, 2012). In a survey of 31,337 children and adolescents, ages 2-18 years, the prevalence of snacking increased from 74% in 1977-78 to 98% in 2003-06, and energy intake from snacks increased by 113 calories per day (Piernas & Poplin, 2012). Analyzing NHANES 2003-2006 data, Reedy and Krebs-Smith (2010) reported that children and adolescents, ages 2-18 years, consumed 40% of their total energy from foods with added sugars and solid fats (e. g., grain desserts, soda, and sweet foods), which is much higher than the recommended allowance of 8% to 20%.

Whether snacking is associated with increased rates of childhood obesity is debatable (Larson & Story, 2013). Some studies suggest that the lack of physical activity rather than snacking plays an important role in childhood and adolescent obesity (Keast et al., 2010; Troiano et al., 2000; Larson & Story, 2013). NHANES data from 1999-2004

showed that the prevalence of overweight and obesity, as well as waist circumference, decreased with increased frequency of snacking among adolescents. Specifically, adolescents who consumed ≥2 snacks per day were less likely to be overweight than non-snackers (Keast et al., 2010). Additionally, a cross-sectional study comparing the dietary habits and behaviors of 4,262 healthy weight, overweight, and obese Chinese children and adolescents found that the overweight and obese group snacked less than the healthy weight group (Guo et al., 2012).

Snacking can provide valuable nutrients to children and adolescents' diet. For example, increasing snacking contributes to the likelihood of eating more fruit and fat for girls and boys, and meeting milk recommendations for boys. However, as girls' snacking increased, so did their added sugar consumption; mainly from soft drinks and fruit drinks, which has negative implications on diet quality (Sebastian et al., 2008). Fruit was the most frequently consumed after-school snack in a study with Canadian children and adolescents. However, the majority of calories were from energy-dense, nutrient-poor snacks (e.g. cookies, sugar-sweetened beverages, and sweets) (Gilbert et al., 2012).

In addition, snacking frequency and foods and beverages consumed as snacks were assessed with a 24-hour food recall in 1,563 pre-adolescents. Obesity was associated with the intake of energy-dense foods, particularly from snacks, but it was not associated with frequency of snacking episodes (Nicklas et al., 2003). Furthermore, Francis et al. (2003) found in a longitudinal study that girls who snacked more frequently had higher intakes of fat from energy-dense foods which led to an increase in weight from ages 5 to 9 years of age. In a similar study, parents of 278 school-aged children

were asked to assess their children's eating habits. Researchers observed that children with a higher BMI were more likely to skip breakfast, snack more often between meals, eat in front of the TV, and drink SSB (Isacco et al., 2010). Researchers have questioned the variability of snacking definitions used in studies. Therefore, these inconsistent findings make it difficult to conclude that snacking contributes to obesity (Larson & Story, 2013).

Influence of the Built Environment on the Home Food Environment

The role between home food availability and accessibility and children's dietary intake. The home food environment influences a child's eating habits and dietary intake. Studies indicate that having food available and accessible in the home will determine the food a child or adolescent will eat (Ding et al., 2012; Gattshall et al., 2008: Spurrier et al., 2008) and the nutritional quality (Santiago-Torres et al., 2014). For example, in a recent study, Luszcynska et al. (2013) found that pre-adolescents consume less snack foods and sugar-sweetened beverages when these foods were not in the home. In similar studies, researchers learned that when parents reported the availability of fruit, 100% fruit juice and vegetables in the home, their children's intake of these foods increased (Cullen et al., 2003; Pearson et al., 2008). Wang et al. (2013) found a similar correlation between the availability of chips and sweets in the home and the increased intake of these foods among overweight and obese children, ages 5-11 years.

On the other hand, in a cross-sectional study examining the relationship between home food availability and food consumption, the researchers observed that even though

parents reported having fruits and vegetables in the home, it was not significantly related to adolescent's intake of these foods (Befort et al., 2006). Similarly, there was no significant association found between food\ availability and vegetable consumption among 5- and 6-year-olds (Campbell et al., 2006). Therefore, these findings may suggest that availability of healthy foods alone may not be adequate to influence children's and adolescent's eating habits and healthy food choices.

Role of food visibility in the home environment. Food visibility increases the attention to food and influences the amount and type of food eaten (Wansink et al., 2006). Understanding food storage practices and food visibility is important in creating a healthier home food environment. One study examined food storage practices with 90 overweight adults in a six-month weight loss program. The researchers found that the participants who removed visible food from their countertops, living room tables, and kitchen tables were more likely to consume fewer calories and lose weight compared to those participants who did no remove visible food items (Krukowski et al., 2010).

A similar study was conducted using separate in-home observations to examine eating style and home food storage habits of obese and non-obese families. Results from the first observation showed that obese families stored more calories from food than non-obese families. However, in the second observation, researchers found that fewer calories of food were stored in obese families' home than non-obese families. The discrepancies of the outcomes from the two observations may be partially explained by obese families removing food from the home before the second observation (Terry & Beck, 1985). No studies have been conducted regarding food visibility and its impact on

a child's weight. Therefore, further understanding this effect is an important aspect in improving the home food environment.

The role of the home food environment on childhood and adolescent obesity. The home environment may play a role in the development of obesity among children (Wang et al., 2012). Homes with healthy weight children are more likely to have healthier food options available, limit access to unhealthy foods, and live closer to a full-service grocery store (Brogan et al., 2012; Williams et al., 2011). However, a healthy weight can be difficult to maintain if a person lives in an obesogenic home environment, which is associated with a lower intake of healthy foods and a higher intake of unhealthy foods (Grunseit et al., 2011; Swimburn et al., 1999).

When conducting in-home food inventories between overweight and non-overweight individuals, researchers learned that homes with higher calories from fat, carbohydrates and protein were associated with a higher BMI among the parents who were responsible for food purchasing and meal preparation (Byrd-Bredbenner & Abbot, 2008). Further, when grocery store receipts were compared between overweight and non-overweight families, foods high in fat and energy were purchased more often among overweight families compared to non-overweight families (Ransley et al., 2003).

One of the first studies to explore the concept of an obesogenic home environment and conduct an in-home observational assessment found that there was no relationship between a persons' weight and the quantity and quality of foods in their home. However, the majority of participants in the study were at a healthy weight and in a predominantly homogeneous neighborhood. The researchers also speculated that the

overweight participants may be consuming high calorie foods more rapidly (Coates et al., 1978).

Other studies have examined the home food environment and its relationship to BMI among children and adolescents (Arcan et al., 2012; Boles et al., 2013; Couch et al., 2014; Downs et al., 2009; Ihmels et al., 2009; MacFarlane et al. 2009; Wang et al., 2013). For example, Ihmels et al. (2009) learned that infrequent family meals, increased SSB intake in the home, and increased sedentary time were significant predictors for children being overweight or obese. Boles et al. (2013) assessed the differences in the home food and activity environment between 82 healthy weight and obese preschoolers. The researchers found that families with obese preschoolers were less likely to have fresh vegetables available, more likely to have a television in their bedroom, and had fewer physical activity devices when compared to their healthier weight peers. Moreover, parents of healthy weight preschoolers provided children more access to healthier foods and made fruits and vegetables more readily available to eat.

Similarly, MacFarlane et al. (2009) examined the home food environment and its relationship to BMI among 293 children in a three-year longitudinal survey study and found that infrequent breakfast consumption and eating dinner while watching TV were associated with an increased BMI after 3 years compared to the baseline. However, self-reported surveys may reflect inaccurate information, especially if the parents are completing the surveys away from their homes and dependent on their memory.

Conversely, Downs et al. (2009) determined that weight status was not related to the home food environment among Cree children in Quebec. Similarly, Wang et al.

(2013) found that food availability in the home was not associated with overweight and obese child's weight. Most recently, Couch et al. (2014) found no significant association between a child being overweight and the availability of low-calorie or high-calorie foods in the home. However, Wang et al. (2013) found that the food availability in the home was associated with overweight and obese children's weight. Also, Arcan et al. (2012) found differences in the home food availability and BMI categories among American-Indian children. Therefore, further research is needed to examine how the home food environment affects weight status among children and adolescents.

   Home food inventories. While self-report surveys (Bryant et al., 2008; Gattshall et al., 2008; Ihmels et al., 2009; Pinard et al., 2014) and home food inventories (Boles et al., 2013; Fulkerson et al., 2008; Marsh et al., 2003; Patterson et al., 1997) have been developed and validated to assess the home food environment and its relationship to a child's predisposition to obesity, few tools have been designed specifically for parents to use in order to help them create a healthier home environment for their children. Bryant et al. (2008) conducted a telephone survey and a subsequent in-home assessment (within 14 days of the telephone interview) for the presence and quantity of healthy and unhealthy foods among 85 families with a child between the ages of 3 and 8 years. In their study, participants were asked to report the food and drink items that were available in the home, and researchers then confirmed their relevance to each category based on pre-determined lists of foods and drinks (Bryant et al., 2008). Boles et al. (2013) developed an in-home observational assessment tool to compare the differences in more than 20 home food and drink items based on their availability, accessibility, and readiness

to eat between healthy weight and obese preschoolers. Even though the tool successfully discriminated between the home food environments of preschoolers of different weight status, it was completed by researchers and not the parents). The Home Food Inventory survey developed by Fulkerson et al. (2008) assessed home food availability of 13 major food categories and ready-access foods in the kitchen and the refrigerator. This survey was completed by both research staff and study participants in the study. The results demonstrated high kappa scores and correlations between participants' and staff's reports on foods in the home, suggesting the tool can be effectively completed by a parent.

Given the consideration that entering private households and conducting an inventory of foods in the homes may create potential participant and researcher burden and inconvenience, particularly when the assessments are performed at multiple time points, the development and validation of a tool specifically designed for parents to complete at home appears necessary. This type of tool will assist parents in controlling and monitoring the types of foods that are available and visible in the home, providing their children more choices of healthier foods and limiting the access to unhealthier foods at home.

Further, few tools have been developed to examine the visibility of foods in a child's home food environment (Fulkerson et al., 2008). Understanding food visibility and storage practices may be relevant in terms of promoting healthy eating behaviors and creating a healthier home food environment. Food visibility refers to food that is on the countertops, top of refrigerators, or a person is able to see the food when opening the refrigerator and freezer without moving any items (Wansink et al., 2006). When food

storage practices were studied with 90 overweight adults in a six-month weight loss program, the participants who removed visible food from their countertops, living room tables, and kitchen tables were more likely to consume fewer calories and lose weight (Krukowski et al., 2010). Wansink et al. (2006) reported that although participants ate more, they tended to underestimate the amount they had consumed when foods like candies were visible and proximate). These very few studies were all conducted in adult population and few tools have been developed to assess the visibility of foods that parents can complete in their homes.

III. Research Direction and Questions

Studying the home food environment has the potential to further understand the causes of obesity and to form intervention strategies to reduce and prevent such a condition (Bryant & Stevens, 2006). Developing a parent-friendly home food inventory is necessary to accurately assess foods in the home environment. Further, comparing the availability and visibility of healthy and unhealthy foods in the home environment of healthy weight and overweight/obese children and adolescents, as well as exploring parent's views of their challenges and strategies in providing healthy foods in the home, is important to elucidate the underlying mechanisms and etiology of obesity in this population. The purpose of this study is to 1) to develop and validate a parent-friendly home food checklist to assess the availability and visibility of healthy and unhealthy food and beverages in the home; 2) to compare the differences in the availability and visibility

of home healthy and unhealthy foods and family meal frequency and quality between

healthy weight and overweight/obese children; and 3) to explore challenges and strategies

in promoting healthy eating in the home among parents of healthy weight and overweight

children. Based on the current literature review, the following research questions were

examined and explored:

Question 1: What is the validity and reliability of a parent-friendly home food inventory tool to assess the home food environment among children and adolescents, ages 6 years to 17 years?

Question 2: Is the availability and visibility of healthy and unhealthy foods and beverages and family meal variables different between the homes of healthy weight and overweight/obese children and adolescents, ages 6 years to 17 years?

Question 3: Are there different challenges and strategies in promoting healthy eating in the home between parents of healthy weight children and parents of overweight/obese children?

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Figure 1: Model of Factors Influencing the Home Food Environment

Micro-level
Socioeconomic Status
(working full-time or not)
Parent's education
Family Food Insecurity
Food Program Participation

Micro-level
Availability, accessibility, and visibility
of healthy and unhealthy foods and
beverages
Food storage practices
Home gardens
Kitchen appliances and cooking
equipment

Micro-level
Family meal frequency & nutritional quality
Parenting styles, practices & rules
Family structure, stress & schedules (single or dual
parent households)
Parental perceptions of challenges & strategies in
promote healthy eating
Macro-level
Parent's gender, age and race
Media, advertising, & marketing exposure

Economic Environment

Built Environment

Sociocultural Environment

Home Food Environment

Micro-level
Children and adolescent's
dietary intake
Taste preferences

Source: M. Nepper, 2015

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Study 1: Validation of a checklist to assess the home food environment of children

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Abstract

Objectives: To develop and test a home food checklist that parents can use to assess the availability and visibility of home healthy and unhealthy foods.

Methods: The in-house assessment was conducted in the homes of 82 parents and their children (9.8 ± 2.6 years). The Home Food Checklist was completed by both parents and researchers, and tested for criterion and construct validity. The agreement between researchers and parents (for criterion validity) was examined using kappa statistics.

Results: The checklist showed acceptable criterion validity (Kappa statistics: 0.41-1.00) between researchers' and parents' assessments for majority of tested items. Substantial construct validity was demonstrated by significant and positive correlations between availability scores of food items on the checklist and self-report 30-day availability scores of corresponding food items in the home (*Ps*<0.05).

Conclusions: The checklist is a useful tool that can be effectively completed by the parents to assess the home food environment.

Introduction

Childhood obesity rates are continuing to increase in the United States and have become epidemic in proportion[1]. The rising obesity rates have significant health consequences, contributing to increased rates of many chronic diseases including cardiovascular diseases, type II diabetes, and certain types of cancers[2]. The home environment is one of the most important settings in regard to a child's dietary intake and the development of obesity[3], since the majority of children and adolescents' food intake occurs in the home[4] and parents are seen as the nutritional gatekeeper influencing the provision of healthy foods to their children[5]. The importance of examining the home food environment has prompted researchers to develop tools to assess the foods in the home[6,7]. Food availability refers to foods that are actually present in the home, either on kitchen countertops, food storage spaces, refrigerators and freezers[8]. Several studies have assessed whether dietary consumption of certain healthy and unhealthy foods was related to the availability of these foods in the home and the majority found that such associations exist although the food items for the observed associations varied including fruit and vegetables, snack and sweet beverages and healthy and unhealthy foods in general[9,10].

While food availability has been explored with inventories, few tools have been developed to examine the visibility of foods in children's homes. Understanding food visibility and storage practices is also important for promoting healthy eating at home. Food visibility refers to food that is on the countertops, top of refrigerators, or a person is able to see the food when opening the refrigerator and freezer without moving any

items[11]. When food storage practices were studied with 90 overweight adults in a six-month weight loss program, the participants who removed visible food from their countertops, living room tables, and kitchen tables were more likely to consume fewer calories and lose weight[12]. Wansink et al.[11] reported that although participants ate more, they tended to underestimate the amount they had consumed when foods like candies were visible and proximate. However, these very few studies were all conducted in adult population.

While self-report surveys[13,14,15,16] and home food inventories[6,7,17,18] have been developed and validated to assess the home food environment and its relationship to a child's predisposition to obesity, few tools have been designed specifically for parents to use in order to help them create a healthier home environment for their children. Bryant et al. conducted a telephone survey and a subsequent in-home assessment (within 14 days of the telephone interview) for the presence and quantity of healthy and unhealthy foods among 85 families with a child between the ages of 3 and 8 years[13]. In their study, participants were asked to report the food and drink items that were available in the home, and researchers then confirmed their relevance to each category based on pre-determined lists of foods and drinks[13]. Boles et al. developed an in-home observational assessment tool to compare the differences in more than 20 home food and drink items based on their availability, accessibility, and readiness to eat between healthy weight and obese preschoolers. Even though the tool successfully discriminated between the home food environments of preschoolers of differing weight status, it was completed by researchers and not the parents[6]. In the study by Fulkerson et al., the Home Food

Inventory Survey was completed by both research staff and study participants, demonstrating high kappa scores (0.61 to 0.83) and correlations (0.72-0.97) between participants' and staff's reports on foods and drinks in the home[7]. However, the Home Food Inventory Survey was created for assessing a large variety of foods available in the home and taking an extended period of time to complete[7]. Longer assessment tools may cause a potential burden to the participants when multiple assessments are involved.

Entering private households to conduct food inventory can be time-consuming and expensive, creating potential participant and researcher burden and inconvenience, particularly when the assessments are performed at multiple time points. Thus, it is necessary to develop a reliable tool for parents to use which is simple, less time-consuming, and yet still captures a variety of healthy and unhealthy foods that are most frequently found in the home. This type of tool will assist parents in controlling and monitoring the types of foods that are available and visible in the home, providing their children more choices of healthy foods and limiting the access to unhealthy food items. The purposes of this study were: 1) to develop and test a simplified, participant-friendly home food checklist that parents can use to assess the availability and visibility of healthy and unhealthy foods and beverages in the home; 2) to determine whether the availability and visibility of home healthy and unhealthy foods were associated with children's dietary intakes of these foods; and 3) to determine whether the availability of home foods and drinks during the in-home assessment was associated with corresponding food and drink items over the past 30 days prior to the home visit.

Methods

Study Participants and Procedures

Parents or primary caregivers and their children were recruited using a convenience sampling methods, with recruitment occurring at elementary and middle schools, nutrition and cooking classes, and other community activities in Lincoln, Omaha, and surrounding areas in Nebraska. Eligible criteria were parents/or primary caregivers (≥19 years) with a school age child between the ages of 6 and 18 years and fluent in English. Parents and children completed an informed consent form before completion of the surveys. Researchers visited the homes within one to two weeks after recruitment and asked parents not to change their food purchasing behaviors or contents in the house before the visit. The researchers visited the home one time and home visits were conducted from May 2014 to May 2015. During the visit, two researchers working as a team and parents independently completed the Home Food Checklist without communicating with each other. The child completed a 41-item Block Food Frequency Screener[19]. Parents also completed a previously validated, brief 30-day Home Food Environment Survey (HFES)[20], which assesses the usual availability of foods and drinks in the home over a 30-day period. During the home visit, the child's weight and height were measured with light clothing and no shoes by researchers using a weight scale and portable stadiometer. Body mass index (BMI) was calculated using Centers for Disease Control and Prevention guidelines and plotted on age/gender-specific growth charts (USDA)[21].

Development of the Home Food Checklist

Modified from previously validated tools[6, 20], the current Home Food Checklist contained 29 healthy and unhealthy food items, 19 fresh, canned/jarred/dried, and frozen fruits and 16 fresh, canned/jarred/dried, and frozen vegetables. The home food checklist developed was based on the instrument by Boles et al. which assessed availability, accessibility, and readiness to eat among preschoolers[6]. Instead of accessibility and readiness to eat as measured in the instrument by Boles et al.[6], the current home food checklist assessed kitchen and refrigerator visibility (in addition to availability) of home healthy and unhealthy foods and drinks among school-aged children (average age: 9.8 ± 2.6 years). According to our pilot study conducted earlier among children with a similar age range[20], most parents stated during the home visit that their children had access to all foods without the assistance of parents or other adults or siblings in the household. Thus, accessibility and readiness to eat might not be relevant to this age group as to the preschoolers targeted by Boles et al[6]. Furthermore, the current home food checklist also assessed the availability of fresh, canned, and frozen forms of each individual fruit and vegetable items, thereby providing researchers a more detailed picture of home fruit and vegetable inventories and raising parents' awareness of keeping a variety of fresh fruits and vegetables at home.

A "yes/no" format was used to indicate the availability of the foods and drinks in the home. To reduce the intrusiveness of the study, two researchers inventoried the foods in the kitchen area only, and asked the parents to report foods in other areas of the home (e.g., basement, garage). Participants were instructed not to change their grocery shopping habits or food placement in the home prior to the home visit. Before parents

initiated their assessments, they were also instructed to physically open cupboards, refrigerators and freezers when necessary in order to perform a thorough assessment and minimize the errors of under-reporting.

The healthy foods and beverages were defined as: whole wheat bread, tortillas, pasta or rice, reduced-fat cheese, reduced-fat yogurt, whole grain, reduced-fat, high fiber and low sodium savory snacks, whole grain, unsweetened and high fiber breakfast cereals, reduced-fat sweet snacks and unsweetened oatmeal, 100% fruit juice, vegetable juice, skim or 1% milk, diet sodas, unsweetened ice tea or diet lemonade, and bottled water. Unhealthy foods and beverages were defined as: white bread, tortilla, pasta or rice, regular cheese, regular yogurt, regular savory snacks, sweetened breakfast cereals, regular sweet snacks, and sweetened oatmeal, white breads and pastas, high-fat cheese and yogurt, 2% or whole milk, sugar-sweetened drinks (fruit drinks, sodas, sweetened lemonades), and sports and energy drinks. The classification of "healthy" and "unhealthy" foods were derived from previous home food inventory tools [6,7] and followed "We Can: Go, Slow, Whoa" food system, in which "Go" foods are considered healthy and "Whoa" foods are unhealthy[22].

To increase the reliability of the coding of the food items, definitions were provided for whole grain, regular, reduced-fat, high fiber, low sodium, sweetened and unsweetened, which were based on the home food environment assessment tools used in the previous studies[6,7] and the Nutritional Standards for School Lunch meals and breakfast from the United States Department of Agriculture (USDA) National School Lunch and Breakfast Program[23]. The final tool assesses the availabilities of 18 healthy

(not including fruits and vegetables) and 11 unhealthy food and drink items, as well as 19 fruit and 16 vegetable items. Each fruit and vegetable item includes availability assessment for its fresh, canned, and frozen forms.

For visibility assessment, instructions were given on the Home Food Checklist for how to assess kitchen and refrigerator visibility. Parents were instructed to look around their kitchen (countertops, tops of refrigerator, dining room/kitchen table) and open their kitchen refrigerator and freezer (without moving food items around) and indicate which food items were visible with a "yes/no" format. The final checklist evaluates 15 and 17 food and drink items for kitchen and refrigerator visibility, respectively. The garage or basement refrigerator or freezer was not used in the completion of the visibility assessment, as the majority of foods eaten are usually in the kitchen refrigerator and freezer.

30-day Home Food Environment Survey

This previously validated 30-day Home Food Environment Survey (HFES)[20] was adapted from the instrument by Gattshall et al.[14] and used to assess the usual availability of foods and beverages in the home over a 30-day period. A five-point scale (never, rarely, sometimes, frequently, or always) was used for survey responses and was scored on a scale of 0-4 with "0" referring "Never" and "4" referring "Always". "Never", "Rarely", "Sometimes", "Frequently", and "Always" were defined as 0%, 25%, 50%, 75%, and 100% of the time, respectively[14,20].

Block Kids Food Frequency Screener

Each child completed a 41-item Block Kids Food Frequency Screener (FFS)[19] in their home with the assistance of the parent or researcher, if necessary. The previously validated Block Kid's Food Frequency Screener assesses intake by food groups over a 7-day time period for children (2-17 years)[24]. For each food item in the survey, the participants indicated how many days in the previous week they consumed the particular item (e.g., none, 1 day, 2 days, 3-4 days, 5-6 day, or every day last week). The responses to the items were scored from 0-5, representing 0, 1, 2 3-4, 5-6, and 7days/week (the past week), respectively. The food groups the screener captured were whole grains, fruits, vegetables, potatoes, dairy, protein foods (meat, poultry, fish and legumes), high fat foods, and sweetened foods with added sugar, as determined by data from the National Health and Nutrition Examination Surveys 2001-2002 and 2003-2004[19,24].

