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Parenting Styles, Parenting Practices, and Dietary Intakes of Preschoolers and Their Parents

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PARENTING STYLES, PARENTING PRACTICES, AND DIETARY INTAKES OF PRESCHOOLERS AND THEIR PARENTS

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DISSERTATION ACCEPTANCE PAGE

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This dissertation is approved as a creditable and independent investigation by a candidate for the Doctor of Philosophy degree and is acceptable for meeting the dissertation requirements for this degree. Acceptance of this does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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ABBREVIATIONS

24HR	24-Hour Recall
AMDR	Acceptable Macronutrient Distribution Ranges
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CFPQ	Comprehensive Feeding Practices Questionnaire
CFQ	Child Feeding Questionnaire
CHES	Comprehensive Home Environment Survey
DGAC	Dietary Guidelines Advisory Committee
DHQ	Diet History Questionnaire
DRI	Dietary Reference Intakes
FFQ	Food Frequency Questionnaire
FR	Food Record
HEI	Healthy Eating Index
HHHQ	Health Habits and History Questionnaire
HomeSTEAD	Home Self-Administered Tool for Environmental Assessment of Activity and Diet
HSFFQ	Harvard Service Food Frequency Questionnaire
IRB	Institutional Review Board
KMO	Kaiser-Meyer-Olkin Test
NCI	National Cancer Institute
NHANES	National Health and Nutrition Examination Surveys
PDI-S	Parenting Dimensions Inventory-Short Version
PSI	Parenting Style Inventory
RDA	Recommended Dietary Allowances

UL	Tolerable Upper Intake Level
USDA	United States Department of Agriculture
WIC	Women, Infants and Children
WWEIA	What We Eat In America

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ABSTRACT

PARENTING STYLES, PARENTING PRACTICES, AND DIETARY INTAKES OF PRESCHOOLERS AND THEIR PARENTS

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Emerging research efforts have focused on the role of parents in the development of dietary behaviors of their children. Parental influences play a particularly important role in determining the children's weight and shaping children's dietary behaviors, especially during early childhood. Parent-related determinants can be classified as two types—general parenting (parenting style) and specific parenting practices (e.g, food parenting practices). Examining the interactions between parental influences and preschoolers' and their parental dietary behaviors and may reveal important insights into how parents influence children's dietary behaviors. Therefore, the goal of this research is to examine the associations between parenting styles, food parenting practices, and dietary intakes of preschoolers and their parents. This research was a part of the *iGrow* Readers program conducted in 2016. A total of 293 parent/child (3-5 years old) dyads were recruited from preschools/daycare centers in South Dakota, Minnesota, and Nebraska. In general, this dissertation includes: 1) conducting exploratory factor analysis to an original existing home environment assessment—the Comprehensive Home Environment Survey (CHES), to identify and evaluate modified factor structures about food parenting practices; 2) identifying the associations between parenting styles and dietary intakes (including nutrients and food group intakes) of preschool-aged children and their parents; and 3) examining the relationship between food parenting practices and dietary intakes of preschool-aged children and their parents.

To modify the original CHES, a content map of food parenting practices was used as a framework to help select items from CHES and guide identification of relevant constructs. A total of 172 parents completed the original CHES. The exploratory factor analysis revealed 40 items that identified 10 food parenting practices factors (subconstructs) under three broad constructs; 4 subconstructs (21 items) within *Structure*, 4 subconstructs (14 items) within *Coercive Control*, and 2 subconstructs (5 items) within *Autonomy Support*. By identifying alternative factor structures, the refined CHES was expected to provide a comprehensive measurement of food parenting practices.

In addition, this study examined the relationship between general parenting styles and dietary intakes of preschool-aged children and their parents. Parenting styles was measured by Parenting Dimensions Inventory-Short (PDI-S) survey and dietary information were collected by Harvard Service Food Frequency Questionnaire (HSFFQ). A total of 218 parent participants completed both surveys. Kruskal-Wallis test and multiple linear regression analyses were performed to examine the association between dietary intakes of preschool children/parents and four parenting styles (i.e., authoritative, authoritarian, indulgent, and uninvolved). Overall, the main findings indicated no significant differences were seen for most assessed children's and parental dietary nutrients and food group intakes between authoritative parenting style and other three parenting styles. Children's food group intakes were positively associated with corresponding parental food group intakes, moreover, authoritative parents predicted more child fruits consumption.

The study continued to examine the relationship between food parenting practices and dietary intakes of preschool children/parents. Food parenting practices were

measured by refined CHES and dietary information were collected by HSFFQ. Spearman's correlation analyses and multiple linear regression analyses were performed to examine the association between dietary intakes of preschool children/parents and food parenting practices (including 3 constructs and 10 subconstructs). Generally, the main findings indicated that for both preschoolers and their parents, food parenting practices construct—*Structure* and its subconstructs were positively related to healthy dietary intakes (e.g., fruits) and inversely related to unhealthy dietary intakes (e.g., sweets). The results suggest that food parenting practices for preschoolers are important to consider when trying to improve healthy children's dietary intakes as well as modify parents' dietary intakes.

This dissertation demonstrated that parenting influence is a key factor for preschoolers on healthy dietary intakes. The results of this study create the opportunity for future investigation of interactive effects between parents' dietary behavior, parenting influences, and children's dietary behavior.