Data Analysis

SPSS version 22 (SPSS, Inc., Chicago, IL, USA) was used to perform all statistical analyses with a *p* value of <0.05 considered statistically significant. Criterion validity was assessed by comparing participants' and researchers' responses on the Home Food Checklist. The researchers who completed the Home Food Checklist were considered the 'gold standard'[7] because they developed the tool, and were trained on how to use the checklist. Kappa statistics were used to evaluate inter-rater reliability between the researchers and parents. Percent agreement was used when insufficient variations occurred among the ratings between researchers and parents, preventing the estimation of kappa scores. The percent agreement was calculated as follow: (The number of agreements/the total number of agreements and disagreements) x100%[6]. Guidelines for

kappa classification were: 0.81-1.00, outstanding; 0.61-0.80, substantial; 0.41-0.60, moderate; 0.21-0.40, fair; and <0.21, poor agreement[25,26]. Sensitivity and specificity values (ranged from 0.1 to 1.0) were calculated for the availability of each food and drink item. Sensitivity was defined as the proportion of food or drink item that was present, as determined by the researchers, which was accurately identified by the parents on the home food checklist as being present. Specificity was defined as the proportion of food or drink item that was not present, as determined by the researchers, which was accurately identified as not being present by the parents[27]. In addition, Cronbach's alpha was used to estimate the internal consistency reliability of the subscales of home healthy and unhealthy food availability, kitchen and refrigerator food visibility and fruit and vegetable availability.

Construct validity was assessed by examining if the availability scores of food and drink categories from the Home Food Checklist during the one-time, in-home assessment were associated with the 30-day availability scores of the corresponding food and drink categories from the previously validated, self-report Home Food Environment Survey[20]. It would be assumed that if the food was present in the house during the home visit, it would be more likely to be available over a certain period (e.g., 30 days). Spearman Correlation Coefficients (r) were used to assess the relationships between the results from the two instruments.

To determine if the foods available at home were associated with children's dietary intakes of these foods, Spearman correlation coefficients (r) were used to examine the relationships between healthy and unhealthy food categories recorded on the Home

Food Checklist and those recorded on the Block Food Frequency Screener[19]. If there were more than one item in each of the above mentioned food and drink categories, summary scores for all the items in that category were calculated and used for analyses.

Results

A total of 82 parents and children dyads participated in the study. The mean ages of the parents and children were 38.9 ± 6.4 years and 9.8 ± 2.6 years, respectively. The majority of the parents in the study were mothers (91.5%). Approximately 29.3% of the adult participants (parents) graduated from college, 45.1% were working full times, and 28.0% of the families were single-parent households. Income level was evenly distributed among the participants, with 22.8% having an income less than $25,000. The majority of the children were females (68.3%) and White (72.0%) with an average BMI of 22.0 kg/m^2 (Table 1). In addition, all of the parents completed the Home Food Checklist within 20 minutes.

Table 2 shows results of criterion validity for the availability of healthy and unhealthy food and drink items. Kappa statistics (agreement between researchers and parents) for majority of healthy and unhealthy food and drink items had moderate to outstanding agreement ranging from 0.41 to 0.90. Four items [regular cheese (0.11), whole grain savory snacks (0.17), high fiber savory snacks (0.06); and reduced-fat sweet snacks (0.17)] had poor agreement. Sensitivity for healthy and unhealthy food and drink items (excluding fruits and vegetables) ranged from 0.40 to 0.93. Specificity for these items was in a range of 0.53 to 0.97, with the exception of whole wheat bread, tortillas, pasta or rice (0.31), regular cheese (0.13), and white bread, tortilla, pasta, or rice (0.38).

Significant correlations were found between researchers and parents for summary scores of all healthy (r=0.75, P<0.0001) and unhealthy (r=0.65, P<0.0001) food and drink items. Cronbach's alpha for healthy and unhealthy food availability (29 items) was 0.72.

Kappa statistics/or percent agreement (percent agreement was calculated for items that showed no variations in assessments between researchers and parents) for 57 forms of 19 fruit and 48 forms of 16 vegetable items had moderate to outstanding agreement ranging from 0.42 to 1.00. Significant and positive correlations were found for summary scores of total fruits (r=0.73, P<0.0001) and vegetables (r=0.72, P<0.0001) between researchers and parents. Cronbach's alpha for fruit and vegetable availability (105 items/forms) was 0.70 (Table 3). Sensitivity and specificity were not calculated for fruits and vegetables because 16 fresh, canned and frozen fruits and 9 fresh, canned and frozen vegetables were not in any of the homes visited.

Criterion validity results for kitchen and refrigerator food and drink visibility are shown in Table 4. Kappa statistics ranged from 0.33 to 0.73 for kitchen visibility of healthy items, except for fresh (0.29) and canned vegetables (0.10). For kitchen visibility of unhealthy items, kappa scores ranged from 0.43 to 0.61. In addition, there were significant correlations between researcher and parent reports of kitchen visibility of total unhealthy food and drink items (r=0.66, P<0.0001). Kappa scores for refrigerator visibility of healthy food and drink items ranged from 0.37 to 0.74, with the exception of 0.21 for fresh and 0.27 for frozen vegetables. Kappa statistics for refrigerator visibility of unhealthy items ranged from 0.50 to 0.90 except for regular cheese (0.30). Significant correlations were observed between researcher and parent reports on summary scores of

total refrigerator healthy (r=0.66, P<0.0001) and unhealthy (r=0.76, P<0.0001) visible

items. Cronbach's alpha for kitchen and refrigerator visibility of a total of 31 surveyed

items was 0.50.

Construct validity was assessed by the correlations between food and drink

categories from the newly developed home food checklist and the corresponding

categories from the previously validated, self-report 30-day Home Food Environment

Survey (Table 5). Except for high-fat savory snacks (P=0.05), the scores of assessed food

and drink categories from the one-time, in-home assessment (from home food checklist)

were significantly and positively correlated to the 30-day availability scores of these

items from the Home Food Environment Survey[20] (Ps < 0.05) (Table 5).

Associations between home food availability and kitchen/refrigerator visibility

scores from the Home Food Checklist and children's dietary intakes from the Block Food

Frequency Screener[19] are shown in Table 6. Availability of home total vegetables was

significantly and positively associated with total intake of vegetables (r=0.40, P<0.0001).

Both home availability and kitchen/refrigerator visibility scores of sugar sweetened

snacks were significant and positively associated with children's dietary intakes of these

foods (availability, r=0.39, P<0.0001; kitchen/refrigerator visibility, r=0.48, P<0.0001).

Children's intake of milk was highly correlated to kitchen/refrigerator milk visibility

scores (r=0.86, P<0.0001); however, no significant correlations were observed between

kitchen/refrigerator fruit (r=0.01, P=0.96) or vegetable (r=0.06, P=0.59) visibility and

children's dietary consumptions of fruit and vegetables. Total home fruit availability was

not associated with children's dietary intakes of fruits (r=-0.09, P=0.45).

Discussion

The current study developed and tested a home food checklist to evaluate the availability and visibility of healthy and unhealthy foods and drinks in the home. Acceptable results for criterion and construct validity and the fact that all participants completed the assessment independently within a short length of time (20 minutes) suggest that this checklist is reliable and has the great potential to serve as a valuable and participant-friendly tool for parents to assess and monitor their home food environment.

Criterion validity was demonstrated by acceptable kappa scores (0.41-1.00) for the availabilities of the majority of the healthy and unhealthy food categories as well as for fresh, canned and frozen fruit and vegetable items between the assessments by researchers and parents. In addition, criterion validity was also indicated by the significant correlations (r) for summary scores of available total healthy and unhealthy food and drink items, and for summary scores of available total fruit and vegetables between researchers' and parents' evaluation. Although we provided specific definitions to increase reliability for "whole grain", "reduced-fat", "high-fiber", "low sodium", "sweetened" and "unsweetened" on the checklist, poor agreements were found for regular cheese (0.11), whole grains savory snacks (0.17), high-fiber savory snacks (0.06), and reduced fat sweet snacks (0.17). Interestingly, parents intended to report a higher prevalence of availability of these foods compared to the researchers, which may in part reflect the desire of parents to make healthy snacks (such as whole grain, high-fiber, and reduced fat sweet snacks) available in the home for their children. However, the above results further suggest that providing clear guidelines on how to accurately read a food

label along with the checklist may be beneficial for helping parents to accurately identify foods, particularly different types of snack foods in the cupboard or refrigerator, and minimize the unnecessary confusion parents may have.

The lower agreement scores on certain foods may also be attributable to the possibility that some parents completed the inventory without actually looking in their freezer or cupboards, as instructed by the researchers during the in-home visit while the researchers explored all items in the freezers and cupboards by moving items around to ensure an accurate count of all assessed items. It is possible that in the future when parents complete the checklist without researchers present and feeling the need to speed up the process, the accuracy of identifying food and drink items would improve. In agreement with previous research when using home food inventories[17,28], our study found that all the items had moderate to high sensitivity and specificity with the exception of three items which had relatively low specificity. However, all of these low-specificity items had high sensitivity scores (0.93 – 0.98). In addition, we also observed high internal consistency reliability for the availability of 29 home healthy and unhealthy foods (Cronbach's alpha=0.72) and availability of 105 forms of fresh, canned, and frozen fruit and vegetable items (Cronbach's alpha=0.70). The high sensitivity, specificity and internal consistency reliability results further indicate that this newly developed checklist is a reliable tool for home food environment assessment.

For kitchen and refrigerator visibility of healthy and unhealthy foods, the majority had acceptable kappa scores. High correlations between researchers and parents were also observed for kitchen or refrigerator visibility scores of total healthy and unhealthy foods.

In addition, the internal consistency reliability for visibility was acceptable in our study. Vegetables had low visibility kappa scores both for kitchen and refrigerator; however, the agreements between researchers and parents for fruit visibility were high except for canned/dried fruits. This suggests that parents might pay more attention to fruits than vegetables when they were assessing the kitchen and refrigerator food visibility.

Construct validity was shown by high correlations between the scores of food and drink categories obtained from the home food checklist and the scores of the corresponding items from the previously validated, self-report 30-day home environment survey. This further suggests that foods and drinks present or absent in the household on a typical day when the in-home assessment was conducted were more likely to reflect the usual availabilities of these foods in the home and were consistent with the regular food purchasing practice of the family.

In the current study, we found that children's dietary intakes of sweet snacks were not only associated with home availability but also associated with kitchen and refrigerator visibility of these foods. The association between availability and children's dietary intakes of home sweet foods has been reported previously[29,30]; however, no research has examined the relationships between home food visibility and dietary consumptions among children. Wansink et al. reported that when foods like candies were visible and proximate to adult participants, the consumptions of these foods increased[11], which was confirmed in the current study. NHANES 2003-2006 data suggested that children and adolescents, ages 2-18 years, consumed 40% of their total energy from foods with added sugars and solid fats (e.g., grain desserts, soda, and sweet foods), which

is much higher than the recommended allowance of 8% to 20%[31]. Previous research has also found that snacking has increased among youth nationwide[32]. Therefore, our findings particularly the positive association between the visibility and children's dietary intakes of sweet snacks are important for weight management and obesity prevention since they may provide a possible explanation and potential solution to the high intakes of sugary foods observed among children. Our results also suggest that educating parents to reduce the availability and visibility of home sweet snacks may improve children's diet quality.

Consistent with previous studies[7,14,33,34,35], we observed significant and positive associations between home vegetable availability and children's vegetable intake. However, the availability of fruit in the home was not associated with children's fruit intake, suggesting the availability of vegetables in the home appeared more relevant compared to fruit since it was directly associated with children's dietary intake of vegetables. Interestingly, neither fruit nor vegetable visibility in the home was associated with children's dietary intakes of fruit and vegetables in our study. In contrast, children's consumption of milk was highly correlated to visibility. The possible explanation could be that children were more likely to see milk cartons when opening the refrigerator, thus encouraging this choice more often. Parents may use the similar strategy to motivate their children to consume more fruit and vegetables and other healthy foods by displaying or wrapping these foods in a way that attracts more of children's attention.

Our study had several limitations. We conducted a single assessment of the home food environment and did not perform the test and re-test reliabilities, and therefore may

not address the consistency of foods and drinks available and visible in the home over a certain time period. Although parents were instructed not to change their home food items before the researchers conducted the home visit, it was possible that parents might have altered food items (removed unhealthy foods and purchased more healthy foods) to achieve a more social desirable environment. However, construct validity results demonstrated significant and positive associations between the availability of foods and beverages from this newly developed checklist and the corresponding items from previously validated, self-report, 30-day Home Food Environment survey, suggesting the availability of foods at the time of the in-house assessment is more likely to reflect what is usually in the home over a longer period of time (i.e., 30 days) as well as the food shopping habits of the parents. Since this simplified Home Food Checklist was particularly designed for parents to assess the availability and visibility of home healthy and unhealthy foods, repeated assessments would be possible for future studies in which the evaluations can be independently completed by the parents without the assistance of the research staff. Furthermore, the quantities of the food and drink items were not assessed by the Home Food Checklist in our study. Since the responses were "Yes" for presence or "No" for the absence of the foods surveyed, the household might score high on total availability of fruits or vegetables even when the quantity was limited for individual items in the respective categories. Lastly, although this newly developed Home Food Checklist was tested among 82 parents of school-age children in the current study, future studies with larger sample size are needed to fully validate this assessment tool.

Implications for Health Behavior

In conclusion, the currently developed Home Food Checklist is a reliable and useful tool to assess the availability and visibility of a variety of home healthy and unhealthy foods. Our results indicate that this simple checklist can be independently and effectively completed by the parents, suggesting the feasibility of multiple assessments of home food environment.

Identifying deficits and areas to improve in children's home food environment is necessary for direct intervention for weight management and combating childhood obesity epidemic. Regularly assessing the availability and visibility of home healthy and unhealthy foods would increase parents' awareness of improving home food environment, thereby helping their children to form healthier eating behaviors. The significant and positive associations of home availability and visibility of sugar sweetened snacks and availability of vegetables with children's dietary intakes of these foods suggest the importance of creating a healthy home food environment by increasing the choices of healthy foods and limiting the unhealthy food options, as well as exploring new ways that would make healthy foods such as fruits and vegetables more attractive and appealing to children.

Human Subjects Approval Statement

Parents and children completed an informed consent form before completion of the surveys and data collection. The study was approved by and all procedures were followed in accordance with the University of Nebraska-Lincoln Institutional Review Board.

Conflict of Interest Disclosure Statement

The authors declare that they have no competing interests.

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Table 1: Characteristics of Study Participants

Child (n = 82)	
Age (year)	9.8 ± 2.6
Gender, n (%)	
Male	26 (31.7)
Female	56 (68.3)
Race/ethnicity, n (%)	
Non-Hispanic White	59 (72.0)
Hispanic or Latino	9 (11.0)
African-American	11 (13.4)
Asian-American	2 (2.4)
Other	1 (1.2)
Body mass index (BMI, Kg/m2)	22 ± 7.7
Parents/caregivers (n=82)	
Age (year)	38.9 ± 6.4
Gender, n (%)	
Male	7 (8.5)
Female	75 (91.5)
College graduate, n (%)	24 (29.3)
Working full time, n (%)	37 (45.1)
Single parent household, n (%)	23 (28.0)
Family income, n (%)	
<$25,000	18 (22.0)
$25,000 - $50,000	17 (20.7)
$50,00 - $75,000	15 (18.3)
$75,00 - $100,000	11 (13.4)
>$100,000	18 (22.0)

Table 2. Kappa statistics for researcher and parent agreement, sensitivity and specificity for of the availability of Food and Drink Items (N=82)

Food and drink item	Kappa[a]	Sensitivity[b]	Specificity[c]	Correlation[d] r (P value)	Cronbach' Alpha
Unhealthy items				0.65 (<0.0001)	
Fruit drinks (not 100% fruit juice)	0.39	0.80	0.58		
Sports or Energy Drinks	0.72	0.90	0.86		
Milk (whole or 2% - any flavor)	0.90	0.89	1.00		
Regular sodas or sweetened drinks	0.73	0.85	0.87		
White bread, tortilla, pasta or rice	0.31	0.93	0.38		
Regular cheese (ex: American, cheddar, Swiss)	0.11	0.96	0.13		
Regular yogurt (made with whole milk)	0.30	0.75	0.78		
Regular ice cream or frozen dessert	0.78	0.80	0.98		
Regular savory snacks (ex: potato chips, peanuts)	0.44	0.91	0.55		
Sweetened breakfast cereal (>6g sugar/serving)	0.41	0.95	0.50		
Regular sweet snacks (ex: cake, cookies)	0.41	0.43	0.88		
Healthy items				0.75 (<0.0001)	
100% fruit juice	0.67	0.91	0.75		
Vegetable juice	0.74	0.89	0.87		
Milk (skim or 1% - any flavor)	0.87	0.92	0.97		
Diet sodas, unsweetened ice tea	0.54	0.88	0.72		
Bottled water	0.61	0.91	0.68		
Whole wheat bread, tortillas, pasta or rice	0.32	0.98	0.31		
Reduced-fat cheese (ex: low-fat cheddar, Swiss)	0.24	0.55	0.81		
Reduced-fat yogurt	0.55	0.93	0.89		
Reduced fat or lite ice cream, frozen yogurt	0.57	0.70	0.86		
Whole grain savory snacks (ex: crackers)	0.17	0.53	0.68		
Reduced-fat savory snacks (ex: pretzels)	0.35	0.52	0.82		
High fiber savory snacks (>3 g fiber/serving)	0.06	0.40	0.70		
Low-sodium savory snacks (<140 mg/serving)	0.36	0.87	0.55		
Whole grain breakfast cereal	0.44	0.91	0.53		
Unsweetened breakfast cereal (<6g sugar/serving)	0.56	0.77	0.81		
High fiber breakfast cereal (>3 g fiber/serving	0.52	0.74	0.78		
Reduced-fat sweet snacks (ex: fat-free cookies)	0.17	0.46	0.75		
Unsweetened oatmeal (<6 g sugar/serving)	0.51	0.77	0.76		

Total Unhealthy & Healthy items:	0.72

[a]Kappa statistics for comparing the assessments between researchers and parents on each item.
[b]Sensitivity: the proportion of food or drink item that was present, as accurately determined by the researchers.
[c]Specificity: the proportion of food or drink items that were not present, as accurately determined by the researchers.
[d]Correlations in summary scores of healthy items or summary scores of availability of unhealthy items between assessments from researchers and from parents using Spearman Correlation Coefficient.

Table 3. Kappa statistics for researcher and parent agreement of the availability of fresh, canned, and frozen fruits and vegetables (n=82)

Item	# of homes available for the item			Kappa Statistics[a]/ Percent Agreement[b]			r (p-value)[c]
	Fresh	Canned	Frozen	Fresh	Canned	Frozen	
Fruit							0.74[c] (<0.0001)
Bananas	39	0	8	0.77	1.00[b]	1.00[b]	
Oranges	36	17	1	0.80	0.46	0.46	
Apples	53	17	3	0.65	0.96[b]	0.98[b]	
Grapes	24	3	4	0.89	0.65	0.65	
Watermelon	5	0	0	1.00[b]	1.00[b]	1.00[b]	
Grapefruit	7	2	0	0.78	0.66	0.66	
Cantaloupe	1	1	0	0.90[b]	1.00[b]	1.00[b]	
Strawberry	12	2	27	0.95	1.00[b]	1.00ǂ	
Pineapples	8	21	10	0.88	0.54	0.54	
Peaches	0	21	12	1.00[b]	0.55	0.55	
Plums	2	2	0	0.56	0.79	0.79	
Pears	19	14	0	0.77	0.59	1.00[b]	
Nectarines	1	0	0	0.66	1.00[b]	1.00[b]	
Tangerines	1	0	0	0.85[b]	1.00[b]	1.00[b]	
Honeydew Melon	0	0	0	1.00[b]	1.00[b]	1.00[b]	
Cherries	1	3	8	0.49	0.43	0.43	
Avocados	8	0	1	0.93	1.00[b]	1.00[b]	
Blueberries	5	1	25	0.55	0.95b	0.73[b]	
Fruit Cocktail	0	11	3	1.00[b]	0.50	0.50	
Vegetables							0.73[c] (<0.0001)
Tomatoes	28	40	5	0.53	0.98[b]	0.65	
Sweet Corn	7	47	34	0.42	0.47	0.53	
Green beans	3	41	22	0.95[b]	0.56	0.55	
Carrots	46	6	19	0.62	0.55	0.83[b]	
Lettuce	44	0	0	0.63	1.00[b]	1.00[b]	
Green peas	22	38	3	0.58	0.59	0.51	
Cabbage	3	1	0	0.52	0.66	1.00[b]	
Broccoli	11	1	39	0.64	1.00[b]	0.49	
Cucumber	13	2	0	0.49	0.66	1.00	
Celery	29	0	1	0.79	1.00[b]	0.49	
Bell pepper	30	2	13	0.46	0.66	0.37	
Spinach	12	5	11	0.57	0.88	0.65	
Cauliflower	5	0	0	0.75	1.00[b]	0.66	
Asparagus	4	1	1	0.74	1.00[b]	0.49	
Onions	42	0	0	0.46	1.00[b]	0.98[b]	
Potatoes	39	7	29	0.45	0.58	0.68[b]	

Cronbach's Alpha for total fruit and vegetable items = 0.70

[a]Kappa statistics for comparing the assessments between researchers and parents on each item;

[b] Percent agreement was reported when researcher or parents showed no variability in assessment (coding), and thus it was not suitable for Kappa statistics. Percent agreement was used and calculated as follow: (number of agreements / number of agreements and disagreements) x 100%

[c] Correlations in summary scores of availability of fresh, canned, and frozen fruit or summary scores of availability of fresh, canned, and frozen vegetables between assessments from researchers and from parents using Spearman Correlation Coefficient.

Table 4. Kappa statistics for researcher and parent agreement of kitchen and refrigerator visibility food and drink items (n=82)

Food and Drink Items	Kappa Statistics[a]	Correlation[b] r (P value)	Cronbach's Alpha
Kitchen Visibility Item			
Healthy Item		0.18 (0.12)	
Fresh Fruit	0.73		
Canned/dried fruit	0.33		
Fresh vegetables	0.29		
Canned vegetables	0.10		
Red-fat savory snacks	0.55		
Unsweetened cereal	0.73		
Whole wheat bread	0.35		
Diet soda	0.36		
Red-fat sweet snacks	0.61		
Unhealthy Items		0.66 (<0.0001)	
Regular savory snacks	0.55		
Sweetened cereal	0.59		
White bread	0.63		
Regular soda	0.43		
Candy	0.53		
Regular sweet snacks	0.61		
Refrigerator Visibility Item			
Healthy Items		0.66 (<0.0001)	
Skim/1% milk	0.74		
100% fruit juice	0.67		
Diet soda	0.73		
Bottled/contained water	0.37		
Reduced-fat cheese	0.38		
Reduced-fat yogurt	0.67		
Fresh vegetables	0.21		
Fresh fruit	0.44		
Frozen fruit	0.64		
Frozen vegetables	0.27		
Lite ice cream/fruit bars	0.50		
Unhealthy Items		0.76 (<0.0001)	
2%/whole milk	0.90		
Fruit drinks/sport drinks	0.50		
Regular soda	0.75		
Regular cheese	0.30		
Reg yogurt (w/whole milk)	0.50		
Regular ice cream	0.83		
Total Kitchen & Refrigerator Visibility (30 items)			0.50

[a] Kappa statistics for comparing the assessments between researchers and parents on each item. [b] Correlations in summary scores for total kitchen visibility healthy items, summary scores for total kitchen visibility unhealthy items, summary scores for total refrigerator visibility healthy items, or summary scores for total refrigerator visibility unhealthy items between assessments from researchers and from parents using Spearman Correlation Coefficient.

**Table 5: Correlations between availability of home food and drinks items from HFC
and 30-day usual availability from HEFS (n=82)**

Food/Drink Categories from HFC and HFES[a]	r (P value)[b]
Fresh fruit	0.29 (0.008)
Frozen fruit	0.50 (<0.0001)
Canned/dried fruit	0.39 (<0.0001)
Fresh vegetables	0.38 (0.001)
Frozen vegetables	0.49 (<0.0001)
Canned/dried vegetables	0.27 (0.02)
Skim/1% milk	0.62 (<0.0001)
2%/whole milk	0.62 (<0.0001)
100% fruit juice	0.51 (<0.0001)
Fruit drinks	0.31 (0.001)
Sports/Energy drinks	0.50 (<0.0001)
Regular soda	0.49 (<0.0001)
Diet soda	0.50 (<0.0001)
High-fat sweet snacks	0.26 (0.02)
Reduced-fat sweet snacks	0.25 (0.03)
High-fat savory snacks	0.22 (0.05)
Reduced-fat savory snacks	0.35 (0.001)

[a] HFC = Home Food Checklist; HFES = Home Food Environment Survey.

[b] Correlations between availability of home food and drinks items from HFC and 30-day usual availability from HEFS using Spearman Correlation Coefficient (r).

Table 6. Correlations between availability or visibility of selected home food and drink items from HFC and children's dietary intakes from FFS (n=82)[a]

Food/drink from HFC[b]	Children's dietary intakes from FFS[b]						
	Total fruit[c]	Total vegs[c]	SSB[c,d]	High-fat savory snacks[c]	Sugar sweet snacks[c]	Milk[c,e]	WW bread
Home availability							
Total fruit[c]	-0.09 (0.45)						
Total Vegs[c]		**0.40 (<0.0001)**					
SSB[c,d]			0.20 (0.07)				
High-fat savory snack[c]				0.16 (0.17)			
Sugar sweet snacks[c]					**0.39 (<0.0001)**		
Milk[c,e]						0.19 (0.08)	
WW breads							0.11 (0.34)
Kitchen and refrigerator Visibility							
Total fruit[c]	0.01 (0.96)						
Total Vegs.[c]		0.06 (0.59)					
SSB,[c,d]			0.22 (0.05)				
High-fat savory snack[c]				0.03 (0.81)			
Sugar sweet snacks[c]					**0.48 (<0.0001)**		
Milk[c,e]						**0.86 (<0.0001)**	
WW Breads							0.18 (0.12)

[a] Data presented as Spearman Correlation Coefficient (P value).

[b] HFC = Home Food Checklist; FFS = Block Food Frequency Screener

[c] Summary scores for all the items in the respective category (fruit, vegetable, Sugary sweetened beverages, high-fat savory snacks, sugary sweetened snacks, savory snacks, or milk) from HFC and FFS were used to calculate correlation coefficient.

[d] Not including real fruit juice

[e] Including all types of milk

Study 2: Assessment of home food environment among healthy weight and overweight/obese children

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Abstract

Background: To measure the differences in the availability and visibility of home healthy and unhealthy foods and family meal frequency and quality between healthy weight and overweight/obese children.

Methodology: In- home assessment for home food availability and visibility was conducted and children's weight and height were measured by researchers. Self-reported survey regarding demographics and family meals were completed by the parents. Logistic regression analysis was used to examine associations of parent and children demographic characteristics, home food availability and visibility and family meal variables with children's weight status. Forty-two overweight/obese and 40 healthy weight children (9.8±2.6 years) and their parents participated in the study.

Results: The availability of home total unhealthy foods was significantly associated with overweight or obesity among children; however, the association was not significant after adjusting for single-parent household and parent working status. Lower refrigerator visibility of home total unhealthy foods (OR=0.60, 95% CI=0.39-0.92, P=0.02) and lower frequency of family meals (OR=0.10, 95% CI=0.01-0.96, P=0.02) were significantly associated with children being overweight or obese after adjustment for covariates. Parents who worked full-time (OR=4.14, 95%CI=1.62-10.54, p=0.008), single parent household (OR=0.19, 95% CI 0.06-0.58, p=0.002), and older parents (OR=1.11, 95% CI 1.03-1.20, p=.004) were positively associated with overweight/obesity of children.

Conclusion: Assessing the home food environment such as the availability and visibility of home healthy and unhealthy foods and the frequency and quality of family meals

among healthy weight and overweight/obese children is necessary for developing direct

interventions for weight management.

Keywords: home food environment, availability, visibility, children, obesity

Introduction

Childhood and adolescent obesity is a major public health concern because of its impact on long-term health consequences that may last into adulthood [1]. Currently, 32.4% of U.S. children and adolescents between the ages of 6 and 19 years are overweight, and 16.5% are obese[2]. The home environment is considered one of the most important settings in regards to the potential development of obesity since 65% of a child's dietary intake is consumed at home[3,4]. Researchers have started to examine the multiple factors in the home environment that may contribute to childhood obesity [5,6,7], which include home food availability and accessibility, family meal quality and frequency, and parental status[5,8,9,10].

Several studies have examined the associations of home food availability with a child's weight status. Some found that the presence or absence of healthy or unhealthy foods in the home environment associated with children's weight status [5,11], while others did not [12,13]. Boles et al. conducted an in-home assessment and reported that families of obese preschoolers were significantly less likely to have fresh vegetables available or accessible in the home as compared to homes of healthy weight preschoolers [5]. However, this type of assessment has not been performed between healthy weight and overweight/obese school-age children in the home environment.

In addition to the availability, assessing home food visibility and storage practices is also important for promoting healthy eating at home. It is suggested that food visibility may increase the attention to food and influence the amount and type of food eaten [14].

When food storage practices were studied with 90 overweight adults in a six-month weight loss program, the participants who removed visible food from their countertops, living room tables, and kitchen tables were more likely to consume fewer calories and lose weight [15]. Wansink et al. also reported that although participants ate more, they tended to underestimate the amount they had consumed when foods like candies were visible and proximate [14]. However, these very few studies were all conducted in adult population and to date no research has assessed the home food visibility among overweight/obese and healthy weight children.

Family meals have been studied in regards to its relationship with a child's weight status with conflicting results [16, 17]. For example, having frequent family meals was associated with eating more fruits and vegetables and breakfast; however, it had no effect on adolescents' BMI [17]. Conversely, Taveras et al. found that eating together most days of the week decreased pre-adolescents' BMI [16]. In addition, Goldfield et al. reported that a higher frequency of family meals was associated with a lower BMI in girls, but not in boys [18]. In a recent systematic review, Valdes et al. reported inconsistent and weak evidence of an inverse association between family meal frequency and risk of childhood overweight and obesity [19]. Furthermore, limited studies have been conducted to determine if there is a relationship between the types of foods served at family meals and children's weigh status [20].

An ecological framework developed by Rosenkranz & Dzewaltowski (2008) that describes the multiple influences of the home food environment on childhood obesity serves as the theoretical framework for this study[4] . This framework depicts the home

food environment as domains that are interactive and overlap, and include the built (food availability and visibility), sociocultural (parent's age, race, gender, family structure, such as single or dual parent household), and family eating patterns (family meals and foods served), and economic (family socioeconomic status) environment. This study will focus on these three domains and its potential influence on a child's weight status (Figure 1). Therefore, the objective of the current study was to assess the differences in the availability and visibility of home healthy and unhealthy food and family meal variables between healthy weight and overweight/obese children. In addition, we sought to determine whether a child's weight status was explained by various demographic characteristics of children or parents.

Materials and Methods

Study participants and procedures.

The study was approved by the University of Nebraska-Lincoln Institutional Review Board. Parents or primary caregivers and their children were recruited using a convenience sampling method, with recruitment occurring at elementary and middle schools, nutrition and cooking classes, family-based weight management programs, and other community activities in Lincoln, Omaha, and surrounding communities in Nebraska. Eligible criteria were parents/or primary caregivers (≥19 years and primarily responsible for household shopping and food preparation) with a school-aged child between the ages of 6 and 18 years and fluent in English. Previous literature [5,21] and our pilot study of children with similar ages [22] yielded medium effect sizes ranging from .57 to .63 for tests of the interested variables. An effect size of .64 with an alpha of .05 and

power set at 80% require 80 total participants and was calculated used G-Power[23].

Forty-two children were included in the overweight/obese group (2 boys and 30 girls),

and 40 children were included in the healthy weight group (14 boys and 26 girls).

Children's average age was 9.8 ± 2.6 years.

Researchers visited the homes within one to two weeks after recruitment and

asked parents not to change their food purchasing behaviors or contents in the house

before the in-home visit. The home visit was conducted from May 2014 to May 2015.

Parents and children completed an informed consent form before completion of the

surveys. Parents completed a previously validated Home Food Environment Survey

(HFES) [22], which assessed demographic characteristics, and family meal frequency and

quality of foods served. Researchers completed a validated Home Food Checklist (HFC)

which assessed the availability and visibility of healthy and unhealthy foods in the home

(Nepper MJ & Chai W, unpublished results). At the home visit, children's weight and

height were measured with light clothing and no shoes using a weight scale and portable

stadiometer. Heights and weights were measured three times by both researchers, and the

measurement that was most accurately collected from both researchers was used. BMI

was calculated using Centers for Disease Control and Prevention guidelines and plotted

on age/gender-specific growth charts [24]. After measurements were taken, the child was

placed in either the healthy weight or overweight/obese group, and no children were

placed in the underweight category. Weight categories were defined: $\geq 95^{th}$ percentile as

obese; between the 85th and 95th percentile as overweight; and between the 5th and 85th

percentile as healthy weight; and $\leq 5^{th}$ percentile as underweight [25].

Home food checklist

Modified from previously validated tools [5, 26], the Home Food Checklist (HFC) contained 30 healthy and unhealthy food and beverage items (ex: sweet and savory snacks, beverages, breakfast/oatmeal cereals, breads/pastas, and dairy foods), 19 fresh, canned/jarred/dried, and frozen fruits, and 16 fresh, canned/jarred/dried, and frozen vegetables. A "yes/no" format was used to indicate the availability of the food in the home. To reduce the intrusiveness of the study, researchers inventoried the foods in the kitchen area only and asked the parents to report any of the foods in other areas of the home (ex: basement, garage). For visibility assessment, parents were instructed to look around their kitchen (countertops, tops of refrigerator, dining room/kitchen table) and open their kitchen refrigerator and freezer and indicate which healthy and unhealthy foods items were visible (without moving any items around) with a "yes/no" format. The garage or basement refrigerator or freezer was not used in the completion of the visibility score, as the majority of foods eaten are usually in the kitchen refrigerator and freezer.

The healthy foods and beverages were defined as whole grain, reduced-fat, high fiber, and low sodium savory snacks; whole grain, unsweetened, and high fiber breakfast cereals; reduced-fat sweet snacks, unsweetened oatmeal, whole grain breads and pastas, reduced-fat yogurt and cheese, 100% fruit juice, vegetable juice, skim or 1% milk, diet sodas, unsweetened ice tea or diet lemonade, and bottled water. Unhealthy foods and beverages were defined as regular savory snacks, sweetened breakfast cereals, regular sweet snacks, sweetened oatmeal, white breads and pastas, high-fat cheese and yogurt, 2% or whole milk, sugar-sweetened drinks (fruit drinks, sodas, sweetened lemonades),

and sports and energy drinks. Classifications of healthy and unhealthy foods and beverages generally followed the Nutritional Standards for School Lunch meals and breakfast from the USDA National School Lunch and Breakfast program [27].

Survey for family meals

Questions regarding family meals were adopted from previous validated surveys and included family meal frequency, the number of take-out foods or fast-foods served at the evening family meal, and if the TV was on during a family meal in a count per week format (1 day or less, 2, 3, 4, 5, 6, or 7 days/week) [28,29,30]. The types of foods (green salads, vegetables (not potatoes), fruit, 100% fruit juice, 2%/whole milk, 1%/skim milk, and regular soda) served at evening meals were from a previously validated survey using a Likert scale ranging from "never" , "sometimes", "usually", or "always" [10].

Data Analysis

SPSS version 22 (SPSS, Inc., Chicago, IL, USA) was used to perform all statistical analyses with a *p* value of <0.05 considered statistically significant. Characteristics of study participants (parents and children) between healthy weight and overweight/obese children groups were compared using Chi-square tests (for categorical variables) or t-test (for continuous variables). Logistic regression was used to determine whether any of the characteristics of parents or children were associated with children being overweight or obese (overweight/obese, yes or no). Participants' characteristics included child's gender, race (White, African-American, Hispanic/Latino, Asian American, or other), and BMI and parent's gender, income level (<$25,000/year,

$25,000-$75,000/year, or >$75,000/year), education (college graduate, yes or no), work status (working full time, yes or no), and if it was a single parent household (yes or no).

The differences in availability and visibility of home foods, family meal variables and foods served at the family evening meals between healthy weight and overweight/obese children were assessed using t –test. Summary scores were used if there were more foods in the individual food category. Logistic regression was used to assess the association of food availability, visibility, family meal variables and foods served at family evening meals with children's weight status (overweight/obese, yes or no). The analyses were repeated after the adjustment for parent's working status (working full-time, yes or no) and number of parents in the household (single parent household, yes or no). Sensitivity analysis was performed to determine which covariates were included in the model. Initially we also included parent's age in the full model. This variable (parent's age) was removed after performing the sensitivity analysis.

Results

Characteristics of the study participants are shown in Table 1. A total of 82 parents (who were primarily responsible for food purchasing and preparation in the household) and children dyads participated in the study. The mean ages of the parents and children were 38.9 years and 9.8 years, respectively. Forty-two of the children were overweight or obese (14 boys and 26 girls) and 40 were in the healthy weight category (12 boys and 30 girls). The majority of the children in the study was White (72%) and had an average BMI of 22.1 ± 7.7. The majority of parents in the study were mothers (91.5%) and lived with a spouse or another caregiver in the home (72%). A total of

45.7% of the adult participants worked full time, 5l.2% graduated from college, and 44.3% of the families had an annual income less than $25,000. Relative to healthy weight children, overweight and obese children were more likely to have an older parent (OR=1.11, 95% CI=1.03-1.20, P=.004); have a parent working full-time (OR=4.14, 95% CI=1.62-10.54, P=.008), and live in a single parent household (OR= 5.25 95% CI=1.72-16.07, P<0.002). Children's gender and race, parent's (main food shopper and preparer) education, and family annual income levels were not associated with children's weight status (Table 1).

Table 2 shows the differences in the home food availability and visibility and family meal frequency and types of foods served at evening family meals between healthy weight and overweight/obese children. Healthy weight children had significantly higher average scores of home total unhealthy foods (P=0.01) compared to overweight/obese children. Homes of healthy weight children were also characterized by higher visibility scores of refrigerator unhealthy foods (P=0.02). No significant differences were observed in the availability and visibility scores in the remaining categories of home healthy and unhealthy foods. With respect to family meals, the frequency of having family evening meals were significantly lower in overweight/obese children than that in healthy weight children (P=0.003). There were no significant differences in the type of foods served at family evening meals and frequency of eating fast foods or eating meals with TV turned on per week between the two groups.

Associations of home food availability and visibility with children's weight status are presented in Table 3. Results from the basic model (without further adjustment

for covariates) showed an inverse association of the availability of home total unhealthy foods (P=0.01) with children being overweight/obese and borderline statistically significant association between lower availability of home unhealthy sweet snacks and overweight/obesity among children (P=0.05). The association of the availability of home total unhealthy foods remained significant after adjusting for single parent household (yes vs. no) and whether the parent (main food purchaser and preparer) was working full-time (P=0.045), but the association of the availability of home total unhealthy sweet snacks did not remain significant after adjustment for single parent household and parent working full-time (P=0.11). Overweight or obesity among children was inversed associated with the refrigerator visibility of home unhealthy foods (P=0.03) and the association remained significant after adjusting for covariates (P=0.02). With regard to family meals, children who had family meals most frequently (more than 5 days a week) were less likely to be overweight or obese relative to those who had fewer family meals (0-2 days/week) (OR=0.11, 95% CI=0.01-0.99, P=0.008) and the results remained significant after the adjustment for single parent household and parent working status (OR=0.10, 95% CI=0.01-0.96, P=0.02). The frequency of fruit (OR=4.47, 95% CI=1.06-18.82, P=0.02) and 1% or skim milk (OR=8.90, CI=1.29-61.23, P=0.04) served at family evening meals was positively and significantly associated with overweight or obese status of the children after adjustment for the covariates (Table 4).

Discussion

The impact of the home environment on a child's weight is multifactorial and complex. This study is among the first to conduct in-home assessments to compare both

the availability and visibility of home healthy and unhealthy foods, as well as family meal frequency and types of foods served at the family evening meals between healthy weight and overweight/obese school-aged children, which factors are based on the theoretical framework of Rosenkranz and Dzewaltowski (2008)[4].

In our study, there were no significant differences in home fruit and vegetable availability, including total, fresh, frozen and canned/jarred/dried fruit and vegetables between healthy weight and overweight/obese children. These results were inconsistent with the study by Boles et al. who reported that fresh vegetables were less likely to be present in the homes of obese preschoolers [5]. However, their study did not examine the availability of frozen and canned/jarred/dried fruits and vegetables in the home. It is possible that the availability of home fresh fruits and vegetables varied during the month because of family budget concerns, especially those families who receive food assistance and purchase most of their fresh fruits and vegetables at the first of the month whereas some of the home visits were scheduled at the end of the month. However, in our study, family annual income levels were not associated with children's weight status, and the aforementioned results did not change materially after adjusting for covariates such as working status of parents and number of parents in the household. Therefore, it is unlikely that our results were confounded by the family budget concerns associated with family income levels, number of the parents in household, and whether a parent was working fulltime. Additionally, in the study by Boles et al., the food environments of healthy weight preschoolers were only compared to their obese counterparts [5]; whereas

the unhealthy weight group in the current study included both overweight and obese school-aged children.

It is interesting to note that the majority of the healthy weight and overweight/obese homes we visited did not have a wide variety of fruits and vegetables available. For example, homes for both weight categories had an average of only 5 different fruits and 8 different vegetables available including all fresh, canned/jarred/dried and frozen items, while the home food assessment survey we used had 53 and 46 total possible different fresh, canned/jarred/dried, and frozen fruits and vegetables, respectively. Although Vereecken et al. reported that 95% of the parents surveyed stated that they mostly or always had fruit and vegetable available in the home [31]. Boles et al. found that out of 18 possible fresh fruit categories and 14 possible fresh vegetable categories, the average amount of different types of fresh fruit and vegetables available in the homes was only 3.2 for fruits and 3.8 for vegetables among homes of healthy weight children [5]. For obese children, the availability of different fruits and vegetables were 3.0 and 2.5, respectively. In contrast, nearly all of the homes visited had some type of regular sugary or high-fat snack food available (e.g., chips, cookies, ice cream) regardless of children's weight status. These results reinforce that home interventions and nutrition education for families need to emphasize on keeping a variety of different fruits and vegetables and limiting the amount of sweet and high-fat snacks at home.

In our study, home total unhealthy food availability was significantly and inversed associated with children being overweight or obese. There was borderline

statistically significant association between home availability of unhealthy sweet snacks and being overweight or obese among children. However, this association (home availability of unhealthy sweet snacks) attenuated (not statistically significant) after the adjustment for the working status of parents and number of parents in the household, suggesting relative to the availability of unhealthy sweet snacks, other factors such as whether parents were working full time or whether the child was living in a single parent household seemed more relevant to the development of childhood obesity.

Environment serves as an important cue to eating behaviors. Having food visible and in close proximity on tables and countertops facilitates consumption and draws attention to that food [32]. Contradictory to our hypothesis, we found that healthy weight children were more likely to have unhealthy foods and beverages (2%/whole milk, fruit drinks, soda, regular cheese and yogurt, regular ice cream) visible in the refrigerator compared to overweight or obese children after adjusting for whether the child was living in the single parent household or the parent (who is the main household food purchaser and preparer) was working fulltime. It was unlikely that the above observed association was confounded by socioeconomic status of the family since parent education and family income levels were not associated with children's weight status in our study. The only study that was conducted among children examined the association between the proximity of foods (ex: crackers and carrots) and food consumption. The researchers found that when energy-dense foods (ex: crackers) and nutrient-dense foods (ex: carrots) were closer to the children, their consumption of both of these foods increased [33], suggesting the proximity of foods appear to contribute more significantly to children's

dietary intake rather than the type of foods present. However, the study did not differentiate the results between healthy weight and overweight/obese children. There are several possible explanations for the observed results in our study: 1) healthy weight children might be more physically active than overweight/obese children, leading to consuming more energy from any visible unhealthy foods (e.g., sugary sweet snacks, high-fat snacks, etc.); 2) having unhealthy foods such as sweet and high-fat snacks visible in the homes of healthy weight children may be less influential on the dietary intake of these children since they may be able to moderate their consumption of unhealthy foods more frequently compared to overweight/obese children; and 3) parents of overweight/obese children may be more restrictive in the types of foods they display in the kitchen and refrigerator due to their children's weight. These findings need to be investigated fully in future studies.

The results of our study add to the body of evidence that having more frequent meals is associated with having a healthy weight child [16, 18]. In our study, parents who were the single caregivers or were working fulltime were more likely to have an overweight or obese child since they might have less time to make family meals. However, the significant and inverse association between family meal frequency and the odds of children being overweight or obese sustained after the adjustment for a single parent household and parents' working status, suggesting our results were not influenced by these potential contributors (ex: single parent household, parent work status). It is suggested that time is a barrier to family meals [34] and that families with overweight children have a more difficult time managing a family meal [35]. Future nutrition

interventions should place an emphasis on strategies, such as easy meal ideas, eating with child, and managing time efficiently, to increase frequency of family meals among families with overweight or obese children.

Our study is one of the few to determine if any differences exist in the types of foods served between healthy weight and overweight/obese children. Similar to other studies regarding the types of foods served at family meals [10], our study found that the majority of families served healthy foods, such as green salads, vegetables and milk at family meals; however, fruit was served less often at evening meals in our study. Overweight/obesity in children was significantly associated with families who usually or always served fruit or 1%/skim milk at their evening meals compared to families that never served these foods at their evening meals after adjustment for confounders (single parent household and parent work status). Jacobs and Fiese found that sugar-sweetened beverages were more likely to be served to overweight children [35]; however, no association between serving regular soda at evening meals and a child being overweight or obese were observed in the current study. It is possible that parents of overweight/obese children were consciously making an effort to serve higher quality foods such as fruits or non-fat or reduced fat milk at meal times because of their heightened concern for their child's weight. Future research should continue to investigate the types of foods served among children and its possible influence on a child's weight to confirm the current results.

Our results suggested that parent's age, parent's working fulltime (vs. not working fulltime) and children living in single parent households were significantly

associated with the odds of children being overweight or obese. It could be explained by the fact that older parents may have a permissive parenting style, or have less control of their children's food intake. In a review of parenting practices and a child's weight, researchers found that parents with less parental control had children with a higher BMI [36], which may in part explain current findings; that is parents who are older, work full-time, or are single caregivers might have a permissive parenting style or less control of their children's food intake. It also could be that single parents or parents who work full-time may not have the time or energy to assure that their children are eating healthy and are physically active, thus increasing the risk of developing overweight or obesity among their children. Furthermore, our results with respect to children living in single parent household were consistent with a previous study that reported significant associations between obesity and children living with divorced single parents among 3,166 third-grade students [37].

Although the in-home food environment assessment mitigated some of the self-report biases, there are limitations of these assessments. First, the in-home food assessments can be expensive, time-consuming and potentially intrusive. The home food observational studies to date only conducted single/one-time assessments, with the exception of one multiple household inventory study [38], which determined the stability of foods routinely purchased and available in the home. Second, the home food inventory only indicated whether the food is present or not and did not assess the quantity of this particular food, which may have limited the variability in responses. In addition, there were possibilities that participants may have altered their home food environment

by adding more healthy foods and eliminating unhealthy foods prior to the in-home assessment. Despite our relatively small sample size, this study elucidates the differences in the home environment between healthy weight and overweight/obese children and sheds light on prevention measures in the area of food content in the home that may be modifiable.

Understanding the aspect of the home food environment of children such as the availability and visibility of home healthy and unhealthy foods and the frequency and quality of family meals is necessary for developing direct interventions for weight management.   Although unexpected, our results also suggested that healthy weight children were likely to have unhealthy foods in the refrigerator compared to overweight or obese children in the study. In addition, majority of the families in the study had a low variety of fruits and vegetables in the home and all the families had unhealthy snacks. Our study suggests that children living with a single parent/caregiver, having parents working full time and having family meals less frequently were more likely to be overweight or obese. Future research should continue to assess the associations between the home food availability and visibility and its influence on weight status, as well as the effect of interventions targeting the improvement of home food inventory, visibility and storage practice on weight management among children.