CHAPTER 1

INTRODUCTION

Over the past three decades, the number of overweight and obese individuals in the United States (U.S.) has increased significantly.[1] Among U.S. children and adolescents aged 2 to 19 years, the prevalence of obesity in 2015-2016 was 18.5%.[1] In order to successfully combat the obesity epidemic, researchers and health professionals must develop effective solutions to counteract the behavioral, social, biological and environmental factors that contribute to unhealthy eating and weight gain.[2,3]

While obesity prevention strategies of the past focused on education and individual behavior modification,[4] a growing body of evidence suggests that eating behaviors, which develop during infancy and early childhood and are largely influenced by the parent and home eating structure,[5,6] set the stage for future habits and may influence a child's weight status.[7] The link between the parent and the weight status of the child becomes especially important when one considers that 1) overweight and obese children are more likely to become obese adults[8,9] and 2) obese children are at an increased risk of chronic disease (e.g. stroke, type 2 diabetes, cancer, hypertension, osteoarthritis, and cardiovascular disease) later on in life.[10-12]

Emerging research efforts have focused on the role of parents in the development of dietary behaviors of their children.[13] Parents can be considered important in determining the children's weight because they act as nutrition "gatekeepers", providing their kids with ability and opportunity to make healthy food choices.[14] Parental influences or parent-related determinants that previous studies examined can be classified as two types—general parenting (parenting style) and specific parenting practices.[15] Although

research in this field has been very extensive, research gaps continue to exist. There is a lack of assessment of parental influences (including general and specific influences) on both parents' and preschoolers' dietary intakes.

The goal of this research is to examine the associations between parenting styles, food parenting practices, and dietary intakes of preschoolers and their parents. Figure 1.1 shows a summary of the main hypothesis of this study, including three following specific aims: 1) conducting exploratory factor analysis to an original existing home environment assessment—the Comprehensive Home Environment Survey (CHES), to identify and evaluate modified factor structures about food parenting practices (arrow a); 2) to explore the relationship between four parenting styles (including authoritative, authoritarian, indulgent, and uninvolved) and dietary intakes of preschoolers and their parents (arrow b); and 3) to explore the relationship between food parenting practices and dietary intakes of preschoolers and their parents (arrow c).

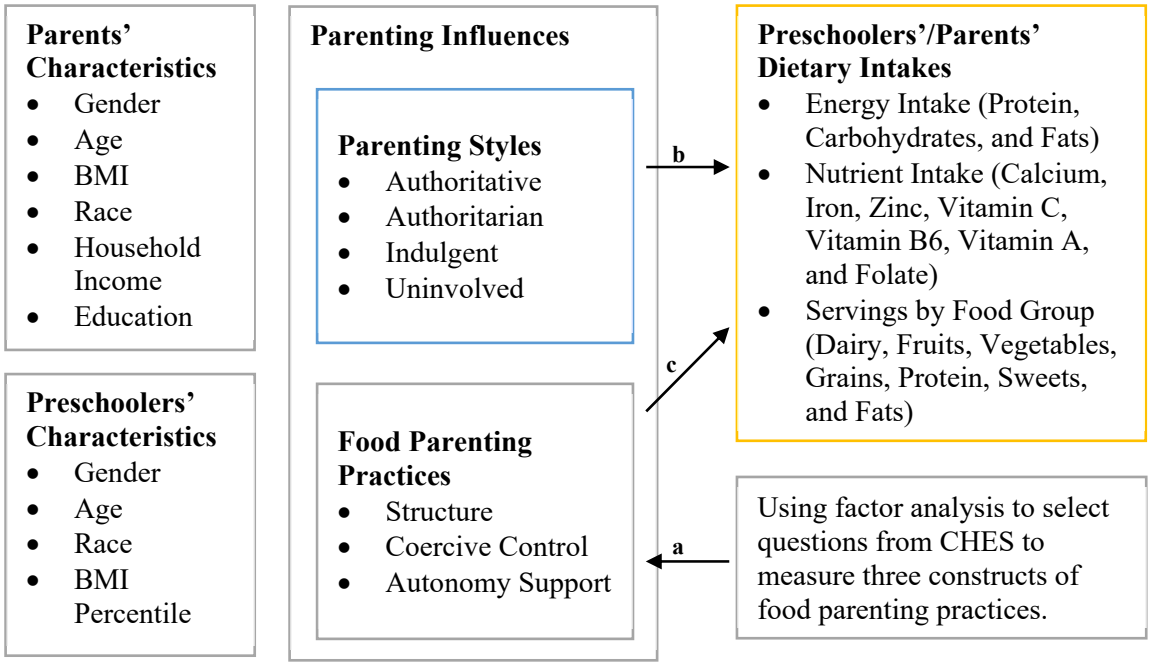

Figure 1.1 Model of Parenting Influences on Dietary Intakes of Preschoolers and Parents