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Table 1. Characteristics of study participants and their associations of children's weight status

Characteristics	All participants	HW[†‡]	OW/OB[†‡]	P[§]	OR (95% CI) for OW/OB[∥]
Children					
N	82	40	42		
Age	9.80 ± 2.57	9.35 ± .352	10.24 ± .434	0.12	1.04 (0.80-1.36)
Gender, n (%)				0.53	
Boys	26 (31.7)	14 (35.0)	12 (28.6)		1.00
Girls	56 (68.3)	26 (65.0)	30 (71.4)		1.35 (0.53-3.42)
Race/ethnicity, n (%)				0.51	
White	59 (72.0)	31 (77.5)	28 (66.7)		1.00
Black	11(13.4)	5 (12.5)	6 (11.9)		1.33 (0.37-4.48)
Hispanic	9 (11.0)	4 (10.0)	5 (14.3)		1.38 (0.34-5.67)
Asian-American	2 (2.4)	0 (0.0)	2(4.8)		
Other	1(1.2)	0 (0.0)	1 (2.4)		
BMI (kg/m^2)	22.1 ± 7.7	16.2 ± 1.6	27.5 ± 7.1	0.001	4.08 (1.77-9.36)**
Parents/caregivers					
N	82	40	42		
Age	38.9 ± 6.4	36.8 ± 5.9	40.8 ± 6.4	0.004	1.11 (1.03-1.20)*
Gender, n (%)				0.06	
Males	7 (8.5)	1(2.5)	6 (14.3)		1.00
Females	75 (91.5)	39(97.5)	36 (85.7)		0.15 (0.02-1.34)
Income, n (%)				0.38	
<$25,000/year	35 (44.3)	14 (17.7)	21 (26.6)		1.00
$25 - $75,000/year	15 (19.0)	9 (11.4)	6 (7.6)		0.44 (0.13-1.53)
>$75,00/year	29 (36.7)	15 (19.0)	14 (17.7)		0.62 (0.23-1.68)
College Grad, n (%)				0.24	
No	40 (48.8)	16 (40.0)	24(57.1)		1.00
Yes	42 (51.2)	24 (60.0)	18 (42.9)		0.50 (0.21-1.21)
Work full-time, n (%)				0.008	
No	37 (45.7)	11 (28.2)	26 (61.9)		1.00
Yes	44 (54.3)	28 (71.8)	16 (38.1)		4.14 (1.62-10.54)**
Single-parent household, n (%)				0.002	
No	59 (72.0)	35 (87.5)	24 (57.1)		1.00
Yes	23 (28.0)	5 (12.5)	18 (42.9.)		5.25 (1.72-16.07)**

Note: Data were given as mean ± standard deviation unless otherwise specified. HW: Healthy weight; OW/OB: overweight/obesity

*P<0.05, **P<0.01.

[†] Weight categories were defined: ≥ 95th percentile, obese; 85th - 95th, overweight; 5th - 85th percentile, healthy weight according to Centers for Disease Control and Prevention Guidelines.

[‡] Healthy weight group (HW) participants included parents or caregivers of healthy weight children and children who were healthy weight; overweight/obesity group (OW/OB) participants included parents of overweight or obese children and children who were overweight or obese.

[§] Differences between healthy weight group and overweight/obese group by Chi-square test for categorical variables or t-test for continuous variables.

[∥] Odds ratio (OR) and 95% confidence interval (95%CI) estimated by logistic regression for children being overweight or obese; Child's age, parent's age, and body mass index were modeled as continuous variables.

Table 2. Home food availability and visibility and family meals between healthy weight and overweight/obese children

Items/categories	Healthy weight*[†] (N = 40) Mean ± SD	Overweight/obese*[†] (N = 42) Mean ± SD	P value[‡]
Home food availability			
Health food items/categories			
Total Fruit[§]	5.45 ± 2.55	5.25 ± 3.35	0.76
Fresh	2.73 ± 1.95	2.69 ± 1.81	0.93
Canned	1.15 ± 1.39	1.64 ± 1.64	0.15
Frozen	1.38 ± 1.50	1.12 ± 1.15	0.39
Total Vegetables[§]	8.55 ± 3.99	9.19 ± 3.59	0.45
Fresh	3.60 ± 1.85	4.31 ± 2.55	0.16
Canned	2.18 ± 1.63	2.10 ± 1.46	0.82
Frozen	2.78 ± 2.21	2.79 ± 1.83	0.98
Healthy Savory Snacks	0.75 ± 0.84	0.93 ± 1.05	0.40
Healthy sweet snacks	0.45 ± 0.64	0.60 ± 0.63	0.30
Healthy beverages[§]	1.00 ± 0.61	0.97 ± 1.52	0.85
Healthy Breakfast Cereal[§]	2.38 ± 1.18	2.07 ± 1.35	0.28
Whole Wheat Breads/pasta	0.59 ± 0.50	0.55 ± 0.50	0.64
Reduced-fat dairy (cheese & yogurt)[§]	1.03 ± 0.73	1.00 ± 0.77	0.88
All Healthy foods[§]	22.68 ± 8.20	22.59 ± 7.46	0.96
Unhealthy food items/categories			
Unhealthy savory snacks	0.90 ± 0.30	0.83 ± 0.38	0.38
Unhealthy sweet snacks	1.50 ± 0.64	1.19 ± 0.74	0.05
Unhealthy beverages[§]	1.30 ± 1.02	0.97 ± 0.78	0.11
Unhealthy Breakfast Cereal[§]	1.54 ± 0.60	1.50 ± 0.60	0.86
White Breads/pasta	0.92 ± 0.27	0.88 ± 0.32	0.53
High-fat dairy (cheese & yogurt)[§]	1.03 ± 0.48	0.81 ± 0.51	0.05
All Unhealthy foods[l]	9.00 ± 2.05	7.60 ± 2.35	0.01**
Kitchen/refrigerator food visibility			
Healthy kitchen food items[l]	1.25 ± 0.89	1.24 ± 1.07	0.96
Unhealthy kitchen food items[l]	1.87 ± 1.38	1.57 ± 1.40	0.33
Healthy refrigerator food items[l]	5.38 ± 1.90	5.20 ± 2.09	0.69
Unhealthy refrigerator food items[l]	2.50 ± 1.30	1.92 ± 1.13	0.02**
Food served at family meals			
Green salad	1.40 ± 0.84	1.36 ± 0.82	0.82
Vegetables	2.48 ± 0.78	2.26 ± 0.77	0.22
Fruit	1.85 ± 0.86	2.05 ± 1.01	0.35
100% fruit juice	0.98 ± 0.95	1.02 ± 1.05	0.83
Whole/2% milk	1.23 ± 1.33	1.24 ± 1.28	0.96
1% or Skim milk	1.49 ± 1.23	1.45 ± 1.32	0.90
Regular soda	0.70 ± 0.88	0.79 ± 0.95	0.67
Family meals			
Family meals per week	5.65 ± 1.46	4.50 ± 1.93	0.003
Fast foods per week	1.38 ± 0.67	1.69 ± 1.00	0.10

| Meals with TV on per week | 2.08 ± 1.94 | 2.52 ± 1.82 | 0.28 |

* Weight categories were defined: $\geq 95^{th}$ percentile, obese; 85th - 95th, overweight; 5th - 85th percentile, healthy weight according to Centers for Disease Control and Prevention Guidelines.

**P<0.05.

[†] Healthy weight group participants included parents or caregivers of healthy weight children and children who are healthy weight; Overweight/obese group participants included parents of overweight or obese children and children who are overweight or obese.

[‡] Differences between healthy weight group and overweight/obese group using t-test.

[¶] Summary scores of all the items in the category were used.

[§] Summary sores of all healthy or unhealthy food items for availability or visibility

Table 3. Associations of home food availability and visibility with overweight/obesity among children (n=82)

Food items/categories	OR (95% CI)* Model I[†]	P value* Model I[†]	OR (95% CI)* Model II[‡]	P value* Model II[‡]
Home food availability				
Health food items/categories				
Total Fruit	1.02 (0.88-1.19)	0.76	1.07(0.90-1.26)	0.44
Fresh	0.99 (0.78-1.25)	0.93	1.13(0.86-1.49)	0.37
Canned	1.25(0.93-1.68)	0.15	1.12(0.74-1.70)	0.58
Frozen	0.86(0.62-1.20)	0.38	0.73(0.49-1.15)	0.18
Total Vegetables	1.05 (0.93-1.18)	0.44	1.07(0.94-1.23)	0.32
Fresh	1.16(0.95-1.41)	0.16	1.26(0.99-1.64)	0.06
Canned	0.97(0.73-1.28)	0.81	0.81(0.57-1.13)	0.22
Frozen	1.00(0.81-1.25)	0.98	1.10(0.86-1.41)	0.46
Healthy Savory Snacks	1.23 (0.77-1.96)	0.39	1.36(0.75-2.39)	0.33
Healthy sweet snacks	1.45 (0.72-2.93)	0.30	1.27(0.57-2.79)	0.56
Healthy beverages	0.93 (0.42-2.03)	0.85	2.22(0.77-6.35)	0.14
Healthy Breakfast Cereal	0.82 (0.58-1.17)	0.27	0.76(0.51-1.15)	0.20
Whole Wheat Breads/pasta	0.81 (0.34-1.94)	0.63	1.05(0.38-2.86)	0.93
Reduced-fat dairy (cheese & yogurt)	0.96 (0.53-1.72)	0.88	1.10(0.56-2.15)	0.78
All Healthy foods	1.00(0.94-1.06)	0.96	1.02(0.95-1.09)	0.57
Unhealthy food items/categories				
Unhealthy savory snacks	0.56 (0.15-2.07)	0.38	0.56(0.13-2.30)	0.42
Unhealthy sweet snacks	0.52 (0.27-1.00)	0.05	0.56(0.27-1.14)	0.11
Unhealthy beverages	0.67 (0.41-1.10)	0.11	0.63(0.36-1.11)	0.11
Unhealthy Breakfast Cereal	1.07 (0.51-2.23)	0.86	0.93(0.41-2.14)	0.87
White Breads/pasta	0.62 (0.14-2.77)	0.53	0.93(0.17-5.18)	0.93
High-fat dairy (cheese & yogurt)	0.40 (0.15-1.04)	0.06	0.46(0.15-1.38)	0.16
All Unhealthy foods	0.76(0.61-0.95)	0.01**	0.79(0.62-1.00)	0.045**
Kitchen/refrigerator food visibility				
Healthy kitchen food items	0.99 (0.64-1.54)	0.96	1.06(0.60-1.86)	0.85
Unhealthy kitchen food items	0.85 (0.62-1.17)	0.32	0.67(0.45-1.02)	0.06
Healthy refrigerator food items	0.96 (0.77-1.19)	0.68	1.03(0.80-1.33)	0.82
Unhealthy refrigerator food items	0.65 (0.45-0.95)	0.03**	0.60(0.39-0.92)	0.02**

*Odds ratio (OR), 95% confidence interval (95% CI), and P value estimated by logistic regression for children being overweight or obese; the food availability or visibility variables were modeled as continuous variables.

**P<0.05

[†] Model I was the basic model without further adjustment for covariates.

[‡] Model II was further adjusted for parent's working status (fulltime vs. non-fulltime) and single-parent household (yes or no).

Table 4. Associations of family meal variables with overweight/obesity among children (n=82)

Family meal variables	OR (95% CI)* Model I[†]	P value* Model I[†]	OR (95% CI)* Model II[‡]	P value* Model II[‡]
Foods at family meals				
Green salad				
Never	1.00		1.00	
Sometimes	1.54 (0.43-3.10)	0.61	1.13 (0.33-3.71)	0.99
Usually/always	0.75 (0.15-3.84)	0.66	1.27 (0.21-7.68)	0.84
Vegetables				
Never	1.00		1.00	
Sometimes	0.75 (0.18-3.17)	0.71	0.68 (0.14-3.43)	0.80
Usually/always	0.38 (0.10-1.55)	0.08	0.63 (0.14-2.88)	0.62
Fruit				
Never	1.00		1.00	
Sometimes	1.13 (0.35-3.61)	0.43	1.20 (0.32-4.54)	0.32
Usually	2.70 (0.83-8.81)	0.06	4.47 (1.06-18.82)	0.02**
100% fruit juice				
Never	1.00		1.00	
Sometimes	1.17 (0.34-4.06)	0.78	1.27 (0.33-4.92)	0.90
Usually/always	1.94 (0.38-9.88)	0.46	1.33 (0.22-8.13)	0.85
Whole or 2% milk				
Never	1.00		1.00	
Sometimes	0.50 (0.08-2.99)	0.62	0.17 (0.02-1.58)	0.18
Usually/always	0.50 (0.10-2.52)	0.56	0.31 (0.05-1.85)	0.66
1% or Skim milk				
Never	1.00		1.00	
Sometimes	2.29 (0.44-11.92)	0.51	1.46 (0.16-13.5)	0.51
Usually/always	1.97 (0.57-6.88)	0.64	8.90 (1.29-61.23)	0.04**
Regular soda				
Never	1.00		1.00	
Sometimes	1.50 (0.22-10.30)	0.79	1.79 (0.20-15.99)	0.78
Usually/always	1.33 (0.25-7.01)	0.93	1.68 (0.26-10.71)	0.82
Family meal				
# of family meals per week				
0-2 days	1.00		1.00	
3-4 days	0.38 (0.04-3.97)	0.83	0.23 (0.02-2.78)	0.74
5-7 days	0.11 (0.01-0.99)	0.008**	0.10 (0.01-0.96)	0.02**
# of fast foods per week				
0-2 days	1.00		1.00	
3-4 days	2.55 (0.61-10.67)	0.97	1.09 (0.21-5.64)	0.97
5-7 days[§]				
# of meals with TV on per week				
0-2 days	1.00		1.00	
3-4 days	1.34 (0.33-5.50)	0.94	0.42 (0.08-2.33)	0.35
5-7 days	1.61 (0.51-5.10)	0.61	0.89 (0.24 – 3.33)	0.66

*Odds ratio (OR), 95% confidence interval (95% CI), and P value estimated by logistic regression for children being overweight or obese; the food availability or visibility variables were modeled as continuous variables.

**$P<0.05$

[†] Model I was the basic model without further adjustment for covariates.
[‡] Model II was further adjusted for parent's working status (fulltime vs. non-fulltime) and single-parent household (yes or no).
[§] Not sufficient participants in the category/group

Figure 1: Model of Factors Influencing the Home Food Environment

Micro-level
Socioeconomic Status
(working full-time or not)
Parent's education
Family Food Insecurity
Food Program Participation

Micro-level
Availability, accessibility, and visibility
of healthy and unhealthy foods and
beverages
Food storage practices
Home gardens
Kitchen appliances and cooking
equipment

Micro-level
Family meal frequency & nutritional quality
Parenting styles, practices & rules
Family structure, stress & schedules (single or
dual parent households)
Parental perceptions of challenges & strategies in
promote healthy eating
Macro-level
Parent's gender, age and race
Media, advertising, & marketing exposure

Built Environment

Economic Environment

Sociocultural Environment

Home Food Environment

Micro-level
Children and adolescent's
dietary intake
Taste preferences

Childhood and Adolescent Obesity

Study 3: Challenges and strategies of healthy eating among parents of healthy weight and overweight children

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Abstract

The home environment is considered one of the most important settings in regards to the development of healthy eating habits among children. The purpose of the current study was to explore challenges and strategies in promoting healthy eating in the home among parents of healthy weight and overweight children (6-12 years). Semi-structured individual interviews with 25 parents (14 of healthy weight and 11 of overweight children) were conducted in family homes in Lincoln and Omaha, Nebraska in the United States from August 2014 to March 2015. Transcripts were recorded and codes and themes were verified by the research team and one qualitative expert. Six themes emerged during the interviews including: 1) Parents are busy and strapped for time; 2) Parents feel a lack of support from spouse/partner for healthy eating in the home; 3) Cost is a challenge in providing healthy food, but parents are resourceful; 4) Children ask for junk food regularly, but parents have strategies to manage; 5) Parents have strategies for picky eaters; and 6) Early exposure, being consistent, and balancing foods are keys to healthy eating for children in the home. The themes were similar among both parents of healthy weight and overweight children, except that only parents of overweight children felt the lack of support from their spouses/partners. Our results suggest while parents faced numerous challenges in promoting healthy eating in the home, they utilized several strategies to overcome these barriers, which are valuable for direct intervention to improve home food environment.

Key Words: Parents, challenges, strategies, healthy eating, overweight, healthy weight

Introduction

The home food environment is one of the most important settings in regard to a child's dietary intake and the development of obesity, since 65% to 72% of daily calories are consumed in the home (Rosenkranz & Dzewaltowski, 2008; Campbell et al., 2007). Research is beginning to explore how factors in the home food environment contribute to children's eating behaviors and weight status. It is suggested that homes with healthy weight children are more likely to have healthier food options available and limit access to unhealthy foods (Brogan et al., 2012). Children's dietary intakes in the home are influenced by parent's support for healthy eating (Briggs & Lake, 2011, Hanson et al., 2005). Parents are seen as the nutritional gatekeepers and the key moderator of food available in the home (Briggs & Lake, 2011, Hanson et al., 2005; Wansink, 2006). Therefore, further understanding parent's views in challenges and strategies in feeding their children healthy foods in the home are necessary for promoting healthy eating and improving home food environment among children and their families, .

Despite their critical roles in the home food environment, parents are faced with many challenges in feeding their children at home, and these perceived challenges surrounding healthy eating in the home may influence a child's eating habits (Roos et al., 2012). A study conducted in an ethnically diverse population indicated that price of food and lack of energy and preparation time was seen as barriers in fruits and vegetable consumption (Yeh et al., 2008). Family focus group results stated that lack of accessibility to healthy foods was another barrier to healthy eating (Berge et al., 2012). In addition, an adolescent's pickiness and taste preference has been reported as a

challenge during family meals (Fulkerson et al., 2008). Interviews with parents of 5- to 6-year old children revealed that the foods made available in the home influenced what their child ate; however, these parents often offered foods based on their child's taste and preferences (Campbell et al., 2006). Similarly, focus groups with Latina mothers found that the types of foods brought into the home were determined by their child's preference, their ability to cook with these foods, and the price (Evans et al., 2011). Although previous studies identified some of the challenges that parents face in providing healthy foods at home, few studies further explored the potential strategies or solutions to overcome these barriers from perspectives of the parents, given the fact that forming effective strategies is critical to help parents promote healthy eating in the home. Furthermore, to our knowledge, whether parents of overweight and healthy weight children face similar issues as well as use the comparable strategies at home regarding feeding their children healthy foods have not been explored yet. Therefore, the purpose of this study was to explore challenges and strategies in promoting healthy eating among parents of healthy weight and overweight children, ages 6 to 12 years. Parents of 6 to 12 year olds were chosen because this age group is unique in that while starting to make their own food choices, they are still primarily dependent on their parents for food in the home. Thus, parental support for healthy eating is particularly important for children in this age group.

Methods

Sample selection

The parents of children, ages 6-12 years, were recruited from the metropolitan area in Lincoln and Omaha, Nebraska, USA to participate in one-on-one interviews. Parents were interviewed in concert with a larger study assessing the home food environment of healthy weight and overweight children and were conducted after the completion of the home food assessment. A subsample of 25 participants (22 mothers and 3 fathers) was selected for the one-on-one, in-depth interviews from August to March 2015 and were chosen based on their willingness to participate in the interviews. All participants were the main food shoppers and preparers for the family household. Eligibility requirements included having a child between the ages of 6 and 12 years, and parents fluent in English. Sample size was determined by the degree of data saturation, in which no new themes developed during the parent interviews. Written consent was obtained from the participants prior to the interviews. The study was approved by the University Institutional Review Board.

Data collection and participants

A qualitative collective case study design was used to explore parents' views of their challenges and strategies in healthy eating for their children at home, which is necessary to provide rich detail and insight into the topic. (Merriam, 2009). Each interview was audiotaped and took approximately 45 minutes to complete. The interview questions were modified from a previously published study (Berge et al., 2012) and were pilot tested with 4 study participants for clarity and comprehension. Questions were then revised and a semi-structured interview format was used, with interviewing occurring after the home environment survey was completed. The interview guide began with a

general knowledge question regarding how parents would define a healthy food and followed with questions on challenges and strategies in feeding children healthy foods at homes. Specific questions surrounded major challenges in providing healthy foods in the home, strategies employed if child asked for an unhealthy food or beverage, and advice for other parents on strategies in feeding children healthy food. Each question included probing questions which elicited further detailed answers from the participants.

     Parents completed a demographic sheet that included parent's age, race, working status, and educational levels, as well as a demographic sheet for their oldest child between the ages of 6 and 12 and included age, gender and race. Children's weight and height were measured with light clothing and no shoes using a weight scale and portable stadiometer. Heights and weights were measured three times by both researchers, and measurement that was most accurately collected from both researchers was used. BMI was calculated using Centers for Disease Control and Prevention guidelines and plotted on age/gender-specific growth charts (United States Department of Health and Human Services [USDHHS], 2002). Weight categories are defined as: $\geq 95^{th}$ percentile is obese; between the 85th and 95th percentile is overweight; and between the 5th and 85th percentile is a healthy weight (Krebs et al., 2007). A total of 25 parents were interviewed. The average age of the participants was 39 ± 7.6 years and 88% were White. All parents graduated from high school and 56% had a bachelor's degree or higher. Fourteen children were healthy weight while eleven were overweight or obese (Table 1).

Data analysis

All interviews was fully transcribed and analyzed by hand with data analysis and data collection occurring simultaneously by the investigator (Creswell, 2002). Each transcription was also independently analyzed and checked for accuracy by the second investigator, who listened to the audio and reviewed the transcription of the interviews. The preliminary exploratory analysis was used to gain a general sense of the data and to review data organization (Creswell, 2002). Inductive data analysis was used to aggregate the text into codes and each code was developed into themes that reflected parent's perceptions of their challenges and strategies in healthy eating for their children in their home (Creswell, 2002). Finally, cross-case theme synthesis was used to examine similarities and differences of themes across the interview transcriptions (Yin, 2009). The transcriptions were analyzed for quotes to determine if they would fit into one of the themes. If a quote was related to a theme, it was placed in that category and used in the working document. To validate the transcribed interviews, four participants were randomly selected to review the themes to determine if their views were adequately portrayed by the investigator. An expert in qualitative research reviewed the transcripts and developed themes independently from the research team. Any discrepancies in the themes were resolved and discussed among the qualitative expert and the research team.

Results

Six themes emerged during the parent interviews on their challenges and strategies including: 1) Parents are busy and strapped for time; 2) Parents feel a lack of support from spouse for healthy eating in the home; 3) Cost is a challenge in providing healthy food, but parents are resourceful; 4) Children ask for junk food regularly, but parents have strategies to manage; 5) Parents have strategies for picky eaters; and 6) Early exposure, being consistent, and balancing foods are keys to healthy eating for children in the home.

Parents are busy and strapped for time

The majority of parents stated that they had overwhelming schedules, which included children's activities and long working hours, causing a lack of time and energy to prepare healthy foods and family meals. For example:

> "Not enough time to cook. I am busy and I don't feel like cooking, so I will go buy fast food" (mother of overweight daughter)

> "Sometimes my kids have activities and I have to do a double shift and sometimes we don't have time to eat together" (mother of overweight daughter)

A mother of a healthy weight son stated that she wanted more time to research healthy food options for her son: "I would say that I wish I had more time to research to know what is the healthiest and why and even how to prepare it"

While acknowledging that the lack of time is a challenge in feeding their children healthy foods at home, parents of both healthy weight and overweight children had strategies that helped them manage healthier eating for their children.

> "I try to stick with meals that I know I can do in 30 minutes, like spaghetti and chicken alfredo and something that I can throw a vegetable into." (mother of healthy weight son)

"I try to cook with the crockpot…like bake a casserole. I work from my house, so I can throw in a roast or a casserole" (mother of overweight daughter)

"I will plan meals around our activities that I can make ahead or if I don't have time to cook that day, so it works out. Planning ahead and then everyone gets to eat good food". (mother of healthy weight daughter)

"I think it is easy to get distracted with all that is going on in the day and so sometimes it is quicker to grab something that is already prepared rather than make something. So now I do more crockpot cooking so it is ready to go on nights, like religious education or a sport event." (mother of overweight son)

Parents lack support from spouses for healthy eating in the home.

Several parents of overweight children voiced concerns over the lack of support from their spouse/partner in having healthy foods at home for their children. Conflicts about what types of foods to have in the home were evident among these parents who felt that their spouse/partner did not support their family's healthy eating efforts.

"Here is our biggest challenge—is that I work 60 to 70 hours a week, so a lot of time my spouse is in charge, which means going out to eat way too much". (mother of overweight daughter)

"I try to limit fries to once a week, although I get sabotaged by his dad. He likes the fries and he will buy the fries regardless if he has already had fries" (mother of overweight son)

"The hardest thing in the family environment is to get both parents on board and on the same page, because my wife and I don't necessarily agree on everything. I tend to be more extreme in the way I want to go and she is more lenient—you know, as far as buying things. One parent can certainly sabotage the other if you are not working together" (father of overweight daughter)

"We do not have a ton of snack food and honestly, if we do, my husband brought it in, and I don't have too much control over that" (mother of overweight daughter).

However, a parent of a healthy weight daughter stated that working together in meal preparation has helped with healthier eating in the home: "Somebody is cooking, while somebody is cleaning, and we have tried to do that and that seems to help".

Cost is a challenge in providing healthy foods, but parents are resourceful

Parents of both healthy weight and overweight children stated that the cost of food was a challenge in providing healthy foods at home for their children and felt that healthier versions of food were more expensive. Participants stated: "Cost is a big motivator"; "The good foods are expensive"; "Healthy foods are way more expensive". One parent of a healthy weight daughter stated that she only received a certain amount of money from WIC (for her younger son) for fruits and vegetables, and she could not financially afford to replenish her food supply:

> "Financially, I get an $8 allowance with my WIC that gives me access to fruits and vegetables. I buy it and when it is gone, it's gone. We can't always replenish it" (mother of healthy weight daughter)

> "I will buy because of price, first, based on our budget and we have a certain amount that we spend at the grocery store" (mother of healthy weight daughter)

> "Things that are on sale because I like to have fresh fruits and vegetables and I shop the ads a lot and go to (name of grocery store), because they had better sales" (mother of an overweight son)

Parents were resourceful when facing financial difficulties with food purchases and would ask neighbors, commodity programs, summer food programs, and food pantries for assistance:

> "My overall barrier is financial problems. I get assistance with getting food and that money runs out and when I don't have enough money, it is hard to turn around and get more [food]. I have gone to the food pantry before—that tends to help a lot. And my neighbor next door will give me food that she doesn't use." (mother of healthy weight son)

> "We participate in this program all through the summer at the library where they give away fresh fruits and vegetables to people and you stand in a line. You get fruits and vegetables for your family for a whole week." (mother of healthy weight son)

However, it was felt that the foods at some commodity programs were not the healthiest, so despite attempts to feed their children healthier options, they were faced with unhealthier food choices at these programs.

> "All the commodity program, everything they give you is fattening. You can go in there and get sheet cakes, cupcakes, and donuts and you can take as many donuts as you want. They are the stuff that the stores are getting rid of." (father of overweight daughter)

Parents felt that even though price was considered a challenge when providing healthy foods to their children at home or lacked the resources to purchase healthier options, the importance of providing these types of foods to their children was evident. "My husband and I have high blood pressure so we don't want to add too much salt. So fresh is good and you can get fresh vegetables most of the time" (mother of a healthy weight daughter). "Right now I am buying for health and I am trying to buy fruits and vegetables and more healthy [foods]" (mother of an overweight daughter).

Children ask for junk food regularly, but parents have strategies to manage

Parents of both healthy weight and overweight children mentioned that if their children asked for an unhealthy food or beverage, they would let their children have this food. One parent of a healthy weight daughter stated: "A lot of time, I just give it to them". Another parent of an overweight daughter stated: "Sometimes I buy it, if it is out of my budget, I don't, but most of the time we buy potato chips and ice cream, but not all the time."

Parents of both healthy weight and overweight parents did have strategies to help them manage unhealthy foods requests. For example, parents cited the unhealthy aspects of choosing junk foods at the store, as a way to educating them on healthier eating habits, as well as offering healthier foods as an alternative. Also, parents of healthy weight and overweight children used other strategies, such as not letting their children sway their food choices for them, or getting the unhealthy food less frequently and letting them eat it (unhealthy food) less frequently at home.

> "I tell them that it is not good for them and that is why we are not going to buy it. The other thing that I say is that it is not healthy for us, but offer them an alternative" (mother of healthy weight daughter).

> "When she was younger, I remember she wanted something so bad, and she was throwing a fit and that is the last time she asked. Some kids go through the store and get whatever they want. We don't raised her like that—(we) went out to the store and (child said) 'hey mom, can I have this?" and I say "no", and she says "maybe next time." (mother of healthy weight daughter)

> "There have been times too that if they are with me (at the grocery store), then I let them pick one treat that is not something that they can't have all at once. It might be something where you can have one of those, but we are going to save some for next week" (mother of overweight son)

Parents have strategies for picky eaters

Parents of healthy and overweight children felt that their children and other family members were picky eaters which made it difficult in healthy eating at home. Parents stated, "The pickiness of everybody and it's not just the girls; my husband is picky" (mother of healthy weight daughter). "My main challenge is someone who doesn't like to eat what is made. They are picky eaters." (mother of healthy weight children). When asked about barriers to healthy eating a mother of an overweight son stated that his inflexibility and dislike of change in his food was discouraging. "My son's inflexibility;

doesn't tolerate change". Another mother of an overweight son felt that fruits and vegetables can go to waste: "He won't try salads or he won't try a certain vegetables, and if I can't eat it all myself, it makes me sick to have to throw it away".

Parents stated they used a variety of strategies to overcome selective taste preferences in the home and seemed frustrated in their attempts. This was especially obvious when a parent tried to get her son to eat more vegetables.

> "I have tried making them try it and that resolved nothing. I have tried rewarding them for trying it. It doesn't change the fact that he doesn't like them (vegetables). He has tried them, but he still doesn't like them" (mother of healthy weight son).

However, several parents were more optimistic in their attempts to have their child overcome picky eating habits, despite a child's dislike of the food. For example, one parent stated: "Don't be afraid to try new things, at least try to have them taste it, and if they don't like it, they don't like it, but don't be afraid to try" (mother of healthy weight son). A mother of an overweight daughter had a garden, which not only helped with food costs, but increased the variety of healthy foods eaten in the home: "We have a garden outside and they pick fruits and vegetables from the garden; having a garden is really helpful".

Early exposure, being consistent, and balancing foods are keys to healthy eating for children in the home.

Parents of both healthy weight and overweight children felt that healthy eating habits should start when children are very young such as toddler and preschool age, so these habits are more likely to become permanent. However, a parent of an overweight

daughter felt that the food choices made available to her daughter when she was a toddler

at daycare influenced their food choices at home.

> "Start very early. I did a lot of quick foods too early; peanut butter too early and macaroni and cheese too early and they ate it a lot at daycare, so they were used to those certain foods. They were used to having donuts for breakfast. I would have investigated that fuller when they were younger. What our little kids are eating. You would be shocked" (mother of overweight daughter)

> "I think it takes time. Once you start bad habits, it is hard to correct them and it takes time to overcome that, but I think they (kids) can and will eat healthier things if that is what you continue to provide for them. I think the big thing is educating yourself and patience and consistency." (mother of overweight son)

> "Have more healthy options available. As you have the more healthy than generally your body craves more healthy and try to phase out the unhealthy things, but start with adding in more healthy" (mother of healthy weight daughter)

Parents felt that patience, consistency, educating themselves on proper nutrition,

and having more healthy foods available in the home were important strategies when

developing healthy eating habits for their children. Parents also felt that if they strived for

a balance between healthy and unhealthy foods that are available and are offered, this

would be an important educational message to their children on how to include all foods

in their diet.

> "Good food needs to be present and available for them to eat so they can choose them and still need some foods that are sugary foods, but I like to have it available (sugary foods) to a point so they know what it is, but they don't go to other people's house and that it all they eat, so they know how to eat it in moderation" (mother of healthy weight daughter)

Discussion

The current study explored parents' perceptions of both challenges and strategies

in terms of healthy eating in the home. Our study is unique in that we interviewed both

parents of overweight and healthy weight children. Our results suggest that while parents

of both healthy weight and overweight children were facing numerous challenges, such as lack of time in preparing and providing healthy foods, lack of support from a spouse, costs of foods and picky eating, they had a variety of valuable strategies to overcome these barriers.

In our study, parents of both healthy weight and overweight children felt stressed about providing healthy meals and foods in the home that the entire family would enjoy and listed several challenges. Participants frequently stated that lack of time, working long hours, children's activities, and weariness from overwhelming schedules were barriers to healthy eating for their children, which were consistent with the findings from the study with low-income parents (Davis et al., 2012). Parents seemed to be attentive to the fact that they needed to provide healthy meals and foods to their child, but getting distracted throughout the day was a concern due to busy work schedules. Parents may then drive through fast food for a quick meal in order to feed their children. These findings are consistent with a review of qualitative studies which concluded that busy family lives was associated with increased chances of feeding children with fast foods (Pocock et al., 2010). Both parents of healthy weight and overweight children in our study all preferred healthy meals that were easy to fix after working long hours and often used crockpot meals. They were also in favor of planning meals in advance, and both parents working together in meal preparation. These were similar to focus group findings among three ethnic groups of mothers (Whites, Blacks, and Hispanics) who wanted meal preparation and meal times to be easy and without undue stress (Sherry et al., 2004)

Some of the parents of overweight children interviewed criticized their

spouses/partners in terms of their negative attitudes and behaviors towards promoting

healthy eating in the home. They stated that their spouse would bring unwanted food into

the home and take their child out to eat if they were not home to prepare a healthy meal,

which often times were unhealthy fast food options. Our results were in agreement with

findings from a focus group with parents of overweight children in a treatment program,

in which one parent tried to promote healthier eating at home for their children, while the

other parent sabotaged the effort and provided unhealthier food to their child (Lyles et al.,

2012). A review of 21 qualitative studies suggest that family dynamics was a barrier in

that parents found it difficult to be a good role model for healthy eating when the other

parent or caretaker undermined their efforts (Pocock et al., 2010). However, in our study,

parents of healthy weight children did not voice concerns over the lack of support for

healthy eating in the home. A similar study comparing healthy and unhealthy diets among

parents of preschool children found that the parents in the 'healthy' group had more

partner support in regards to their child's diet although the researchers did not further

differentiate the findings according to children's weight status (Peters et al., 2014). One

parent of a healthy weight child stated that working together in the meal preparation

promoted healthier eating in their home, which might be a useful strategy for overcoming

differences among family members in terms of feeding their children healthy food

particularly for parents of overweight children

Price was seen as a challenge in feeding children healthy foods in their home for

both parents of healthy weight and overweight children. This is supported by a focus

group study in which parents stated that the cost of healthy foods was a common dietary

barrier (Davis et al., 2012). Parents implied that healthy foods were more expensive and

often were unable to buy more food if they ran out of money. A father of an overweight

child would seek food assistance from the local food pantry, however, voiced frustration

on the unhealthy food options that were available to him. Previous NHANES research

has shown that SNAP participants have a higher intake of sugar-sweetened beverages,

high-fat milk and processed meats compared with non-participants (Leugh et al., 2013).

A mother of a healthy weight child stated that she would go to another store to find better

quality foods to purchase for her family, while another mother of a healthy weight child

would participate in a summer fruit and vegetable program in order to provide more

healthful options for their family. However, both parents of healthy weight and

overweight children felt that eating healthy foods were important for good health and

would try to purchase the healthier options despite the cost.

Some parents employed strategies to combat unhealthy food requests, but seemed

torn between giving their children sweetened foods that they liked and yet still having

healthy foods in the home. In order to avoid conflict with their children, parents would

give unhealthier food options to them if requested and felt too overwhelmed by the

requests to say no to their child, which was seen in both healthy weight and overweight

children. This is supported by a focus group study with mothers who stated that even

though most of the time they would say no to unhealthy food requests, they would give in

to such requests to "keep the peace" (Pettigrew & Roberts, 2007). In contrast, one parent

was adamant in not purchasing unhealthy foods for her healthy weight daughter and

made all the food choices for her. Research evidence showed that indulgent parent feeding style is associated with weight increase, whereas an authoritarian parenting style may lead to a healthy weight in children (Vollmer & Mobley, 2013).

Parents of overweight children stated that starting earlier in childhood to feed their children healthier foods was an important strategy and some felt that they started too late. Both parents of healthy weight and overweight children also recommended that being consistent in feeding healthier foods (e.g. fruits and vegetables) and maintain a balanced approach, such as having healthier options most of the time, but teaching their children moderation in unhealthy food choices. Similarly, other studies have also suggested that starting in early childhood is important for the development of healthier eating habits for later in childhood (Pocock et al., 2010).

There are several strengths of the present study. We explored challenges and strategies of healthy eating in the home among parents of both healthy weight and overweight children, presenting a unique, qualitative contribution to the field of home food environment research. The interview format used in the study also allowed parents to expand upon responses, which created a further understanding of the issues parents having in terms of promoting healthy eating in the home. Our study has limitations. The sample size of parents of overweight children was relatively small (n=11). Therefore, the findings may not provide us a thorough overview of all the issues that parents of overweight children face. However, despite the sample size, we found that there were important challenges that are faced by parents of both healthy weight and overweight

children and valuable strategies given by the parents to overcome these barriers, which would help to develop direct intervention for promoting healthy eating at home.

Conclusion

Understanding how the challenges and strategies of parents of healthy weight and overweight children in supporting healthier eating in their home is important for developing interventions and formulating strategies to improve eating habits among children and combat childhood obesity. Our study reinforces the important issues parents face in proving healthy food at home, including frequent junk food requests, scarcity of time and money concerns, and the lack of support from a spouse for healthy eating in the home of overweight children. However, parents of both healthy weight and overweight children had numerous strategies that were used to overcome these challenges, including meal planning, working together as a family in meal preparation, food assistance programs and being consistent in serving healthy foods, which are valuable tips that can be applied in family-based nutritional education programs for weight management.

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Table 1. Characteristics of Study Participants

Child (N = 25)	
Age (year)	9.64 ± 1.6
Gender, n (%)	
Male	8 (32.0)
Female	17 (68.0)
Race/ethnicity, n (%)	
Non-Hispanic White	22 (88.0)
Hispanic or Latino	1 (4.0)
African-American	1 (4.0)
Asian-American	1 (4.0)
Body mass index (BMI, Kg/m^2)	20.4 ± 6.3
Weight status, n (%)*	
Healthy weight	14 (56.0)
Overweight/Obese	11 (44.0)
Parent/caregiver (N = 25)	
Age (year)	39.0 ± 7.6
Gender, n (%)	
Male	3 (12.0)
Female	22 (88.0)
Parent educational status, n (%)	
High school graduate	3 (12.0)
Associate's Degree	3 (12.0)
Some college	5 (20.0)
College graduate (Bachelor's degree)	7 (28.0)
Master's Degree or above	7 (28.0)
Parent your current work situation	
Working full-time	11 (44.0)
Working part-time	6 (24.0)
Stay-at-home caregiver	6 (24.0)
Currently unemployed	2 (8.0)

* Weight status for children was defined using body mass index-for-age percentiles (underweight, <5th percentile; healthy weight, 5th – 84th; overweight, 85th – 94th; Obese, ≥ 95th).

Table 2. Themes, challenges and strategies for parents of overweight and healthy weight children

Themes (n=6)	Challenges to healthy eating in the home	Strategies to overcome challenges
Parents are busy and strapped for time.	Parent's long working hours interfere with healthy meals and food preparation. Kid's activities interfere with food preparation Lack of energy	Crockpot and quick/easy meals Planning meals around activities or make ahead so family has healthy meals in the home
Parents lack support from spouse for healthy eating n the home	Unhealthy foods are brought into the home. One parent will take children out to eat if the other parent is not home.	Work together as a family to have healthy foods in the home and in preparing healthy meals
Cost is a challenge in providing healthy foods but parents are resourceful	Parents felt healthy foods were expensive Only can spend a certain amount at the grocery store Received unhealthy foods at food assistant programs	Received food from pantries, summer feeding programs, neighbors, and commodity programs Parents felt that healthy foods were worth the cost because of the health benefits.
Children ask for junk food regularly but parents have strategies to cope	"The easy way out is to just buy it" Parents will let children have unhealthy foods out of frustration or to please the child	Parents will not purchase. Educate on unhealthy foods. Offer alternatives Let them have unhealthy foods once a month.
Parents have strategies for picky eaters	Family members were picky making it difficult for healthy eating in the home Parents were frustrated despite numerous attempts to feed healthy foods to children	Don't be afraid to try new foods. Gardening helps increase acceptance of fruits and vegetables

Early exposure, being consistent, and balancing foods are keys to healthy eating for children in the home	Food choices made to child while in daycare influenced food choices later in childhood.	Having healthy options available. Be consistent in providing healthy foods Parents need to educate themselves on proper nutrition. Keep healthy foods available for children. Start early in exposing children to healthy foods

Conclusion

Childhood obesity rates are continuing to increase in the United States and have become epidemic in proportion. The rising obesity rates have significant health consequences, contributing to increased rates of many chronic diseases including cardiovascular diseases, type II diabetes, and certain types of cancers. The home environment is one of the most important settings in regard to a child's dietary intake and the development of obesity, since the majority of children and adolescent's food intake occurs in the home. Further, parents are seen as the nutritional gatekeeper influencing the provision of healthy foods in the home and possibly a child's weight.

The results of the validation study of a home food checklist determined that acceptable criterion and construct validity and internal consistency reliability was found and these results suggest that this checklist is participant-friendly and can be independently completed by the parents. When the home food checklist was used in an assessment of the home food environment between healthy weight and overweight children, the study found that overweight children and adolescents had lower scores of total unhealthy foods and total unhealthy refrigerator foods visible compared to healthy weight children. Additionally, overweight among children was inversely associated with refrigerator visibility of unhealthy foods in the home. Although these results are unexpected, it may be possible that healthy weight children may be less influenced by the visibility and availability of unhealthy foods (ex: high-fat foods, sweetened breakfast cereal) in the home and are able to moderate their consumption of these foods more frequently compared to overweight children, and parents of overweight children may be

more restrictive of the foods they have available in the home and on display in the refrigerator. Further, the assessment of the home environment found that overweight children and adolescents were more likely to have a single parent, who was older and working full-time compared to healthy weight children. After adjusting for single-parent household and parent's working status, overweight children were more likely to have fewer family meals and to serve skim/1% milk and fruit at family meals compared to healthy weight children and adolescents.

Our study reinforces the important issues parents face in providing healthy food at home, including frequent junk food requests, scarcity of time and money concerns, and the lack of support from a spouse for healthy eating in the home of overweight children. However, parents of both healthy weight and overweight children had numerous strategies that were used to overcome these challenges, including meal planning, working together as a family in meal preparation, food assistance programs and being consistent in serving healthy foods, which are valuable tips that can be applied in family-based nutritional education programs for weight management. Future research should continue to assess the associations between the home food availability and visibility and its influence on weight status, as well as the effect of interventions targeting the improvement of the availability of healthy food in the home and education to assist parents in overcoming barriers in providing healthy foods to their children and adolescents in the home environment.

Appendix

Appendix A: Home Food Checklist

Please mark "Yes" or "No" if you have this food anywhere in your house?   Please write "Yes" or "No" if you have this food?

FOOD	AVAILABLE	
1. 100% fruit juice (ex: orange or apple juice)	☐ Y	☐ N
2. Fruit drinks (not 100% fruit juice) (ex: Sunny Delight)	☐ Y	☐ N
3. Vegetable Juice (ex: tomato juice)	☐ Y	☐ N
4. Sports or Energy drinks (ex: Gatorade, Red Bull)	☐ Y	☐ N
5. Milk (whole, 2%)	☐ Y	☐ N
6. Milk (Skim, 1%)	☐ Y	☐ N
7. Regular Sodas (ex. Coke, Mountain Dew)	☐ Y	☐ N
8. Diet sodas, unsweetened ice tea or diet lemonade	☐ Y	☐ N
9. Bottled water	☐ Y	☐ N
10. Whole wheat or whole grain bread, tortillas, pasta or rice	☐ Y	☐ N
11. White bread, tortilla, pasta or rice	☐ Y	☐ N
12. Regular cheese (ex: American, cheddar, Swiss, parmesan)	☐ Y	☐ N
13. Reduced-fat cheese (ex: low-fat cheddar, Swiss)	☐ Y	☐ N
14. Regular yogurt (made with whole milk)	☐ Y	☐ N
15. Reduced-fat yogurt	☐ Y	☐ N
16. Regular ice cream or frozen desserts	☐ Y	☐ N
17. Reduced-fat or light ice cream, frozen fruit juice bar or frozen yogurt	☐ Y	☐ N

Food	Available Yes/No
Savory Snacks: Crackers, potato chips, corn chips, tortilla chips, cheese curls or puffs, bagel chips, popcorn, pretzels, peanuts, cashews or other nuts.	Whole grain
	Regular
	Reduced Fat
	High fiber (≥3 grams/serving)
	Low sodium (≤140 mg/serving)
Breakfast Cereal	Whole grain
	Sweetened (>6g sugar sv)
	Unsweetened (<6g sugar /sv)
	High fiber (≥3g/sv)
Sweet Snacks: Cookies, cake/cupcakes, muffins, brownies/bars, other snack cakes, pastries, sweet rolls, donuts, sports bars, granola bars, ice cream, frozen ice cream treats, frozen yogurt, frozen treats made with ice milk, frozen yogurt, sherbet, or sorbet, frozen fruit juice bars	Reduced fat
	Regular
Oatmeal	Sweetened (≥6 g sugar/serving)
	Unsweetened (<6 g sugar/serving)

"Reduced-fat" may be labeled "reduced-fat, "low-fat", "light", "non-fat", or "skim".
"Whole Grains" may be labeled "whole grain", "whole wheat".
"Sweetened" has 6 grams or more of sugar per serving.
"Unsweetened" has less than grams of 6 per serving
"High Fiber" has 3 grams or more of fiber per serving.
"Low Sodium" has 140 mg of sodium or less per serving

Subject ID:	Date: / /	Assessment performed by:

Do you have these fruits in your home?
Write "yes" or "no" in each column
"Yes" if you have the food; "No" if you do not

Fruits		Fresh	Canned/Jar	Frozen
1. Bananas				
2. Oranges				
3. Apples				
4. Grapes				
5. Watermelon				
6. Grapefruit				
7. Cantaloupes				
8. Strawberries				
9. Pineapples				
10. Peaches				
11. Plums				
12. Pears				
13. Nectarines				
14. Tangerines				
15. Honeydew Melon				
16. Cherries				
17. Avocados				
18. Blueberries				
19. Fruit Cocktail				

Do you have these vegetables in your home?
Write "yes" or "no" in each column
"Yes" if you have the food; "No" if you do not

Vegetables		Fresh	Canned/Jar	Frozen
1. Tomatoes				
2. Corn, sweet				
3. Green beans				
4. Carrots				
5. Lettuce				
6. Green peas				
7. Cabbage				
8. Broccoli				
9. Cucumber				
10. Celery				
11. Bell pepper				
12. Spinach				
13. Cauliflower				
14. Asparagus				
15. Onions				
16. Potatoes				

	Yes/No
Subject ID:	Date: / / Assessment performed by:

	Yes/No
Fresh fruit	
Canned or dried fruit	
Fresh vegetables	
Canned vegetables	
Regular snack crackers, chips, popcorn	
Reduced-fat snack crackers, pretzels, chips, popcorn	
Sweetened cereal	
Unsweetened cereal	
Whole wheat bread or rolls	
White bread or rolls	
Regular soda pop	
Diet soda pop	
Candy	
Regular cookies, cake, cupcakes, muffins	
Reduced-fat cookies, cake, cupcakes, muffins	

	Yes/No
Skim or 1% milk (any flavor)	
2% or whole milk (any flavor)	
100 % fruit juice (any flavor)	
Fruit drinks/sports drinks (not 100% juice)	
Regular soda pop	
Diet soda pop	
Bottled/contained water	
Regular cheese (example: American, cheddar, Swiss, parmesan)	
Reduced-fat cheese (example: low fat cheddar, low fat Swiss)	
Reduced-fat yogurt	
Regular yogurt (made from whole milk)	
Fresh ready-to-eat vegetables	
Fresh ready-to-eat fruit	
Frozen fruit	
Frozen vegetables	
Regular ice cream/frozen desserts	
Lite ice cream, frozen fruit bars or frozen yogurt	

"Reduced-fat" products may be labeled "reduced-fat", "low-fat", "light", "nonfat", or "skim"

Instructions: Please look around your kitchen (countertops, top of refrigerator, tables) and please open your refrigerator and freezer. Which of the following items above can you see without moving anything around? Please write "yes" if you See the food and "no" if you do not see the food.