REFERENCES

1. Hales CM, Carroll MD, Fryar CD, Ogden CL. Prevalence of obesity among adults and youth: United States, 2015-2016. *NCHS Data Brief.* 2017(288):1-8.
2. Boehmer TK, Hoehner CM, Deshpande AD, Brennan Ramirez LK, Brownson RC. Perceived and observed neighborhood indicators of obesity among urban adults. *Int J Obes (Lond).* 2007;31(6):968-977.
3. Hill JO, Peters JC. Environmental contributions to the obesity epidemic. *Science.* 1998;280(5368):1371-1374.
4. Swinburn B, Egger G, Raza F. Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. *Prev Med.* 1999;29(6 Pt 1):563-570.
5. Couch SC, Glanz K, Zhou C, Sallis JF, Saelens BE. Home food environment in relation to children's diet quality and weight status. *J Acad Nutr Diet.* 2014;114(10):1569-1579.e1561.
6. Scaglioni S, Arrizza C, Vecchi F, Tedeschi S. Determinants of children's eating behavior. *Am J Clin Nutr.* 2011;94(6 Suppl):2006s-2011s.
7. Agras WS, Kraemer HC, Berkowitz RI, Hammer LD. Influence of early feeding style on adiposity at 6 years of age. *J Pediatr.* 1990;116(5):805-809.
8. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med.* 1997;337(13):869-873.
9. Grilo CM, Pogue-Geile MF. The nature of environmental influences on weight and obesity: a behavior genetic analysis. *Psychol Bull.* 1991;110(3):520-537.

10. Guo SS, Chumlea WC. Tracking of body mass index in children in relation to overweight in adulthood. *Am J Clin Nutr.* 1999;70(1 Part 2):145-148.

11. Freedman DS, Khan LK, Serdula MK, Dietz WH, Srinivasan SR, Berenson GS. The relation of childhood BMI to adult adiposity: the Bogalusa Heart Study. *Pediatrics.* 2005;115(1):22-27.

12. Wijga AH, Scholtens S, Bemelmans WJ, et al. Comorbidities of obesity in school children: a cross-sectional study in the PIAMA birth cohort. *BMC Public Health.* 2010;10:184. doi:10.1186/1471-2458-10-184.

13. Kremers S, Sleddens E, Gerards S, et al. General and food-specific parenting: measures and interplay. *Child Obes.* 2013;9 Suppl:S22-S31.

14. Hingle MD, O'Connor TM, Dave JM, Baranowski T. Parental involvement in interventions to improve child dietary intake: a systematic review. *Prev Med.* 2010;51(2):103-111.

15. Gerards SM, Kremers SP. The role of food parenting skills and the home food environment in children's weight gain and obesity. *Curr Obes Rep.* 2015;4(1):30-36.

CHAPTER 2

LITERATURE REVIEW

A review of literature was conducted to better understand the influence of the parenting influences and perception on childhood weight status. In the review, childhood obesity prevalence, dietary intakes of children, the impact of parenting influences, and methods for assessing the parenting influences.

2.1 The Impact of Overweight and Obesity in Children and Adolescents

Obesity is defined as having excess body fat. Body mass index (BMI), expressed as weight in kilograms divided by height in meters squared (kg/m^2), is commonly used to classify obesity among adults and is also recommended for use with children and adolescents.[1] The Centers for Disease Control and Prevention (CDC) defines obesity in children and adolescents as BMI at or above the 95th percentile for young people of the same age and sex.[2] Childhood obesity has immediate and long-term effects on physical, social, and emotional health. Children and adolescents with overweight or obesity are having higher risks of chronic health conditions and diseases, such as asthma, sleep apnea, bone and joint problems, type 2 diabetes, and risk factors for heart disease.[3-5] Children with obesity are bullied and teased more than their normal weight peers and are more likely to suffer from social isolation, depression, and lower self-esteem.[5-7] In the long term, a child with obesity is more likely to have obesity as an adult.[8]

In the United States, the percentage of children and adolescents with obesity has more than tripled since the 1970s.[9] In 2015-2016, the most recent national estimate for the prevalence of obesity shows that nearly 1 in 5 (18.5%) youth aged 2-19 years in the

United States has obesity.[10] Overall, the prevalence of obesity among adolescents (12-19 years) (20.6%) and school-aged children (6-11 years) (18.4%) was higher than among preschool-aged children (2-5 years) (13.9%).[10] The prevalence of obesity in the United States remains higher than the Healthy People 2030 goals of 15.5% among youth.[11]

Many nationally representative studies and trend analyses using data from 2-year cycles of the National Health and Nutrition Examination Surveys (NHANES) have been published on obesity among children and adolescents based on different time periods.[12] The author Ogden et al. reported that during an approximately 25-year period (1988-1994 through 2013-2014), there was a significant quadratic trend in obesity prevalence among children and adolescents aged 2 to 19 years.[12] For different age groups, the prevalence of obesity increased until 2003-2004 and then decreased in children aged 2 to 5 years, increased until 2007-2008 and then leveled off in children aged 6 to 11 years, and increased among adolescents aged 12 to 19 years between 1988-1994 and 2013-2014.[12] In another similar trend analyses, Hales et al. reported that from 1999-2000 through 2015-2016, a significantly increasing trend in obesity was observed in youth aged 2 to 19 years.[10] The observed increasing change in prevalence between 2013-2014 and 2015-2016, however, was not significant among youth.[10]

Cohort studies indicate that excess weight during childhood is a predictor of future obesity, with high correlations with BMI over time.[13-16] Several researchers have tried to predict the potential impact of the childhood obesity epidemic in the United States. Ward et al. predicted that of 57.3% today's children will be obese at the age of 35 years, and roughly half of the projected prevalence will occur during childhood.[17] They also found that an obese 2-year-old is more likely to be obese at 35 years of age than an

overweight 19-year-old, which highlighted the importance of promoting a healthy weight throughout childhood and adulthood.[17]

2.2 Dietary Intakes of Children

As we stated above, childhood obesity has been dramatic increase in U.S. and is a serious public health concern. There is a general agreement childhood obesity at the individual level ultimately results from an imbalance between energy intake and energy expenditure.[18] In other words, many children have been consuming more energy than they expend in physical activity, or need for normal growth and development.[19] Thus, this section will address children dietary intakes the United States.