Appendix B: Food Categories

Category		Sub-Category	Items
Dairy	Cheese	Regular cheese	Shredded or block cheese, sliced cheese, ricotta or cottage cheese, cream cheese, Cheez Whiz, Velveeta, canned cheese or other similar cheese
		Reduced fat cheese	Shredded or block reduced-fat cheese, sliced reduced-fat cheese, string cheese, mozzarella cheese, reduced–fat ricotta or cottage cheese, reduced-fat cream cheese or Neufchatel
	Milk & other dairy drinks	Whole or 2% milk	Whole or 2% milk, almond milk, rice or soy milk
		Reduced fat milk	Skim milk or 1% milk, chocolate or flavored milk, almond milk, rice or soy milk, or reduced-fat yogurt drinks
	Yogurt	Regular yogurt	Regular yogurt
		Red fat yogurt	Reduced-fat, fat-free or lite yogurt
	Greek Yogurt	Regular	Regular Greek yogurts
		Reduced fat	Reduced-fat, fat-free or lite Greek yogurts
Vegetable	All vegetables (fresh, frozen or canned)		Potatoes, asparagus, beets, bell peppers, broccoli, cabbage, cauliflower, carrots, celery, corn. cucumbers, green beans, lettuce, mushrooms, peas, spinach/other greens, squash, sweet potatoes, tomatoes, mixed vegetables
Fruit	Fresh, frozen, dried canned		Apples, apple sauce, apricots, avocado, bananas, blueberries, cranberries, dates, grapes, grapefruit, kiwi, lemons or limes, mango, melons, mixed fruit, nectarines, oranges, pears, peaches, pineapple, plums, prunes, raisins, raspberries, strawberries, tangerines/clementines (if canned, packed in lite juice or 100% juice)
Frozen Desserts	Regular frozen desserts		Ice cream, frozen treats
	Reduced fat, fat-free or lite frozen desserts		Reduced-fat, fat-free, or lite ice cream, frozen yogurt, frozen treats made with ice milk, frozen yogurt, sherbet, or sorbet, frozen fruit juice bars
Bread	Whole Wheat bread		Whole Wheat or 100% Wheat bread or rolls, English muffins, bagels, tortillas, pita bread (first ingredient is "whole wheat" or "100% whole grain"
	White bread		White bread or rolls, English muffins, bagels, tortillas (flour or corn), pita bread, croissants
Sweet Snacks (Prepared	Regular prepared desserts & other sweet snacks		Cookies, cake/cupcakes, muffins, brownies/bars, other snack cakes, pastry, sweet rolls, donuts, candy

Desserts)	Reduced fat, fat-free, or lite prepared desserts	Reduced-fat, fat-free, or lite cookies or cakes/cupcakes
Savory Snacks (Chips, Crackers and Other Snack Foods)	Regular snacks	Regular snack crackers, snack crackers, potato chips, corn chips, tortilla chips, cheese curls or puffs, bagel chips, buttered popcorn, peanuts, cashews or other nuts, granola bars, sports bars
	Reduced fat, fat-free, or lite snacks	Reduced-fat, fat-free, or lite (or baked) snack crackers, potato chips, tortilla chips, cheese curls or puffs, bagel chips, graham crackers, pretzels, unbuttered or 94% fat-free popcorn, reduced-fat granola bars, sports bars
	_____ Low-sodium snacks	Low-sodium snack crackers, potato chips, popcorn
	_____ Whole Grain/Whole Wheat snacks	Whole wheat or whole grain snack crackers that are labeled "whole grain", "whole wheat"
Dry Breakfast Cereal	Whole Grain	Ready-to-eat cereals that are labeled "whole grain," "whole wheat" or have at least 3 grams of fiber per serving and less than 6 g/sugar
	Low sugar cereal	Ready-to-eat cereals that indicate on the nutrition label that they have less than 6 grams of sugar per serving (not whole grain)
	High sugar cereal (sweetened)	Ready-to-eat cereals that indicate on the nutrition label that they have 6 or more grams of sugar per serving (not whole grain)
	_____ Good source or high fiber cereal	Ready-to-eat cereal that contains >3 grams of fiber/serving (indicates on label "good source", "rich in fiber" or "high fiber"
Beverages	Regular beverages	Regular soda pop, prepared iced teas or lemonade, sports drinks, 100% fruit juice, fruit drinks (ex: Capri Sun, Sunny Delights)
	Unsweetened beverages	Diet soda pop, prepared unsweetened iced teas or lemonade (ex: Crystal Light), bottled water
Candy		Chocolate candy, hard candy, fruit rollups, fruit snacks or other fruit-based candy, chewy candy
Kitchen Visibility	Healthy kitchen	Fresh fruit, canned or dried fruit, fresh vegetables, whole grain, low sodium, reduced-fat, fat-free or lite snack crackers, pretzels, chips, and unbuttered popcorn; whole grain and low sugar cereal, reduced-fat cookies, cake, cupcakes, muffins
	Non-healthy kitchen	Regular snack crackers, pretzels, chips, and buttered popcorn, dry sweetened cereal, bread or rolls, regular soda pop, sports drinks, candy, regular cookies, cake, cupcakes, muffins
Refrig visibility	Healthy refrigerator and freezer	Skim milk or 1% milk, 100% fruit juice, diet soda pop, bottled water, reduced-fat cheese, reduced-fat yogurt and yogurt drinks, fresh ready-to-eat vegetables and fruit; frozen or canned fruits; frozen vegetables; reduced-fat, fat-free or lite frozen yogurts
	Non-healthy refrigerator and freezer	Whole or 2% milk, fruit drinks/sports drinks, regular soda pop, regular cheese, regular yogurt; regular ice cream or frozen desserts

Appendix C: Home Food Environment Survey

Thank you for completing the following survey. This survey should be completed by the parent or caregiver. If you have any questions, please contact the researchers (402) 472-7822 or martha.nepper@huskers.unl.edu

PART A:

The questions below pertain to the oldest child in the household (between the ages of 6-18 years)

Your child's age: _____

Your child's gender: M   F

Your child's race/ethnicity (check all that apply):
____ **Non-Hispanic White**
____**Hispanic or Latino**
____**Black (African-American)**
____**Asian-American**
____**American Indian or Native American**
____**Other**

Your relationship to child:_____

Your child's weight_____   **height**_____

The questions below pertain to the parent completing survey:

Your age_____

Gender: M   F

Your family's annual income:
____   **<$25,000**
____   **$25,000 - $50,000**
____   **$50,001 - $75,000**
_____   **$75,0001 - $100,000**
_____   **>$100,000**

What is the highest grade or year of school that you (parent) have completed?
____   **Some high school**
____   **High school graduate or GED**
____   **Associate's Degree**
____   **Some college**
____   **College graduate (Bachelor's Degree)**
____   **Some graduate school**
_____ **Master's Degree or above**

What is the highest grade or year of school that has been completed by any member of your family (ex: yourself or your partner/spouse)?

____   **Some high school**
____   **High school graduate or GED**
____   **Associate's Degree**
____   **Some college**
____   **College graduate (Bachelor's Degree)**
____   **Some graduate school**
_____ **Master's Degree or above**

Which of the following best describes your current work situation?
____ **Working full-time**
____ **Working part-time**
____ **Stay-at-home caregiver**
____ **Unemployed (not working outside of the home)**

How many parents or caregivers are in the home?
____ **One parent or caregiver**
____ **Two parents or caregivers**

PART B:

Thinking about **the past 30 days**, please answer the following questions about the types of **foods you had in your house**. Please circle the appropriate number for each food item.

> **Definitions for "Never", "Rarely", "Sometimes", "Frequently", and "Always" are:**
>
> **Never = 0 times per week**
> **Rarely = 1 to 2 times**
> **Sometimes = 3 to 4 times per week**
> **Frequently = 5 to 6 times per week**
> **Always = 7 times per week**

Fruit (e.g., apples, oranges) – fresh and ready-to-eat	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
Frozen fruit (ex: strawberries in freezer)	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
Canned fruit, packed in lite syrup or its own juices	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
Vegetables (e.g., carrots) – fresh and ready-to-eat	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
Frozen vegetables (ex: green beans, peas)	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
Canned vegetables	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
Regular cakes, brownies, muffins , cookies or pastries (not reduced-fat; already made or homemade)	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
Reduced-fat or lower-calorie cakes, brownies, muffins, cookies, or pastries (already made or homemade)	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
Regular chips and snack crackers (ex: potato chips, corn chips, Ritz) tortilla chips)	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
Reduced-fat, lower calorie or baked chips, pretzels, snack crackers	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
100% fruit juice (ex: orange, apple)	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
Fruit drinks (e.g., Snapple, Sunny delight)	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
Regular sodas - (e.g., Coke, 7-up, etc.) (not diet)	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**

Diet soda or unsweetened beverages (ex: ice tea, Crystal Light).	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
Sports and energy drinks (e.g., Gatorade)	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
Milk (whole, 2%)	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**
Milk (1% fat or fat free)	**Never**	**Rarely**	Sometimes	**Frequently**	**Always**

PART C. Based on **the past 30 days,** please circle the appropriate response for each statement.

Easily reached **means that your child can see this food on the countertops or in the refrigerator, or can reach this food and eat or drink it without your help.**

Hiding place **means that this food is put in a place that is not visible to your child and your child does not know where it is.**

In our home, we stored…

A. <u>**Sugared drinks and regular sodas**</u> in places where **can be seen and they are easily reached.**

Never	**Rarely**	Sometimes	**Frequently**	**Always**

B. <u>**Sugared drinks and regular sodas**</u> in a **hiding place.**

Never	**Rarely**	Sometimes	**Frequently**	**Always**

C. <u>**Regular sweet snack foods**</u> in a place where they **can be seen and easily reached** (includes foods like regular cookies, ice cream, cake, candy, etc).

Never	**Rarely**	Sometimes	**Frequently**	**Always**

D. <u>**Regular sweet snack foods**</u> in a **hiding place**

Never	**Rarely**	Sometimes	**Frequently**	**Always**

E. <u>**Regular savory snack foods**</u> in a place where they can be **seen and easily reached** (includes foods like regular chips, crackers, nuts, etc.)

Never	**Rarely**	Sometimes	**Frequently**	**Always**

F. <u>**Regular savory snack foods**</u> in a **hiding place**

Never	**Rarely**	Sometimes	**Frequently**	**Always**

G. <u>**Fresh fruits and vegetables**</u> in a place where they **can be seen and easily reached**

Never	**Rarely**	Sometimes	**Frequently**	**Always**

PART D: Please answer the following questions about your family evening meals that are served in your home.

1. How many days of the week does your family eat an evening meal together at home?
   This includes all, or most of your family living in your house. *(please circle your response)*

| One day or less | 2 days | 3 days | 4 days | 5 days | 6 days | 7 days |

2. How many days of the week does your family eat fast-food or take-out meals at home for your evening meal (including pizza)? _____

| One day or less | 2 days | 3 days | 4 days | 5 days | 6 days | 7 days |

3. How many days of the week does your family eat an evening meal in front of the TV (turned one)? *(please circle your response)*

| One day or less | 2 days | 3 days | 4 days | 5 days | 6 d | 7 d |

Please think about the foods and beverages that your family eats and drinks for the family evening home meal and circle the answer that best shows how often these foods/beverages are served.

Never is "0 times per week"; **Sometimes** is "once a week"; **Usually** is "twice a week"; and **Always** is "3 or more times per week".

| Green Salad | **Never** | **Sometimes** | **Usually** | **Always** |

| Vegetables (other than potatoes) | **Never** | **Sometimes** | **Usually** | **Always** |

| Fruit (not including juice) | **Never** | **Sometimes** | **Usually** | **Always** |

| 100% Fruit juice (e.g., orange, apple, grape) | **Never** | **Sometimes** | **Usually** | **Always** |

| Milk: whole/2% | **Never** | **Sometimes** | **Usually** | **Always** |

| 1%/Skim | **Never** | **Sometimes** | **Usually** | **Always** |

| Regular soda (not diet) (ex: Coke, 7-Up) | **Never** | **Sometimes** | **Usually** | **Always** |

Thank you for completing the survey!!

Appendix D: Food Frequency Questionnaire

ID NUMBER

Please write your name in this box. **Use a pencil to complete this survey.**

	HOW MANY DAYS LAST WEEK DID YOU EAT OR DRINK IT?							HOW MUCH IN ONE DAY?		
	None last week	1 day last week	2 days last week	3-4 days last week	5-6 days last week	Every day last week				
Cereal, like corn flakes, Frosted Flakes	○	○	○	○	○	○	▶	○ 1 bowl	○ 2 bowls	○ 3 bowls
Cooked cereal, like oatmeal	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Eggs, breakfast sandwiches or breakfast burritos	○	○	○	○	○	○	▶	○ 1 egg	○ 2 eggs	○ 3 eggs
Breakfast bars, granola bars, Protein bars	○	○	○	○	○	○	▶	○ 1/2	○ 1	○ 2
Glasses of milk	○	○	○	○	○	○	▶	○ 1 glass	○ 2 glasses	○ 3+glasses
Real fruit juice, like orange juice, apple juice, or Mexican fruit drinks like licuados (DO NOT include soda)	○	○	○	○	○	○	▶	○ 1 glass	○ 2 glasses	○ 3+glasses
Drinks like Coke or 7-Up, Sunny Delight, Hawaiian Punch, or aguas frescas (DO NOT include diet soda)	○	○	○	○	○	○	▶	○ 1 bottle	○ 2 bottles	○ 3+bottles
Apples, bananas, or oranges	○	○	○	○	○	○	▶	○ 1/2	○ 1	○ 2
Applesauce, fruit cocktail	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Any other fruit, like strawberries, grapes	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
French fries, hash browns, tater tots	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Other potatoes, like mashed or boiled	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Ketchup or salsa	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Lettuce salad	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Tomatoes, including on salad	○	○	○	○	○	○	▶	○ 1/4 tomato	○ 1/2 tomato	○ 1 tomato
Green beans or peas	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Other vegetables, like corn, carrots, greens, broccoli	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Vegetable soup, tomato soup, any soup or stew with vegetables in it	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Chili beans, pinto beans, black beans, including in burritos	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot

	HOW MANY DAYS LAST WEEK DID YOU EAT OR DRINK IT?							HOW MUCH IN ONE DAY?		
	None last week	1 day last week	2 days last week	3-4 days last week	5-6 days last week	Every day last week				
Refried beans	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Hamburgers, cheeseburgers	○	○	○	○	○	○	▶	○ 1 small	○ 1 large	○ 2 large
Hot dogs, corn dogs, or sausage	○	○	○	○	○	○	▶	○ 1	○ 2	○ 3
Lunch meat like boloney, ham, Lunchables	○	○	○	○	○	○	▶	○ 1 slice	○ 2 slices	○ 3+ slices
Pizza or pizza pockets	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Spaghetti or ravioli with tomato sauce	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Macaroni and cheese	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Chicken, including nuggets, wings, tenders, also in sandwiches or stew	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Fish, fish sticks or sandwiches, tuna, shrimp	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Burritos or tacos	○	○	○	○	○	○	▶	○ 1/2	○ 1	○ 2
Beef like roast, steak or in sandwiches	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Meat balls, meat loaf, beef stew, Hamburger Helper	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Pork, like chops, roast, ribs	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Popcorn	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Snack chips like potato chips, Doritos, Fritos, tortilla chips	○	○	○	○	○	○	▶	○ A few	○ Small bag	○ Large bag
Ice cream	○	○	○	○	○	○	▶	○ 1 scoop	○ 2 scoops	○ 3 scoops
Candy, candy bars	○	○	○	○	○	○	▶	○ Mini	○ Small	○ Large
Cookies, donuts, cakes like Ho-Hos	○	○	○	○	○	○	▶	○ A little	○ Some	○ A lot
Cheese. Remember cheese in sandwiches or nachos with cheese or quesadillas	○	○	○	○	○	○	▶	○ 1 slice	○ 2 slices	○ 3+ slices
Whole wheat bread or rolls (NOT white bread)	○	○	○	○	○	○	▶	○ 1 slice	○ 2 slices	○ 3 slices

What kind of cereal did you eat? (MARK THE ONE YOU ATE THE MOST OF)

○ Plain Cheerios, Grape Nuts, Shredded Wheat, Wheaties, Wheat Chex, Kix
○ Honey Nut Cheerios, Cap'n Crunch, Lucky Charms, Life, Golden Grahams, Frosted Mini Wheats, Raisin Bran
○ Other sweet cereals, like Frosted Flakes, Froot Loops
○ Any other cereal, like Corn Flakes, Rice Krispies

What kind of milk did you drink? (MARK ONLY ONE)
○ Whole milk   ○ Low fat 1% milk   ○ Chocolate milk   ○ Lactaid milk
○ Reduced fat 2% milk   ○ Nonfat milk   ○ Soy milk   ○ Don't know

Appendix E: Interview Protocol

**Assessment of the home food environment among
children and adolescents, age 6-18 years.**

Participant ID No: _____

Date and time:

Length of interview:

Introduction:

I want to thank you for taking the time to participate in the research study and for talking with me today. I will be recording and transcribing what we say today. After the notes have been transcribed, I will ask you to review the transcriptions and the notes that I made during our interview. I would like you to look at these transcriptions and notes and make any necessary comments or changes and return them back to me. It is important that I reflect in my writing what you have said and what you mean. The transcription will be a verbatim one, so you will see "uhs" and "ahs" that you say. If I should any quotes in the final written paper, those will not be included in the transcription. The surveys you completed and this transcript are given a non-identifiable number and all personal information is removed and destroyed. The interview will take approximately 30 minutes. Do you have any questions so far?

I am interested in your view of the food choices that are available for your kids in your home. More specifically, what motivates you to buy the food you do and what kind of barriers or challenges do you face when buying and preparing foods for your kids at home. I really want to know your perspective on these issues so please feel free to discuss your views openly. I may also ask you some additional questions as we go along in order to clarify anything that is unclear. Do you have any questions?

1. How would you define a healthy food? (Probe: Tell me more about this)
2. Tell me about an evening family meal time at your house. What is served? Who is there?
3. What are the challenges you face in having family meals?
4. How do you overcome these challenges?
5. Tell me about the sort of things that motivate what you buy at the grocery store and bring home to your kids?
6. Can you tell me about this ways you think would help your children eat healthier?
7. Suppose your child asked you to buy a food or beverage at the store that is not what you think he/she should eat or drink. How do you handle that situation?
8. Tell me about the challenges or barriers that you face in providing healthy foods in your home for your child?
9. How do you overcome these challenges? (Probe: Tell me more about that)
10. Some say it is hard to feed kids foods that are healthy and that they like. What is your opinion on this?
11. Our goal is to help parents have a healthier home. What advice do you have for us?

Appendix F: Participant-Parent Consent Form

UNIVERSITY 1 OF
Nebraska
Lincoln

IRB# 20140714393EP
Date Approved: 07/01/2014
Valid Until: 06/30/2015

COLLEGE OF EDUCATION AND HUMAN SCIENCES
Department of Nutrition & Health Sciences

Participant/Parental-Legal Guardian Informed Consent Form Phase II: (Home Visit)
IRB#14393
Assessment of the Home Food Environment
Among Children and Adolescents, ages 6-18 years

Purpose:
This research study will aim to evaluate the home food environment of children and adolescents and its relationship to what your child eats. You and your child/legal ward are invited to participate in this study because you are a parent of a child or adolescent between the ages of 6 and 18 years and your child/legal ward is between the ages of 6 and 18 years.

Procedures:
The researchers will use a checklist of food items and, with your assistance, will view the inside of your kitchen refrigerator and freezer, and kitchen cupboards. The researchers will also ask you about the foods you have in other parts of your home (ex: garage, basement), but will not physically view these areas of your home. We ask that you do not change your home environment in anyway before the researchers visit your home. For example, do not clean out your cupboards, counters, or refrigerators or change your grocery shopping habits.
We also ask that you collect all your food receipts for any food purchases made at grocery stores, supermarkets, or convenience stores for two weeks prior to the researcher's visit to your home. Please put these receipts in an envelope and give them to the researchers when they arrive at your house. This information will help us assess what types of foods you purchase for you and your family. Please do not change your grocery shopping habits or purchases. Collecting grocery store receipts over a two week period will take approximately one hour.

 You will complete a Home Food Environment Survey, which will take approximately 15 minutes. If you have already completed this survey, you do not need to complete the same survey again. Your child will complete a Food Frequency Questionnaire, which will take approximately 15 minutes. You will be able to assist your child or adolescent with both surveys.

 The researchers will also ask you questions regarding your home food environment (ex: barriers) and this interview will be audiotaped. No identifiable information will be contained in this audiotape. Said audiotape and its transcription will be secured in a locked file cabinet at the Department of Nutrition and Health Sciences at the University of Nebraska-Lincoln and will only be accessed by the investigators and research assistant of this study. Also, your child's weight and height will be measured with your child wearing light clothing and no shoes. The researchers will use a portable weight and height scale. Measurements will be plotted on a growth chart. You will be present when your child's measurements are taken and will receive this information for your health records.

Benefits:
You will receive your child's weight and height and a nutrition tip handout.

Risks and/or Discomforts:
There are no known risks or discomforts associated with this research.

Confidentiality:
Any information obtained during this research study which could identify you will be kept strictly confidential. Any names, addresses, phone numbers, and grocery store receipts will be deleted after the study is complete. The data will be stored in a locked cabinet in the primary investigator's office and will only be seen by the investigators during the study and for two years after the study is complete. The information obtained in this study may be published in scientific journals or presented at scientific meetings, but the data will be reported as aggregated data and no identifying information will be released.

Compensation:
You will receive a $20 gift card to Wal-Mart after the researchers have been in your home for 40 minutes or until the Home Observation Assessment, completion of surveys and interview, and collection of grocery store receipts are completed. If after 40 minutes, you and your child/legal ward feel uncomfortable and decide to withdraw from the study, you collect one to two weeks of grocery store receipts, you or your child/legal ward cannot all of the survey questions, or you do not wish to participate in the interview, or your child/legal ward does not want to be measured, you will still receive the $20 gift card. However, if you decide to not participate in the study when the researchers come to your home, your child/legal ward does not want to be measured, you and your child/legal ward do not complete any of the survey questions, you do not want to participate in the interview, and you have not collected any grocery store receipts, you will not receive the $20 gift card. The researcher will ask you to complete a Research Participant Disclosure Form, which includes your name and address, and acknowledges your receipt of the gift card. The form will be kept at the Bursar's Office at the University of Nebraska-Lincoln (402- 472-1734) in a secured locked file cabinet for seven (7) years and will not be linked to the data collected from the surveys.

Opportunity to Ask Questions:
You and your child/legal ward may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study. You may also contact the investigators at the phone numbers below. Please contact the University of Nebraska-Lincoln Institutional Review Board at (402) 472-6965 to voice concerns about the research or if you have any questions about your rights as a research participants.

Freedom to Withdraw:
Participation in this research study is voluntary. You and your child can refuse to participate or withdraw at any time without harming your relationship with the researchers or the University of Nebraska-Lincoln, or in any other way receive a penalty or loss of benefits to which you are otherwise entitled.

Consent, Right to Receive a Copy:
You are voluntarily making a decision whether or not to participate in this research study, as well as making a decision whether or not to allow your child/legal ward to participate in this research study. Your signature certifies that you have decided to allow yourself and your child/legal ward to participate having read and understood the information presented. You will be given a copy of this consent form to keep.

Name of Child to be Included:

_____
(Name of Child: Please print)

Name & Signature of Parent/Legal Guardian:

_____
(Name of Parent/Legal Guardian: Please print)

_____   _____
(Signature of Parent/Legal Guardian)   Date

> [ ] I would like to be contacted to participate in the focus group study of this research project. I understand that the researchers will keep my name, phone number and e-mail address in a locked file cabinet in the primary investigator's office located in the Department of Nutrition & Health Sciences located at UNL. My contact information will be destroyed immediately after the completion of the focus group study (Spring 2015).