2.2.1 Recommendation for Dietary Intakes of Children

Ideally, children should consume a diet that provides an adequate intake of all essential nutrients needed for normal growth and development. In addition to consuming a variety of nutrient-rich foods and beverages from all the major food groups, the total diet should not only promote health in childhood, but also reduce risk for future chronic disease.[19]

MyPlate, which was released by the United States Department of Agriculture (USDA) in 2011 provided recommendation of five major food groups (fruits, vegetables, grains, protein foods, and dairy) for children.[20] The MyPlate daily checklist shows children's food group targets—what and how much to eat within calorie allowance.[20] For example, for 1000 calories a day, children ages 1-3 years should consume 1 cup fruits, 1 cup vegetables, 3 ounces grains, 2 ounces protein, and 2 cups dairy; and limit sodium to 1,500 mg/day, saturated fat to 11 g/day, and added sugars to 25 g/day.[20] They also have recommended tips for each food group, including focusing on whole fruits, choosing a

variety of vegetables, making half of grains whole grains, varying protein routine, and moving to low-fat or fat-free milk or yogurt.[20]

The 2015-2020 Dietary Guidelines for Americans provides the USDA food patterns for all U.S. population including children and adolescents by age-sex groups.[21] The current USDA Food Patterns identify amounts of foods to consume from five major food groups (fruits, vegetables, grains, protein foods, and dairy) and their sub-groups.[22] Table 2.1 presents the recommendation of the USDA Food Patterns for children aged 1-3 years and 4-8 years.[23]

Table 2.1 Recommendation of the USDA Food Patterns for Children

Food Groups/Items	**Daily Recommendation Amount**			
	Ages 1-3		**Ages 4-8**	
	Boy	**Girl**	**Boy**	**Girl**
Vegetables	1.0-1.5 cup-equivalents		1.5-2.5 cup-equivalents	
Fruits	1.0-1.5 cup-equivalents		1.0-2.0 cup-equivalents	1.0-1.5 cup-equivalents
Total grains	3.0-5.0 ounce-equivalents		4.0-6.0 ounce-equivalents	
Dairy	2.0-2.5 cup-equivalents		2.5-3.0 cup-equivalents	
Protein foods	2.0-4.0 ounce-equivalents		3.0-5.5 ounce-equivalents	3.0-5.0 ounce-equivalents
Oils and solid fats	15-17 g		17-27 g	17-24 g
Added sugars	maximum limit of 10% of calories			
Saturated fats	maximum limit of 10% of calories			
Sodium	Tolerable Upper Intake Level (UL) 1500 mg		UL 1900 mg	

Note: Food group amounts shown in cup-(c) or ounce-equivalents (oz-eq). Oils are shown in grams (g). Quantity equivalents for each food group are: vegetables and fruits, 1 cup-equivalent is: 1 cup raw or cooked vegetable or fruit, 1 cup vegetable or fruit juice, 2 cups leafy salad greens, ½ cup dried fruit or vegetable; grains, 1 ounce-equivalent is: ½ cup cooked rice, pasta, or cereal; 1 ounce dry pasta or rice; 1 medium (1 ounce) slice bread; 1 ounce of ready-to-eat cereal (about 1 cup of flaked cereal); dairy, 1 cup-equivalent is: 1 cup milk, yogurt, or fortified soymilk; 1½ ounces natural cheese such as cheddar cheese or 2 ounces of processed cheese; protein foods, 1 ounce-equivalent is: 1 ounce lean meat, poultry, or seafood; 1 egg; ¼ cup cooked beans or tofu; 1 Tbsp peanut butter; ½ ounce nuts or seeds.[23]

2.2.2 Dietary Intakes with Childhood Obesity

The 2015 Dietary Guidelines Advisory Committee (DGAC) examined the evidence linking specific dietary with childhood obesity.[24] The DGAC indicates that the dietary intake and diet-related behaviors associated with increased adiposity in children include: increased total energy intake; higher energy density of the diet; higher total fat intake; higher intake of sugar-sweetened beverages; low intake of fruits and vegetables; large amounts of fruit juice, especially for overweight children; large portions of food and beverages; frequent consumption of "fast foods".[24] In addition, the dietary intake and diet-related behaviors associated with decreased adiposity in children include: lower total energy intake; lower energy density of the diet; lower total fat intake; lower intake of sugar-sweetened beverages; higher intakes of fruits and vegetables; smaller amounts of fruit juice; smaller portions of food and beverages; less frequent consumption of "fast foods".[24]

A systematic review by Ambrosini et al. focused on childhood dietary patterns and obesity suggests that dietary patterns in childhood or adolescence that are higher in energy-dense and low-fiber foods, such as sweets, refined grains, and processed meats, as well as sugar-sweetened beverages, whole milk, fried potatoes, certain fats and oils, and fast foods increase the risk of obesity later.[25] Another review by Perez-Escamilla et al. concluded that energy-dense diets are a risk factor for obesity in children. These results from the present review provide evidence that these correlated dietary factors may be important for childhood obesity.[26]

2.2.3 Current Dietary Intakes of Children by Food Groups

U.S. children's average intake of foods from the food groups are far from amounts recommended in the Healthy U.S.-Style Eating Pattern.[21] One national study by Ford et al. analyzed dietary intake data for children ages 2-5 years (2009-2010 and 2011-2012) and reported that the overall diet quality among U.S. preschool children was low, as indicated by the mean Healthy Eating Index (HEI) score (46.5 of a possible 100 pts).[27] The 2015 DGAC report current dietary intakes by U.S. children using data from the What We Eat In America (WWEIA), NHANES dietary survey (2007-2010), and the National Cancer Institute (NCI)'s examination of the usual intake distributions, and percent of the U.S. population meeting USDA Food Pattern recommendations for their age and sex.[28,29] The following paragraphs describe the current dietary intakes by U.S. children for each food group.

Fruits. Although evidence suggests that increase consumption of fruits and vegetables confers some protection against increased adiposity in children, however, current intake by U.S. children does not meet recommendations, either with respect to numbers of daily servings or variety of types consumed.[19] The majority of children ages 1-3 years and 4-8 years meet the recommended intakes for total fruit, which is 1 cup and 1 to 1.5 cups per day, respectively.[24] Few older children (ages 9-13 years) consume the recommended daily amounts, which range from 1.5 to 2 cups for older children.[24] Among both boys and girls ages 1-3 years, whole fruit comprises slightly more than half of the daily fruit intake and the remainder is consumed though 100% fruit juice.[24] Among children ages 4-8 and 9-13 years, fruit intake includes both 100% juice and whole fruit, but whole fruit comprises the majority of intake.[24]

Vegetables. Only 10% and 15% of boys and girls ages 1-3 years, consume the recommended 1 cup of vegetables per day.[24] For children ages 4-8 years, less than 5% consume the recommended amount.[24] Vegetable consumption is lowest among boys ages 9-13 years (1% consume the recommended 2 to 2.5 cups/day) and girls ages 14-18 years (less than 1% consume the recommended 2 to 2.5 cups/day).[24]

Grains (Whole and Refined). The 2015 Dietary Guidelines for Americans recommended that half of all grain intake should come from whole grains.[21] For age-sex groups children, intakes of total grains are close to the target amounts, but intakes do not meet the recommendations for whole grains and exceed limits for refined grains.[21] For example, for boys ages 1-3 years, average intakes of whole grains (0.6 ounce-equivalents/day) are far below recommended levels (1.5-2.5 ounce-equivalents/day), and average intakes of refined grains (3.5 ounce-equivalents/day) are well above recommended limits.[21]

Dairy. Dairy foods in the USDA Food Patterns include fluid milk, cheese, yogurt, ice cream, milk based replacement meals and milk products.[24] It was recommended that consumption of low-fat and fat-free foods in the dairy group to ensure intake of these key nutrients while minimizing intake of saturated fat, which is a nutrient of concern for overconsumption.[22] More than 60 percent of U.S. children ages 1-3 years meet or exceed the recommended intake of 2 cup equivalents per day, with most of this intake coming in the form of fluid milk.[24] Intake falls in older children to about 30 percent of boys and girls meeting or exceeding the recommended 2.5 cup equivalents per day for those ages 4 to 8 years and 3 cup equivalents per day for children ages 9 to 13 years.[24] The DGAC examined that increasing the proportion of fat-free milk and decreasing the proportion of

cheese, would increase the intake of magnesium, potassium, vitamin A, vitamin D and decrease intake of sodium and saturated fat.[24]

Protein Foods. Protein foods contains a broad group of foods including meat, poultry, fish/seafood, eggs, soy, nuts, and seeds.[24] Nearly 80% of boys and 75% of girls ages 1-3 years meet or exceed the protein foods recommendation of 2 ounce equivalents/day.[24] More than 60% of boys and girls ages 4-8 years meet or exceed the recommended intake of 3 to 4 ounce equivalents/day.[24] Intake declines somewhat for boys and girls ages 9-13 years, as approximately 40% and 45% meet or exceed the recommended 3 ounce equivalents/day.[24]

Other Dietary Components. Saturated fats and added sugars are components of the diet that should be limited because they are not nutrient-dense, however, they are overconsumed in the U.S. population.[24] From NHANES data, the average intakes of saturated fats and added sugars for children in all age groups are higher than the dietary guidelines maximum limit levels (maximum limit of 10% of calories for saturated fats, and maximum limit of 10% of calories for added sugar).[21] Almost 35% of all saturated fats comes from mixed dishes, especially those dishes containing cheese, meat, or both, such as burgers, sandwiches, and tacos; pizza; rice, pasta, and grain dishes; and meat, poultry, and seafood dishes.[21] The other saturated fats are majorly from snacks and sweets, protein foods, and dairy products.[21] Almost half (47%) of all added sugars consumed by the U.S. population comes from beverages, the other major sources of added sugars are snacks and sweets, dairy desserts, candies, and so on.[21]