Name and phone number of investigators:

Martha Nepper, PhD Student, UNL   Office: (402) 472-7822 e-mail: martha.nepper@huskers.unl.edu
Weiwen Chai, PhD, Assistant Professor, UNL   Office: (402) 472-7822 e-mail: wchai2@unl.edu

Appendix G: Youth Assent

UNIVERSITY OF Nebraska
Lincoln

IRB# 20140714393EP
Date Approved: 07/01/2014
Valid Until: 06/30/2015

COLLEGE OF EDUCATION AND HUMAN SCIENCES
Department of Nutrition & Health Sciences

Youth Assent Form (Phase II)
Assessment of the Home Food
Environment Among Children and
Adolescents, ages 6-18 years IRB #14393

We are inviting you to participate in this research study because you are between the ages of 6 and 18 years of age, and we are interested in what foods you eat.

You will complete a survey that asks you what types of foods you eat and how often. This form is called a Food Frequency Questionnaire, and you can ask your parents for help. Being in the study will have no direct benefits to you. Your responses will be kept strictly confidential (secret) and there is no way for us to know which responses belong to you or someone else. We may publish a summary of everyone's responses and present such a summary at a scientific meeting, but your identity and responses will be totally confidential.

Your weight and height will be measured with you wearing light clothing and no shoes. The researchers will use a portable weight and height scale. Measurements will be plotted on a growth chart, and your parents will be given this information. Your parents will be present while you are being measured.

We will also ask your parents for their permission for you to do this study. Please talk this over with me before you decide whether or not to participate. By completing the questionnaire, you are giving consent to participate in the study.

If you have any questions while filling out the Food Frequency Questionnaire or after the study is completed, please have your parents contact one of the researchers below.

_____   _____
Signature of Youth (ages 6-18 years)   Date

Name and phone number/e-mail of investigators:
Martha Nepper, PhD Nutrition Student, UNL
Weiwen Chai, PhD, Assistant Professor, UNL

Appendix H: IRB Approval Letter

July 1, 2014

Martha Nepper
Department of Nutrition and Health Sciences
6210 North 155th Street OMAHA, NE 68116

Weiwen Chai
Department of Nutrition and Health Sciences
104B LEV, UNL, 68583-0806

IRB Number: 20140714393EP
Project ID: 14393
Project Title: Assessment of the Home Environment for Healthy Eating among Children and Adolescents, age 6-18 years

Dear Martha:

This letter is to officially notify you of the approval of your project by the Institutional Review Board (IRB) for the Protection of Human Subjects. It is the Board's opinion that you have provided adequate safeguards for the rights and welfare of the participants in this study based on the information provided. Your proposal is in compliance with this institution's Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46). Your project has been approved as an Expedited protocol, category 4 & 7.

Date of EX Review: 05/27/2014 & 06/25/2014

You are authorized to implement this study as of the Date of Final Approval: 07/01/2014. This approval is Valid Until: 06/30/2015.

At this time, Lincoln Public Schools and Omaha Public Schools are not permitted locations where research/recruitment may take place until site approvals have been obtained through the District. LPS notification will be conducted on your behalf on August 1, 2014.
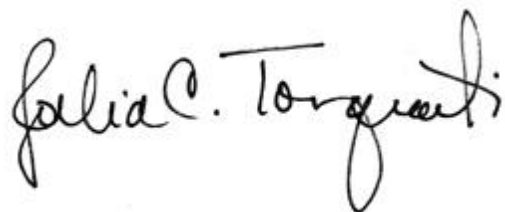
We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:
* Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
* Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
* Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
* Any breach in confidentiality or compromise in data privacy related to the subject or others; or
* Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

For projects which continue beyond one year from the starting date, the IRB will request continuing review and update of the research project. Your study will be due for continuing review as indicated above. The investigator must also advise the Board when this study is finished or discontinued by completing the enclosed Protocol Final Report form and returning it to the Institutional Review Board.

If you have any questions, please contact the IRB office at 472-6965.

Sincerely,

Julia C. Torquati

Appendix I: Data Tables for BMI-for-Age Charts Boys 6 to 17 years

Data Table of BMI-for-age Charts Boys 6 years –17 years

Age (in months)	3rd % BMI Value	5th % BMI Value	10th % BMI Value	25th % BMI Value	50th % BMI Value	75th % BMI Value	85th % BMI Value	90th % BMI Value	95th % BMI Value	97th % BMI Value
71.5	13.5599	13.741	14.042	14.6129	15.3799	16.3495	16.9909	17.4913	18.3632	19.0396
72.5	13.5543	13.736	14.0377	14.6112	15.3835	16.3634	17.0141	17.5233	18.4142	19.1088
73.5	13.5492	13.731	14.0341	14.6104	15.3883	16.3787	17.0388	17.5569	18.4669	19.1800
74.5	13.5446	13.727	14.0313	14.6105	15.3942	16.3953	17.0650	17.5921	18.5215	19.2532
75.5	13.5406	13.724	14.0292	14.6116	15.4012	16.4133	17.0926	17.6288	18.5777	19.3284
76.5	13.5371	13.721	14.0278	14.6135	15.4094	16.4326	17.1216	17.6669	18.6356	19.4055
77.5	13.5341	13.719	14.0271	14.6164	15.4186	16.4531	17.1520	17.7065	18.6951	19.4843
78.5	13.5316	13.717	14.0271	14.6202	15.4290	16.4749	17.1838	17.7476	18.7561	19.5649
79.5	13.5298	13.716	14.0279	14.6248	15.4404	16.4980	17.2168	17.7900	18.8187	19.6471
80.5	13.5284	13.716	14.0293	14.6303	15.4528	16.5222	17.2512	17.8338	18.8827	19.7308
81.5	13.5276	13.716	14.0315	14.6366	15.4663	16.5477	17.2869	17.8789	18.9481	19.8161
82.5	13.5274	13.717	14.0343	14.6438	15.4808	16.5744	17.3238	17.9253	19.0149	19.9029
83.5	13.5278	13.719	14.0379	14.6519	15.4963	16.6021	17.3619	17.9729	19.083	19.9910
84.5	13.5287	13.721	14.0421	14.6608	15.5128	16.6311	17.4012	18.0218	19.1523	20.0805
85.5	13.5302	13.723	14.0471	14.6705	15.5303	16.6611	17.4416	18.0719	19.2229	20.1712
86.5	13.5323	13.727	14.0527	14.6810	15.5487	16.6922	17.4832	18.1231	19.2947	20.2631
87.5	13.535	13.731	14.0591	14.6924	15.5681	16.7244	17.5259	18.1754	19.3676	20.3561
88.5	13.5382	13.735	14.0661	14.7045	15.5884	16.7576	17.5697	18.2289	19.4416	20.4503
89.5	13.5421	13.741	14.0738	14.7174	15.6096	16.7918	17.6146	18.2834	19.5166	20.5454

90.5	13.5465	13.747	14.0822	14.7312	15.6317	16.8270	17.6604	18.3389	19.5927	20.6415
91.5	13.5516	13.753	14.0913	14.7457	15.6546	16.8632	17.7073	18.3955	19.6697	20.7385
92.5	13.5572	13.760	14.1011	14.7609	15.6785	16.9003	17.7552	18.4530	19.7476	20.8364
93.5	13.5635	13.768	14.1113	14.7770	15.7032	16.9384	17.8039	18.5115	19.8265	20.9350
94.5	13.5704	13.776	14.1227	14.7938	15.7287	16.9774	17.8536	18.5708	19.9062	21.0344
95.5	13.5779	13.786	14.1346	14.8113	15.7551	17.0172	17.9042	18.6311	19.9866	21.1345
96.5	13.5860	13.795	14.1471	14.8296	15.7823	17.0579	17.9557	18.6922	20.0679	21.2353
97.5	13.5947	13.806	14.1603	14.8486	15.8102	17.0995	18.0080	18.7541	20.1499	21.3366
98.5	13.6041	13.817	14.1741	14.8684	15.8390	17.1419	18.0612	18.8169	20.2325	21.4385
99.5	13.6140	13.828	14.1886	14.8888	15.8685	17.1851	18.1151	18.8803	20.3158	21.5408
100.5	13.6246	13.841	14.2038	14.9100	15.8988	17.2290	18.1698	18.9445	20.3997	21.6436
101.5	13.6358	13.853	14.2197	14.9319	15.9299	17.2738	18.2252	19.0095	20.4842	21.7468
102.5	13.6477	13.867	14.2362	14.9545	15.9616	17.3193	18.2814	19.0751	20.5693	21.8504
103.5	13.6601	13.881	14.2534	14.9778	15.9941	17.3655	18.3382	19.1413	20.6548	21.9543
104.5	13.6732	13.896	14.2712	15.0017	16.0274	17.4124	18.3958	19.2082	20.7408	22.0584
105.5	13.6869	13.911	14.2897	15.0264	16.0613	17.4600	18.4539	19.2757	20.8273	22.1627
106.5	13.7012	13.928	14.3088	15.0517	16.0959	17.5083	18.5128	19.3437	20.9141	22.2672
107.5	13.7162	13.944	14.3286	15.0776	16.1311	17.5572	18.5722	19.4123	21.0013	22.3719
108.5	13.7318	13.962	14.3490	15.1043	16.1671	17.6068	18.6322	19.4814	21.0889	22.4766
109.5	13.7480	13.980	14.3700	15.1316	16.2037	17.6570	18.6927	19.5511	21.1767	22.5814
110.5	13.7648	13.998	14.3917	15.1595	16.2409	17.7078	18.7539	19.6211	21.2648	22.6862
111.5	13.7822	14.017	14.4140	15.1881	16.2788	17.7591	18.8155	19.6917	21.3532	22.7910

112.5	13.8003	14.037	14.4370	15.2173	16.3172	17.8111	18.8776	19.7626	21.4417	22.8957
113.5	13.819	14.058	14.4605	15.2471	16.3563	17.8636	18.9402	19.8340	21.5305	23.0003
114.5	13.8382	14.079	14.4847	15.2775	16.3960	17.9166	19.0033	19.9057	21.6193	23.1048
115.5	13.8581	14.101	14.5095	15.3085	16.4363	17.9702	19.0668	19.9778	21.7083	23.2091
116.5	13.8786	14.123	14.5349	15.3402	16.4771	18.0242	19.1308	20.0502	21.7974	23.3132
117.5	13.8997	14.146	14.5609	15.3724	16.5186	18.0787	19.1951	20.1229	21.8865	23.4171
118.5	13.9215	14.169	14.5876	15.4053	16.5605	18.1338	19.2598	20.1959	21.9757	23.5207
119.5	13.9438	14.193	14.6148	15.4387	16.6030	18.1892	19.3249	20.2691	22.0649	23.624
120.5	13.9667	14.218	14.6426	15.4727	16.6461	18.2452	19.3904	20.3427	22.1540	23.7269
121.5	13.9902	14.243	14.6709	15.5072	16.6897	18.3015	19.4561	20.4164	22.2432	23.8295
122.5	14.0143	14.269	14.6999	15.5423	16.7338	18.3583	19.5222	20.4903	22.3322	23.9317
123.5	14.0390	14.296	14.7294	15.5780	16.7784	18.4155	19.5886	20.5644	22.4211	24.0335
124.5	14.0642	14.323	14.7595	15.6142	16.8235	18.4730	19.6553	20.6387	22.51	24.1348
125.5	14.0901	14.351	14.7902	15.6509	16.8690	18.5309	19.7222	20.7132	22.5986	24.2357
126.5	14.1165	14.379	14.8214	15.6882	16.9151	18.5892	19.7893	20.7877	22.6871	24.3360
127.5	14.1435	14.407	14.8532	15.7260	16.9616	18.6479	19.8567	20.8624	22.7755	24.4358
128.5	14.1710	14.437	14.8855	15.7643	17.0086	18.7068	19.9243	20.9371	22.8636	24.5351
129.5	14.1991	14.467	14.9184	15.8032	17.0560	18.7661	19.9922	21.0120	22.9515	24.6338
130.5	14.2278	14.497	14.9518	15.8425	17.1039	18.8257	20.0601	21.0869	23.0391	24.7319
131.5	14.2570	14.528	14.9857	15.8823	17.1521	18.8857	20.1283	21.1618	23.1265	24.8294
132.5	14.2867	14.560	15.0202	15.9226	17.2008	18.9458	20.1966	21.2367	23.2135	24.9263
133.5	14.3170	14.592	15.0551	15.9634	17.25	19.0063	20.2651	21.3117	23.3003	25.0224

134.5	14.3478	14.624	15.0906	16.0047	17.2995	19.0670	20.3337	21.3867	23.3867	25.1180
135.5	14.3792	14.657	15.1266	16.0464	17.3494	19.1280	20.4024	21.4616	23.4728	25.2128
136.5	14.4111	14.691	15.1631	16.0886	17.3997	19.1892	20.4712	21.5365	23.5586	25.3069
137.5	14.4434	14.725	15.2000	16.1312	17.4503	19.2506	20.5401	21.6114	23.644	25.4003
138.5	14.4763	14.759	15.2375	16.1743	17.5013	19.3123	20.6091	21.6862	23.7289	25.4929
139.5	14.5097	14.794	15.2754	16.2178	17.5527	19.3741	20.6781	21.7609	23.8135	25.5848
140.5	14.5436	14.830	15.3138	16.2617	17.6044	19.4362	20.7472	21.8355	23.8976	25.6759
141.5	14.5780	14.866	15.3526	16.3061	17.6565	19.4984	20.8163	21.9100	23.9814	25.7662
142.5	14.6128	14.903	15.3919	16.3508	17.7089	19.5608	20.8855	21.9844	24.0646	25.8557
143.5	14.6481	14.940	15.4316	16.3960	17.7616	19.6234	20.9546	22.0587	24.1475	25.9444
144.5	14.6839	14.977	15.4718	16.4415	17.8146	19.6861	21.0238	22.1329	24.2298	26.0323
145.5	14.7202	15.015	15.5124	16.4875	17.8679	19.7490	21.0930	22.2069	24.3117	26.1194
146.5	14.7569	15.053	15.5535	16.5338	17.9215	19.812	21.1622	22.2807	24.3931	26.2056
147.5	14.7940	15.092	15.5949	16.5805	17.9754	19.8751	21.2313	22.3544	24.4739	26.2910
148.5	14.8316	15.131	15.6368	16.6275	18.0296	19.9383	21.3004	22.4279	24.5543	26.3755
149.5	14.8696	15.171	15.6790	16.6749	18.0840	20.0017	21.3695	22.5012	24.6342	26.4592
150.5	14.9080	15.211	15.7216	16.7226	18.1387	20.0651	21.4385	22.5743	24.7135	26.5420
151.5	14.9468	15.251	15.7647	16.7707	18.1936	20.1286	21.5074	22.6472	24.7923	26.6239
152.5	14.9860	15.292	15.8080	16.8191	18.2488	20.1922	21.5763	22.7199	24.8705	26.7050
153.5	15.0257	15.333	15.8518	16.8678	18.3042	20.2559	21.6451	22.7924	24.9482	26.7852
154.5	15.0657	15.375	15.8959	16.9168	18.3598	20.3196	21.7138	22.8646	25.0254	26.8645
155.5	15.1060	15.416	15.9404	16.9662	18.4157	20.3834	21.7825	22.9366	25.1020	26.9429

156.5	15.1468	15.459	15.9852	17.0158	18.4718	20.4473	21.8510	23.0084	25.1781	27.0205
157.5	15.1879	15.501	16.0303	17.0657	18.5280	20.5111	21.9194	23.0799	25.2536	27.0972
158.5	15.2293	15.544	16.0757	17.1159	18.5845	20.5751	21.9877	23.1512	25.3285	27.1730
159.5	15.2711	15.588	16.1215	17.1663	18.6411	20.6390	22.0559	23.2222	25.4028	27.2480
160.5	15.3132	15.631	16.1675	17.2170	18.6979	20.7029	22.1240	23.2929	25.4766	27.3221
161.5	15.3557	15.675	16.2139	17.2680	18.7548	20.7669	22.1919	23.3634	25.5499	27.3953
162.5	15.3984	15.719	16.2605	17.3192	18.8120	20.8309	22.2597	23.4336	25.6225	27.4677
163.5	15.4414	15.764	16.3074	17.3706	18.8692	20.8948	22.3273	23.5035	25.6946	27.5392
164.5	15.4847	15.808	16.3546	17.4222	18.9267	20.9588	22.3948	23.5731	25.7661	27.6099
165.5	15.5283	15.854	16.4020	17.4741	18.9842	21.0227	22.4622	23.6425	25.8371	27.6797
166.5	15.5722	15.899	16.4496	17.5261	19.0419	21.0866	22.5293	23.7116	25.9075	27.7487
167.5	15.6163	15.944	16.4975	17.5784	19.0997	21.1504	22.5964	23.7803	25.9773	27.817
168.5	15.6607	15.990	16.5456	17.6308	19.1575	21.2143	22.6632	23.8488	26.0466	27.8844
169.5	15.7053	16.036	16.594	17.6834	19.2155	21.2781	22.7299	23.9170	26.1153	27.9510
170.5	15.7501	16.082	16.6425	17.7362	19.2736	21.3418	22.7964	23.9849	26.1835	28.0168
171.5	15.7952	16.129	16.6912	17.7891	19.3318	21.4055	22.8627	24.0525	26.2511	28.0819
172.5	15.8404	16.175	16.7401	17.8422	19.3900	21.4691	22.9288	24.1198	26.3182	28.1462
173.5	15.8859	16.222	16.7892	17.8954	19.4483	21.5327	22.9948	24.1868	26.3848	28.2098
174.5	15.9315	16.269	16.8384	17.9488	19.5067	21.5962	23.0606	24.2536	26.4509	28.2726
175.5	15.9773	16.316	16.8878	18.0022	19.5651	21.6596	23.1261	24.3200	26.5164	28.3348
176.5	16.0232	16.364	16.9374	18.0558	19.6236	21.7229	23.1915	24.3861	26.5815	28.3963
177.5	16.0693	16.411	16.9870	18.1094	19.6820	21.7861	23.2567	24.452	26.6460	28.4571

178.5	16.1156	16.459	17.0368	18.1632	19.7406	21.8493	23.3217	24.5175	26.7101	28.5172
179.5	16.1619	16.507	17.0867	18.2170	19.7991	21.9123	23.3865	24.5828	26.7737	28.5768
180.5	16.2084	16.554	17.1367	18.2709	19.8576	21.9753	23.4511	24.6477	26.8368	28.6357
181.5	16.2550	16.602	17.1867	18.3248	19.9162	22.0381	23.5155	24.7124	26.8995	28.6941
182.5	16.3016	16.650	17.2368	18.3788	19.9747	22.1008	23.5797	24.7768	26.9618	28.7518
183.5	16.3483	16.698	17.2870	18.4329	20.0332	22.1635	23.6437	24.8410	27.0236	28.8091
184.5	16.3951	16.746	17.3373	18.4869	20.0917	22.226	23.7075	24.9048	27.0851	28.8659
185.5	16.4420	16.795	17.3876	18.5410	20.1501	22.2883	23.7711	24.9684	27.1461	28.9221
186.5	16.4889	16.843	17.4379	18.5951	20.2085	22.3506	23.8345	25.0318	27.2068	28.9779
187.5	16.5358	16.891	17.4882	18.6491	20.2669	22.4127	23.8977	25.0949	27.2671	29.0333
188.5	16.5827	16.939	17.5386	18.7032	20.3252	22.4746	23.9608	25.1577	27.3271	29.0883
189.5	16.6296	16.987	17.5889	18.7572	20.3834	22.5365	24.0236	25.2203	27.3867	29.1429
190.5	16.6766	17.036	17.6392	18.8112	20.4416	22.5982	24.0862	25.2826	27.4460	29.1972
191.5	16.7235	17.084	17.6895	18.8651	20.4996	22.6597	24.1486	25.3447	27.5051	29.2512
192.5	16.7703	17.132	17.7397	18.919	20.5576	22.7211	24.2108	25.4066	27.5639	29.3049
193.5	16.8172	17.180	17.7899	18.9727	20.6155	22.7823	24.2729	25.4683	27.6224	29.3583
194.5	16.8639	17.228	17.8400	19.0265	20.6732	22.8434	24.3347	25.5298	27.6807	29.4116
195.5	16.9106	17.276	17.8900	19.0801	20.7308	22.9043	24.3964	25.5910	27.7389	29.4647
196.5	16.9572	17.324	17.9399	19.1336	20.7883	22.9651	24.4579	25.6521	27.7968	29.5176
197.5	17.0037	17.372	17.9897	19.187	20.8457	23.0257	24.5192	25.7130	27.8546	29.5705
198.5	17.0501	17.419	18.0394	19.2402	20.9029	23.0861	24.5803	25.7737	27.9122	29.6233
199.5	17.0964	17.467	18.0890	19.2933	20.9599	23.1463	24.6412	25.8343	27.9697	29.6760

200.5	17.1425	17.514	18.1384	19.3463	21.0168	23.2064	24.7020	25.8947	28.0272	29.7288
201.5	17.1885	17.562	18.1877	19.3990	21.0735	23.2663	24.7626	25.9550	28.0846	29.7816
202.5	17.2343	17.609	18.2368	19.4516	21.1300	23.3260	24.8231	26.0151	28.142	29.8346
203.5	17.2800	17.656	18.2857	19.5040	21.1863	23.3855	24.8834	26.0752	28.1993	29.8877
204.5	17.3254	17.702	18.3344	19.5562	21.2424	23.4449	24.9436	26.1351	28.2567	29.9409
205.5	17.3707	17.749	18.3829	19.6082	21.2983	23.5040	25.0036	26.1949	28.3142	29.9944
206.5	17.4157	17.795	18.4312	19.6600	21.3540	23.563	25.0635	26.2547	28.3717	30.0482
207.5	17.4606	17.841	18.4792	19.7115	21.4094	23.6217	25.1232	26.3144	28.4293	30.1023
208.5	17.5051	17.887	18.5270	19.7627	21.4646	23.6803	25.1828	26.3740	28.4871	30.1567
209.5	17.5495	17.933	18.5745	19.8137	21.5195	23.7387	25.2423	26.4336	28.5451	30.2116
210.5	17.5935	17.978	18.6217	19.8644	21.5741	23.7968	25.3017	26.4932	28.6033	30.2669
211.5	17.6373	18.023	18.6687	19.9148	21.6285	23.8548	25.361	26.5528	28.6617	30.3228
212.5	17.6808	18.068	18.7153	19.9649	21.6826	23.9126	25.4201	26.6124	28.7204	30.3792
213.5	17.7239	18.112	18.7616	20.0146	21.7364	23.9701	25.4792	26.6720	28.7794	30.4362
214.5	17.7668	18.15	18.8076	20.0641	21.7898	24.0275	25.5382	26.7316	28.8387	30.4938
215.5	17.8093	18.200	18.8532	20.1131	21.8430	24.0847	25.5971	26.7914	28.8984	30.5522
216.5	17.8515	18.243	18.8985	20.1619	21.8958	24.1416	25.6561	26.8512	28.9586	30.6114
217.5	17.8932	18.286	18.9434	20.2102	21.9483	24.1984	25.7148	26.9110	29.0192	30.6713
218.5	17.9347	18.329	18.9879	20.2581	22.0005	24.2549	25.7735	26.9710	29.0803	30.7322
219.5	17.9757	18.371	19.0319	20.3056	22.0522	24.3112	25.8322	27.0312	29.1419	30.794
220.5	18.0163	18.412	19.0756	20.3527	22.1037	24.3674	25.8909	27.0914	29.2040	30.8567
221.5	18.0565	18.454	19.1188	20.3994	22.1547	24.4233	25.9495	27.1519	29.2668	30.9205