Conclusion. Positive, healthy eating habits provide an excellent foundation for a lifetime of healthy eating. Many young children start out eating very well, unfortunately,

many of these early life healthy habits seem to disappear as children reach school age and beyond.[24] Across all age and sex groups, the majority of the U.S. children does not meet recommended intakes for vegetables and whole grains food groups, and exceeds recommended intakes of refined grains, solid fats, and added sugars.[24] More actions are needed to help children achieve healthy dietary patterns that are higher in fruit, vegetables, whole grains, lean protein, and non-fat and low-fat dairy.[24]

2.2.4 Children Dietary Intakes Assessing Tools

The usefulness of dietary intake assessments in children goes far beyond its potential in preventing childhood obesity.[30] Dietary intake assessments such as food record, diet history, 24-hour recall, and food frequency questionnaires have been widely used in the evaluation of children's diet.[30,31] Since this dissertation is focused on preschoolers the following paragraphs discuss the most common assessing tools for preschoolers' dietary intakes.

The preschool years are characterized as a time of increasing autonomy, expanding language skills, increasing ability to control behavior, and broadening social circumstances, such as attending preschool or staying with friends or relatives.[31] Most children consume the foods eaten by the rest of the family by age 2 to 3 years.[32] Although the preschool child's intake may fluctuate widely from meal to meal and day to day, over a week's time the intake remains relatively stable because preschool children have the ability to self-regulate food intake and to adjust their caloric intake to meet caloric needs.[32]

Assessing the dietary intakes of preschool children could be very difficult because of preschool children eat small amounts of food at frequent intervals.[33,34] In addition, they

are not able to complete questionnaires on their own and have a limited cognitive ability to recall, estimate, and otherwise cooperate[34,35]. They often spend time under the care of several individuals, and their food habits and nutrient intakes may change rapidly.[33] Even though it is hard to assess preschoolers' dietary intakes, researchers still worked hard on developing and validating the reliable assessment tools. The common dietary assessment tools for preschoolers are discussed as followed:

Food Record (FR). FR are used to record food intake at the time of consumption, over a number of days that are not necessarily sequential.[31] Most studies ask respondents to enter the information on hard copy form, although tape-recording, bar-coding, and electronic weighing also have been used to collect descriptive and quantity information.[31] To ensure accuracy, tools including scales, measuring cups, food models, or pictures are used to measure the amount of the foods.[36] FR has two different types, weighed FR (the respondent weighs on a small scale all food and beverages consumed) and estimated FR (the respondent estimates all food consumed using household measures or portion size estimating aides).[37,38] Two UK studies found close agreement between food records and the reference methods.[37,38] Davies found close agreement (3%) at a group level between energy intake from 4-day weighed FRs and total energy expenditure measurements in a group of 81 preschool children.[37] In this study, mothers weighed all food consumed at home, but used a notebook to record details of food consumed away from home.[37] Another study found close agreement (7%) between energy intake estimates from a 5-day weighed FR and a diet history conducted in the homes.[38]

24-Hour Recall (24HR). The 24HR is a retrospective assessment method in which an interviewer prompts a respondent to recall and describe all foods and beverages

consumed in the preceding 24 hours or the preceding day.[31] The interview may be conducted in-person or by telephone and may be paper and pencil or computer assisted. Portion size estimating aides assist the respondent to recall amounts consumed.[31] More studies were conducted to validate the 24HR with the reference methods, including validating 3-pass 24HR interviews with the doubly labeled water energy expenditure measurements, validating 24HR interview with direct observation of intakes, and validating 24HR interviews and 1- to 3-day weighed FRs.[39-42] These studies revealed that the 24HR may overreport the energy intake in children.

Food Frequency Questionnaire (FFQ). The food frequency questionnaire is a retrospective method asking respondents to report their usual frequency of consumption of each food from a list of foods for a specific period (several months or a year).[31] Food lists vary by the purpose of the study and study population. Frequency of consumption categories also vary by questionnaire but usually include per day, week, or month.[31] The common types of FFQs includes: 1) Semi-quantitative FFQ: portion size information is collected (portion sizes are specified as standardized portions or choice); 2) Non-quantitative FFQ: portion size information is not collected; 3) NCI Health Habits and History Questionnaire (HHHQ): semi quantitative FFQ developed at the National Cancer Institute under the direction of Gladys Block; 4) Harvard Service Food Frequency Questionnaire (HSFFQ): FFQ developed at Harvard University by Walter Willett and colleagues, portion size information is included as part of the food item rather than as a separate listing; and 5) NCI Diet History Questionnaire (DHQ): semi-quantitative FFQ, using an embedded question approach, developed at the NCI under the direction of Amy Subar and Fran Thompson.[43,44]

In this dissertation, HSFFQ was used to assess the dietary intakes of preschoolers and their parents. The HSFFQ was developed at Harvard School of Public Health.[45,46] The questionnaires list different food items and ask the number of times the food was consumed during the past 4 weeks.[45,46] This questionnaire consists of 87 food items for adults (86 food items for children) and 9 questions about food habits, supplements and services.[45,46] More details about the methods for using and analyzing HSFFQ will be discussed in Chapter 4.

Many previous studies evaluated the validity of the FFQ with the reference methods, all found the FFQ overestimated energy and other nutrients.[35,47-51] One validation study found the HSFFQ overestimated energy intake by 59%.[47] Three studies comparing various FFQs with multiple (2 to 4) 24HR recalls spaced at varying intervals, found the FFQ overestimated intake by 42% , 66% to 73%, and 70%.[35,48,49] Two studies examined the validity of the HSFFQ in a Women, Infants and Children (WIC) population with widely varying results.[50,51] Blum et al. founded the HSFFQ (modified for a 1-month time period) agreed closely with results from three 24HR interviews (administered 10 days apart).[50] The FFQ overestimated energy intake slightly (0.2% overestimation) and was within 10% of 24HR intakes for 20 nutrients.[50] However, the other validation study compared the HFFQ with three 24HR interviews and found low correlations for energy (HSFFQ = 0.13) and also for five nutrients with FFQ.[51]

In a recent systematic review of dietary assessment tools for children, the author suggested that a FFQ may be the best method for assessing dietary intake in children between 9 months and 11years of age compared with 24HR and FR.[30] The inconsistency

about the quality of the interview is possibly because of the misreporting of intake, or varying levels of expertise and backgrounds of the interviewers.[30]

2.3 Parenting Influences on Children Dietary Intakes

While childhood obesity prevention strategies of the past focused on education and individual behavior modification,[52] a growing body of evidence suggests that dietary behaviors, which develop during infancy and early childhood and are largely influenced by the parent and home eating structure,[53,54] set the stage for future habits and may influence a child's weight status.[55] Parenting influences on children dietary intakes from previous is typically classified at two types: general parenting (parenting style) and parenting practices,[56,57] which are discussed in the following paragraphs.

2.3.1 Food Parenting Practices

Parenting practices refers to parental behaviors in a specific context, for example, food parenting practices.[57] Food parenting practices are parental behaviors intended to influence children's food intake.[57] Empirical studies have explored that food parenting practices are crucial in explaining child eating behaviors and weight status.[53,58-60] For example, parents can have great influences on their children's practices by controlling availability and accessibility of foods, meal and snack routines, providing rules and limits, using food to control negative emotions.[56,61]

In order to clarify terminology and definitions of food parenting practices, Vaughn and colleagues developed a content map that presents three food parenting constructs— *Structure*, *Coercive Control*, and *Autonomy Support*—as well as specific food parenting practice subconstructs.[61] This content map is the theoretical framework used in this dissertation.

Structure. "*Structure*" is defined as "parent's organization of children's environment to facilitate children's competence".[62] With regard to food parenting practices, *Structures* is encompassing parents' consistent enforcement of rules and boundaries about eating, strategies used by parents to help children learn and maintain certain dietary behaviors, and the parents' physical organization of their children's food environment.[61] *Structure* includes parenting practices[61] such as *rules and limits*, *limited or guided choices*, *monitoring*, *creation of meal- and snack-time routines*, *role modeling*, *home food availability and accessibility*, *food preparation methods*, and *unstructured practices*: 1) *Rules and limits*: parent sets clear expectations and boundaries regarding what, when, where, and how much his/her child should eat; 2) *Guided choices*: parent allows the child a choice in what he/she eats, but options from which the child must choose are determined by the parent; 3) *Monitoring*: parent tracks what and how much the child is eating so that he/she can make sure the child eats sufficient amounts of healthy foods and avoids overeating unhealthy foods; 4) *Meal and snack routines*: parent implements consistency and predictability around meals and snacks with regard to their location, timing, presence of family members, conversational tone, and presence/absence of distractions; 5) *Modeling*: parent purposefully demonstrates healthy food choices and eating behaviors to encourage similar behaviors in the child; or parent unintentionally exhibits unhealthy eating behaviors in front of the child; 6) *Food availability*: the amount and types of foods that a parent brings into the home; 7) *Food accessibility*: how readily accessible the parent makes healthy and unhealthy foods in the home; 8) *Food preparation*: the preparation and cooking methods that a parent employs when preparing meals and snacks, which may impact the healthfulness of the foods served; 9)

Unstructured practices: parent allows child complete control of their eating, including timing and frequency of meals and snacks, and amount and type of foods eaten.[61]

Previous studies found that most of *Structure* parenting practices can positively influence a child's dietary behaviors. A recent study by Couch and colleagues involving children aged 6-11 found that a number of parenting practices were linked to improved child diet quality[53], including modeling of healthy eating, making healthful foods readily available in the home, and setting home food rules on snacking type, place, and size.[53] Other studies found that a child's tendency toward certain foods can be modified through familiarity (i.e., repeated exposure to and consumption of novel foods)[54,63-69] and through parental and peer modeling.[54,58,70-76] To demonstrate the effects of parental modeling, Epstein and colleagues assessed the relationship between mother and child (ages 10-12) purchases of healthy and unhealthy foods and found food purchasing behaviors were similar between the two.[77] Harper and Sanders observed similar parental-modeling effects as toddlers in their study were more apt to try a food when the parent was also eating the food.[71] Not only do parents influence their child's food preferences and eating behaviors by modeling their own food choices, food preferences, and dietary behaviors, but they can also alter them through parenting practices and the food environment established at home (i.e., the foods made available to the child and the accessibility and palatability of those foods).[53,64,78,79] In a review by Larsen et al., it is suggested that the most influential parenting practices are those that impact the food environment as opposed to those that are directed toward the child's appetite.[60]