222.5	18.0962	18.495	19.1615	20.4456	22.2054	24.4790	26.0082	27.2125	29.3303	30.9855
223.5	18.1355	18.535	19.2038	20.4914	22.2556	24.5345	26.0668	27.2734	29.3944	31.0515
224.5	18.1743	18.575	19.2456	20.5367	22.3055	24.5899	26.1255	27.3345	29.4592	31.1188
225.5	18.2127	18.615	19.2869	20.5815	22.3549	24.6450	26.1842	27.3958	29.5248	31.1874
226.5	18.2505	18.653	19.3277	20.6258	22.4039	24.6999	26.2429	27.4574	29.5913	31.2573
227.5	18.2878	18.692	19.3679	20.6695	22.4525	24.7546	26.3017	27.5193	29.6585	31.3287
228.5	18.3245	18.730	19.4076	20.7128	22.5007	24.8091	26.3605	27.5815	29.7267	31.4015
229.5	18.3608	18.767	19.4467	20.7555	22.5484	24.8635	26.4194	27.6441	29.7958	31.4758
230.5	18.3964	18.804	19.4853	20.7976	22.5956	24.9176	26.4784	27.7070	29.8659	31.5517
231.5	18.4314	18.840	19.5232	20.8392	22.6424	24.9716	26.5375	27.7703	29.9370	31.6293
232.5	18.4659	18.875	19.5605	20.8801	22.6887	25.0254	26.5967	27.8341	30.0092	31.7086
233.5	18.4997	18.910	19.5972	20.9205	22.7345	25.0790	26.6560	27.8982	30.0825	31.7897
234.5	18.5328	18.944	19.6333	20.9603	22.7799	25.1324	26.7155	27.9629	30.1570	31.8727
235.5	18.5653	18.978	19.6686	20.9994	22.8247	25.1857	26.7752	28.0280	30.2327	31.9576
236.5	18.5971	19.011	19.7033	21.0379	22.8690	25.2388	26.8350	28.0936	30.3097	32.0445
237.5	18.6282	19.043	19.7373	21.0757	22.9129	25.2917	26.8950	28.1597	30.3879	32.1334
238.5	18.6586	19.074	19.7706	21.1129	22.9562	25.3445	26.9553	28.2265	30.4675	32.2245
239.5	18.6882	19.105	19.8031	21.1494	22.9990	25.3972	27.0157	28.2938	30.5485	32.3178
240	18.7027	19.120	19.8191	21.1674	23.0202	25.4235	27.0460	28.3277	30.5896	32.3653
240.5	18.7170	19.135	19.8348	21.1852	23.0413	25.4497	27.0764	28.3617	30.6310	32.4134

Appendix J: Data Tables BMI-for-age Girls 6 years to 17 years

Data Tables BMI-for-Age Charts Females, 6 years to 17 years

Age (in months)	3rd % BMI Value	5th % BMI Value	10th % BMI Value	25th % BMI Value	50th % BMI Value	75th % BMI Value	85th % BMI Value	90th % BMI Value	95th % BMI Value	97th % BMI Value
71.5	13.2390	13.42991	13.7483	14.36138	15.20441	16.30785	17.06531	17.67402	18.77829	19.6798
72.5	13.2334	13.42587	13.74694	14.36552	15.2169	16.33273	17.09974	17.71678	18.83778	19.75462
73.5	13.2285	13.42254	13.74637	14.37063	15.23058	16.35906	17.13575	17.76122	18.89907	19.83129
74.5	13.2242	13.41992	13.74661	14.3767	15.24543	16.38679	17.17331	17.8073	18.96211	19.90976
75.5	13.2206	13.41801	13.74764	14.38372	15.26142	16.41589	17.21237	17.85496	19.02685	19.98995
76.5	13.2176	13.41681	13.74946	14.39168	15.27854	16.44633	17.2529	17.90417	19.09324	20.07183
77.5	13.2153	13.41632	13.75206	14.40056	15.29676	16.47809	17.29485	17.95489	19.16123	20.15533
78.5	13.2137	13.41654	13.75544	14.41035	15.31607	16.51113	17.3382	18.00708	19.23077	20.2404
79.5	13.2128	13.41748	13.75961	14.42104	15.33644	16.54542	17.38291	18.06069	19.30182	20.32698
80.5	13.2125	13.41912	13.76454	14.43263	15.35785	16.58094	17.42894	18.11569	19.37432	20.41502
81.5	13.2129	13.42147	13.77024	14.44509	15.38029	16.61764	17.47626	18.17203	19.44822	20.50447
82.5	13.214	13.42453	13.7767	14.45842	15.40374	16.65551	17.52482	18.22968	19.52349	20.59528
83.5	13.2157	13.42829	13.78393	14.47261	15.42817	16.69451	17.5746	18.28859	19.60008	20.68739
84.5	13.2181	13.43276	13.7919	14.48765	15.45357	16.73462	17.62557	18.34873	19.67794	20.78075
85.5	13.2212	13.43793	13.80063	14.50352	15.47991	16.7758	17.67768	18.41007	19.75702	20.87531
86.5	13.2250	13.4438	13.8101	14.52021	15.50718	16.81803	17.7309	18.47255	19.83728	20.97103
87.5	13.2294	13.45037	13.8203	14.53772	15.53537	16.86129	17.7852	18.53615	19.91867	21.06786
88.5	13.2345	13.45764	13.83124	14.55603	15.56444	16.90553	17.84055	18.60082	20.00116	21.16573
89.5	13.2403	13.4656	13.8429	14.57513	15.59439	16.95075	17.89692	18.66653	20.08469	21.26462

90.5	13.2468	13.47425	13.85529	14.59501	15.6252	16.9969	17.95426	18.73325	20.16923	21.36447
91.5	13.2539	13.48359	13.86839	14.61566	15.65684	17.04396	18.01256	18.80093	20.25473	21.46524
92.5	13.2617	13.49362	13.88221	14.63706	15.6893	17.09191	18.07177	18.86955	20.34116	21.56688
93.5	13.2702	13.50432	13.89673	14.65922	15.72257	17.14072	18.13187	18.93906	20.42846	21.66935
94.5	13.2793	13.51571	13.91194	14.68211	15.75662	17.19037	18.19283	19.00943	20.51661	21.77259
95.5	13.2891	13.52777	13.92785	14.70572	15.79143	17.24082	18.2546	19.08063	20.60555	21.87658
96.5	13.2996	13.5405	13.94445	14.73005	15.827	17.29206	18.31718	19.15262	20.69525	21.98126
97.5	13.3107	13.5539	13.96173	14.75508	15.86329	17.34405	18.38051	19.22537	20.78568	22.0866
98.5	13.3225	13.56797	13.97968	14.78081	15.9003	17.39678	18.44458	19.29884	20.87678	22.19255
99.5	13.3350	13.58269	13.99829	14.80722	15.93802	17.45022	18.50936	19.37301	20.96853	22.29907
100.5	13.3481	13.59807	14.01757	14.8343	15.97641	17.50434	18.57481	19.44784	21.06089	22.40613
101.5	13.3618	13.6141	14.03751	14.86204	16.01546	17.55912	18.64091	19.52329	21.15381	22.51367
102.5	13.3762	13.63077	14.05809	14.89043	16.05517	17.61454	18.70762	19.59935	21.24727	22.62168
103.5	13.3912	13.64809	14.07931	14.91946	16.09551	17.67057	18.77493	19.67596	21.34123	22.73009
104.5	13.4069	13.66605	14.10116	14.94911	16.13646	17.7272	18.8428	19.75312	21.43565	22.83889
105.5	13.4232	13.68463	14.12364	14.97938	16.17801	17.78438	18.91121	19.83077	21.53049	22.94803
106.5	13.4401	13.70384	14.14675	15.01026	16.22014	17.84212	18.98012	19.9089	21.62573	23.05747
107.5	13.4577	13.72368	14.17046	15.04173	16.26284	17.90037	19.04952	19.98748	21.72133	23.16719
108.5	13.4759	13.74413	14.19478	15.07378	16.30609	17.95912	19.11937	20.06647	21.81725	23.27714
109.5	13.4947	13.76519	14.2197	15.10641	16.34988	18.01835	19.18965	20.14584	21.91347	23.3873
110.5	13.5141	13.78685	14.2452	15.1396	16.39418	18.07803	19.26034	20.22558	22.00996	23.49762
111.5	13.5341	13.80911	14.27129	15.17334	16.43899	18.13815	19.3314	20.30564	22.10667	23.60808

112.5	13.5547	13.83197	14.29796	15.20762	16.48428	18.19867	19.40282	20.38601	22.20358	23.71865
113.5	13.5759	13.85541	14.32519	15.24242	16.53005	18.25959	19.47457	20.46665	22.30066	23.82929
114.5	13.5977	13.87943	14.35298	15.27775	16.57627	18.32088	19.54662	20.54754	22.39789	23.93997
115.5	13.6201	13.90402	14.38132	15.31358	16.62293	18.38251	19.61895	20.62866	22.49522	24.05066
116.5	13.6431	13.92918	14.4102	15.3499	16.67002	18.44447	19.69154	20.70997	22.59264	24.16134
117.5	13.6667	13.9549	14.43962	15.38671	16.71751	18.50675	19.76436	20.79145	22.69011	24.27198
118.5	13.6908	13.98118	14.46957	15.42399	16.7654	18.5693	19.83739	20.87308	22.78761	24.38254
119.5	13.7155	14.008	14.50003	15.46173	16.81368	18.63213	19.91061	20.95484	22.88511	24.49299
120.5	13.7407	14.03535	14.531	15.49992	16.86231	18.6952	19.984	21.03669	22.98258	24.60333
121.5	13.7665	14.06324	14.56247	15.53855	16.9113	18.7585	20.05753	21.11861	23.08	24.71351
122.5	13.7928	14.09166	14.59444	15.57761	16.96062	18.82202	20.13118	21.20059	23.17734	24.82351
123.5	13.8197	14.12059	14.62688	15.61709	17.01026	18.88572	20.20493	21.28259	23.27458	24.93331
124.5	13.8471	14.15003	14.6598	15.65696	17.06021	18.94959	20.27876	21.3646	23.3717	25.04288
125.5	13.8750	14.17997	14.69319	15.69724	17.11045	19.01362	20.35264	21.44659	23.46867	25.15221
126.5	13.9035	14.21041	14.72703	15.73789	17.16097	19.07779	20.42657	21.52854	23.56546	25.26126
127.5	13.9324	14.24133	14.76132	15.77891	17.21174	19.14207	20.50052	21.61043	23.66206	25.37002
128.5	13.9618	14.27272	14.79605	15.8203	17.26277	19.20645	20.57446	21.69224	23.75845	25.47846
129.5	13.9918	14.30459	14.8312	15.86203	17.31403	19.27091	20.64838	21.77396	23.8546	25.58657
130.5	14.0222	14.33691	14.86677	15.9041	17.36551	19.33544	20.72227	21.85555	23.95049	25.69432
131.5	14.0531	14.36969	14.90275	15.94649	17.41719	19.40001	20.79609	21.937	24.0461	25.80169
132.5	14.0845	14.4029	14.93913	15.98919	17.46907	19.46462	20.86984	22.01829	24.14141	25.90868
133.5	14.1163	14.43656	14.9759	16.0322	17.52112	19.52924	20.94349	22.0994	24.23641	26.01525

134.5	14.1486	14.47063	15.01305	16.07549	17.57333	19.59386	21.01703	22.18031	24.33108	26.12139
135.5	14.1813	14.50512	15.05056	16.11907	17.6257	19.65846	21.09045	22.26101	24.42539	26.22709
136.5	14.2144	14.54002	15.08844	16.1629	17.6782	19.72302	21.16371	22.34148	24.51933	26.33233
137.5	14.2480	14.57531	15.12666	16.207	17.73082	19.78754	21.23681	22.4217	24.61288	26.43709
138.5	14.2820	14.61099	15.16522	16.25134	17.78356	19.85199	21.30974	22.50166	24.70603	26.54136
139.5	14.3164	14.64705	15.20411	16.2959	17.83638	19.91636	21.38246	22.58133	24.79876	26.64513
140.5	14.3512	14.68347	15.24332	16.34069	17.88929	19.98063	21.45498	22.66071	24.89106	26.74838
141.5	14.3864	14.72025	15.28283	16.38568	17.94227	20.0448	21.52727	22.73977	24.98291	26.8511
142.5	14.4219	14.75737	15.32264	16.43087	17.99531	20.10884	21.59931	22.8185	25.0743	26.95328
143.5	14.4578	14.79484	15.36274	16.47625	18.04838	20.17274	21.67111	22.89689	25.16522	27.0549
144.5	14.4941	14.83262	15.40311	16.52179	18.10149	20.23648	21.74263	22.97493	25.25564	27.15596
145.5	14.5307	14.87073	15.44374	16.5675	18.15461	20.30006	21.81386	23.05259	25.34557	27.25645
146.5	14.5677	14.90914	15.48462	16.61335	18.20774	20.36346	21.8848	23.12987	25.43498	27.35636
147.5	14.6050	14.94784	15.52574	16.65934	18.26085	20.42667	21.95543	23.20675	25.52387	27.45567
148.5	14.6426	14.98682	15.5671	16.70546	18.31395	20.48967	22.02573	23.28323	25.61223	27.55439
149.5	14.6805	15.02607	15.60867	16.75168	18.36701	20.55245	22.0957	23.35928	25.70005	27.6525
150.5	14.7187	15.06559	15.65044	16.79801	18.42002	20.61499	22.16532	23.43491	25.78731	27.75
151.5	14.7571	15.10535	15.69241	16.84442	18.47298	20.67729	22.23458	23.51008	25.87401	27.84688
152.5	14.7959	15.14535	15.73456	16.89091	18.52586	20.73934	22.30346	23.58481	25.96013	27.94314
153.5	14.8349	15.18558	15.77689	16.93746	18.57866	20.80112	22.37196	23.65907	26.04568	28.03877
154.5	14.8741	15.22602	15.81937	16.98407	18.63136	20.86261	22.44007	23.73285	26.13065	28.13377
155.5	14.9136	15.26666	15.86199	17.03071	18.68396	20.92382	22.50777	23.80615	26.21502	28.22813

156.5	14.9533	15.30749	15.90476	17.07738	18.73643	20.98472	22.57506	23.87895	26.2988	28.32185
157.5	14.9932	15.34849	15.94764	17.12407	18.78878	21.04531	22.64192	23.95126	26.38197	28.41494
158.5	15.0333	15.38966	15.99063	17.17076	18.84098	21.10557	22.70835	24.02305	26.46453	28.50739
159.5	15.0736	15.43098	16.03372	17.21744	18.89302	21.1655	22.77434	24.09433	26.54648	28.59919
160.5	15.1141	15.47244	16.0769	17.26409	18.9449	21.22508	22.83987	24.16508	26.62782	28.69036
161.5	15.1547	15.51403	16.12014	17.31072	18.9966	21.28431	22.90494	24.23529	26.70853	28.78088
162.5	15.1954	15.55572	16.16345	17.35729	19.04811	21.34317	22.96954	24.30497	26.78862	28.87077
163.5	15.2363	15.59752	16.2068	17.40381	19.09942	21.40166	23.03366	24.37411	26.86808	28.96002
164.5	15.2774	15.63941	16.25018	17.45026	19.15052	21.45977	23.09731	24.44269	26.94692	29.04864
165.5	15.3185	15.68136	16.29358	17.49662	19.20139	21.51749	23.16045	24.51071	27.02513	29.13663
166.5	15.3597	15.72338	16.33699	17.54289	19.25204	21.5748	23.22311	24.57818	27.1027	29.22399
167.5	15.4010	15.76544	16.38039	17.58905	19.30243	21.63171	23.28525	24.64508	27.17965	29.31073
168.5	15.4423	15.80753	16.42378	17.63509	19.35257	21.68819	23.34689	24.71141	27.25597	29.39686
169.5	15.4837	15.84964	16.46712	17.68099	19.40245	21.74426	23.40801	24.77716	27.33167	29.48237
170.5	15.5251	15.89175	16.51042	17.72675	19.45204	21.79989	23.46861	24.84234	27.40673	29.56729
171.5	15.5666	15.93385	16.55366	17.77236	19.50136	21.85508	23.52868	24.90694	27.48118	29.6516
172.5	15.6080	15.97592	16.59682	17.81779	19.55037	21.90982	23.58823	24.97096	27.555	29.73533
173.5	15.6494	16.01795	16.63989	17.86304	19.59907	21.96411	23.64723	25.0344	27.6282	29.81848
174.5	15.6908	16.05992	16.68286	17.90809	19.64746	22.01794	23.7057	25.09725	27.70079	29.90107
175.5	15.7322	16.10183	16.72571	17.95294	19.69552	22.0713	23.76363	25.15951	27.77277	29.98309
176.5	15.7735	16.14364	16.76842	17.99756	19.74325	22.12419	23.82101	25.22119	27.84414	30.06456
177.5	15.8147	16.18536	16.81099	18.04195	19.79062	22.1766	23.87784	25.28228	27.91491	30.1455

178.5	15.8559	16.22696	16.8534	18.0861	19.83764	22.22852	23.93412	25.34279	27.98509	30.22591
179.5	15.8969	16.26842	16.89563	18.12998	19.88429	22.27996	23.98985	25.40271	28.05468	30.3058
180.5	15.9378	16.30974	16.93767	18.1736	19.93057	22.3309	24.04503	25.46204	28.12369	30.3852
181.5	15.9786	16.35089	16.97951	18.21693	19.97646	22.38135	24.09964	25.5208	28.19213	30.46411
182.5	16.0192	16.39185	17.02112	18.25996	20.02195	22.43128	24.1537	25.57897	28.26	30.54255
183.5	16.0596	16.43262	17.0625	18.30269	20.06704	22.48072	24.20721	25.63656	28.32732	30.62053
184.5	16.0999	16.47318	17.10363	18.3451	20.11172	22.52963	24.26015	25.69357	28.39408	30.69807
185.5	16.1399	16.51351	17.14448	18.38717	20.15598	22.57804	24.31254	25.75002	28.46031	30.77519
186.5	16.1797	16.55358	17.18506	18.42889	20.19981	22.62592	24.36437	25.80589	28.52602	30.8519
187.5	16.2192	16.5934	17.22534	18.47025	20.2432	22.67329	24.41564	25.8612	28.5912	30.92822
188.5	16.2585	16.63293	17.2653	18.51124	20.28614	22.72013	24.46636	25.91595	28.65588	31.00417
189.5	16.2976	16.67216	17.30494	18.55184	20.32862	22.76644	24.51653	25.97014	28.72007	31.07976
190.5	16.3363	16.71107	17.34423	18.59205	20.37064	22.81222	24.56614	26.02379	28.78378	31.15502
191.5	16.3747	16.74965	17.38316	18.63184	20.41219	22.85747	24.61521	26.07689	28.84702	31.22997
192.5	16.4127	16.78787	17.42171	18.67121	20.45326	22.90219	24.66372	26.12945	28.90981	31.30462
193.5	16.4504	16.82573	17.45986	18.71015	20.49383	22.94637	24.7117	26.18148	28.97215	31.379
194.5	16.4878	16.8632	17.49761	18.74863	20.53392	22.99002	24.75913	26.23299	29.03407	31.45314
195.5	16.5247	16.90025	17.53492	18.78665	20.57349	23.03313	24.80603	26.28399	29.09558	31.52704
196.5	16.5612	16.93689	17.5718	18.82419	20.61256	23.07571	24.8524	26.33448	29.1567	31.60075
197.5	16.5973	16.97308	17.60821	18.86125	20.65111	23.11774	24.89824	26.38446	29.21743	31.67427
198.5	16.6329	17.0088	17.64415	18.8978	20.68912	23.15924	24.94356	26.43396	29.27781	31.74764
199.5	16.6681	17.04404	17.67959	18.93384	20.72661	23.2002	24.98836	26.48298	29.33784	31.82088

200.5	16.7027	17.07879	17.71452	18.96935	20.76355	23.24062	25.03265	26.53153	29.39755	31.89401
201.5	16.7369	17.11301	17.74892	19.00432	20.79994	23.28051	25.07643	26.57962	29.45695	31.96706
202.5	16.7705	17.14669	17.78278	19.03874	20.83578	23.31986	25.11972	26.62726	29.51606	32.04007
203.5	16.8035	17.17981	17.81607	19.07258	20.87105	23.35867	25.16251	26.67447	29.57491	32.11305
204.5	16.8360	17.21234	17.84878	19.10585	20.90576	23.39696	25.20482	26.72125	29.6335	32.18603
205.5	16.8679	17.24429	17.88089	19.13852	20.93988	23.43471	25.24665	26.76761	29.69187	32.25905
206.5	16.8991	17.2756	17.91238	19.17059	20.97343	23.47193	25.28802	26.81358	29.75004	32.33212
207.5	16.9297	17.30628	17.94324	19.20204	21.00638	23.50863	25.32892	26.85915	29.80802	32.40529
208.5	16.9596	17.3363	17.97344	19.23285	21.03874	23.5448	25.36937	26.90436	29.86584	32.47859
209.5	16.9889	17.36564	18.00298	19.26301	21.07049	23.58045	25.40938	26.9492	29.92352	32.55204
210.5	17.0174	17.39427	18.03182	19.29252	21.10163	23.61558	25.44895	26.9937	29.98109	32.62567
211.5	17.0453	17.42218	18.05996	19.32135	21.13216	23.65019	25.4881	27.03787	30.03857	32.69952
212.5	17.0723	17.44935	18.08737	19.34949	21.16206	23.68429	25.52684	27.08173	30.09599	32.77362
213.5	17.0986	17.47576	18.11403	19.37693	21.19134	23.71788	25.56517	27.12528	30.15337	32.84802
214.5	17.1241	17.50137	18.13993	19.40366	21.21997	23.75097	25.60311	27.16856	30.21074	32.92272
215.5	17.1487	17.52618	18.16505	19.42965	21.24797	23.78356	25.64067	27.21157	30.26812	32.99779
216.5	17.1726	17.55015	18.18937	19.45491	21.27532	23.81564	25.67786	27.25433	30.32554	33.07324
217.5	17.1955	17.57328	18.21286	19.47941	21.30202	23.84724	25.7147	27.29686	30.38304	33.14912
218.5	17.2176	17.59553	18.23552	19.50314	21.32805	23.87835	25.75118	27.33918	30.44063	33.22546
219.5	17.2387	17.61689	18.25732	19.52608	21.35343	23.90898	25.78733	27.3813	30.49835	33.30231
220.5	17.2589	17.63733	18.27824	19.54823	21.37812	23.93912	25.82317	27.42325	30.55623	33.37969
221.5	17.2781	17.65683	18.29826	19.56957	21.40215	23.9688	25.85869	27.46505	30.6143	33.45766

222.5	17.2964	17.67537	18.31736	19.59008	21.42548	23.99801	25.89392	27.50671	30.6726	33.53624
223.5	17.3136	17.69293	18.33552	19.60975	21.44813	24.02676	25.92887	27.54826	30.73114	33.61548
224.5	17.3298	17.70948	18.35273	19.62857	21.47008	24.05505	25.96356	27.58971	30.78997	33.69542
225.5	17.3450	17.725	18.36896	19.64651	21.49134	24.08289	25.99799	27.63109	30.84911	33.77609
226.5	17.3590	17.73946	18.38419	19.66358	21.51188	24.11029	26.03219	27.67242	30.90861	33.85756
227.5	17.3720	17.75286	18.39841	19.67975	21.53171	24.13725	26.06617	27.71372	30.96849	33.93984
228.5	17.3838	17.76515	18.41159	19.695	21.55082	24.16378	26.09993	27.75502	31.0288	34.023
229.5	17.3945	17.77632	18.42371	19.70933	21.56921	24.18988	26.13351	27.79633	31.08956	34.10707
230.5	17.4039	17.78635	18.43475	19.72272	21.58686	24.21557	26.16692	27.83769	31.15082	34.1921
231.5	17.4122	17.79521	18.4447	19.73516	21.60378	24.24084	26.20016	27.8791	31.21261	34.27814
232.5	17.4193	17.80288	18.45352	19.74662	21.61996	24.26571	26.23326	27.92061	31.27496	34.36522
233.5	17.4258	17.80934	18.46121	19.7571	21.63539	24.29019	26.26624	27.96223	31.33793	34.45341
234.5	17.4295	17.81456	18.46773	19.76658	21.65006	24.31427	26.29911	28.00399	31.40154	34.54273
235.5	17.4327	17.81852	18.47308	19.77505	21.66397	24.33798	26.33189	28.04591	31.46583	34.63326
236.5	17.4346	17.82119	18.47722	19.78248	21.67712	24.3613	26.36459	28.08801	31.53085	34.72503
237.5	17.4351	17.82256	18.48014	19.78887	21.68949	24.38426	26.39723	28.13034	31.59664	34.8181
238.5	17.4342	17.82259	18.48182	19.7942	21.70108	24.40686	26.42984	28.17291	31.66324	34.9125
239.5	17.4319	17.82127	18.48223	19.79846	21.71189	24.4291	26.46243	28.21574	31.73069	35.00831
240	17.4303	17.82009	18.48196	19.80018	21.717	24.4401	26.47872	28.23727	31.76474	35.05675
240.5	17.4282	17.81856	18.48136	19.80162	21.72191	24.45101	26.49502	28.25888	31.79903	35.10556