Coercive Control. The food parenting practices content map by Vaughn et al. purposefully used the term *Coercive Control* to highlight a specific type of control: one

that reflects attempts to dominate, pressure, or impose the parents' will upon the child.[61,62] The definition of *Coercive Control* is "parent's pressure, intrusiveness, and dominance in relation to children's feelings and thoughts, as well as their behaviors".[61] *Coercive Control* for the content map of food parenting practices allows the isolation of specific parent-centered feeding strategies thought to have a negative impact on children's eating behaviors and preferences from those parenting behaviors intended to structure a child's environment to influence the child's socialization around food.[61] *Coercive Control* includes *restriction*, *pressure to eat*, *threats and bribes*, and *using food to control negative emotions*: 1) *Restriction*: parent enforces strict limitations on the child's access to foods or opportunities to consume those foods. Typically, restrictive practices are used to control child's intake of unhealthy foods; 2) *Pressure to eat*: parent insists, demands, or physically struggles with the child in order to get the child to eat more food; 3) *Threats and bribes*: parent threatens to take/takes something away for misbehavior or promises/offers something to the child in return for desired behavior; 4) *Using food to control negative emotions*: parent uses food to manage or calm the child when he/she is upset, fussy, angry, hurt, or bored.[61]

Most previous studies suggested *Coercive Control* that has a negative impact on children's eating habits. For example, experimental studies demonstrate that children who are pressured to eat certain foods may show decreased preference for those foods later on, while children who are restricted may develop increased preferences for restricted foods. Parenting practices that restrict a child's access to certain foods may unintentionally promote the overconsumption of those foods.[59,60,80,81] In addition, studies have suggested that regularly using food as a threat or a bribe may make it more difficult for children to

form preferences for new foods through mere exposure, may lead to increased snack consumption, and may predict increases in BMI.[82-84] Similarly, parents who use food as a reward may be promoting the consumption of the reward food and decreasing the likelihood that the child will consume the disliked food.[60,74]

Autonomy Support. "*Autonomy Support*" is "promoting psychological autonomy and encouragement of independence".[61] With regard to food parenting practices, *Autonomy Support* includes 1) providing sufficient structure within which the child can be involved in making food choices at a developmentally appropriate level, 2) engaging in conversations with the child about reasons for rules and boundaries regarding food, and 3) creating an emotional climate during these parent-child food interactions in which the child feels unconditionally loved, valued, and accepted by parents.[62] ***Autonomy Support*** for the content map of food parenting practices[61] includes *nutrition education*, *child involvement*, *encouragement*, *praise*, *reasoning*, and *negotiation*: 1) *Nutrition education*: the explanations selected may educate the child about foods' nutritional qualities, such as the benefits of eating healthy foods or the consequences of eating unhealthy ones; 2) *Child involvement*: parent actively involves the child during meal planning, grocery shopping, meal preparation, or mealtime; 3) *Encouragement*: parent suggests or offers specific foods to the child as a prompt for the child to eat the target foods. Parents may also command or direct their child to eat, but prompts come without a consequence for noncompliance; 4) *Praise*: parent provides positive reinforcement by verbally commending the child for eating specific foods or trying new foods; 5) *Reasoning*: parent uses logic or explanations to persuade the child to change his or her eating behavior; 6) *Negotiation*: parent engages with child to come to an agreement about

what or how much the child will eat. Negotiation allows for resolution of different opinions between parent and child by finding an acceptable compromise.[61]

From previous studies, few literatures have assessed the impact of nutrition education and child involvement on child diet or weight. However, there are literature showing a positive association between encouragement and children's intake of fruits and vegetables.[85] Strategies like praise, reasoning, and negotiation may serve as specific types of encouragement and support.[61] Intervention studies have shown that praise may be an effective strategy for increasing acceptance of new foods,[86,87] predicting success of child obesity treatment, and encouraging children to consume healthy foods.[88] In addition, some studies support that reasoning is associated with increased fruit and vegetable intake, but less support with decreased sweet and snack intake.[89,90] Vereecken et al. conducted a longitudinal study and suggested that negotiation is associated with child fruit and vegetable intake.[91]

2.3.2 Parenting Styles

Parenting style or general parenting refers to the parenting across situations and reflects the emotional climate in which children are raised.[57] Parenting style was traditionally categorized by a combination of the two underlying dimensions of parents' responsiveness and demandingness toward their children.[57,92] Responsiveness (or warmth, involvement, and nurturance) means parents' responds to their child's needs; and demandingness (or behavioral control, restrictiveness) means parents' control toward their children.[57] Cross-tabulating these two dimensions divides general parenting into four different parenting styles, characterizing "authoritative styles" as parents who are both demanding and responsive, "authoritarian styles" as parents who are demanding but

low responsive, “indulgent styles” as parents who are responsive but low demanding, and “neglectful styles” as parents who are neither demanding nor responsive.[57,92]

Authoritative and authoritarian styles have been widely investigated in relation to childhood obesity.[93] These parenting styles have been found to be associate with children’s self-regulatory skills.[93] High levels of parental control were reported to limit children’s ability to control themselves over various situations (e.g., eating), and has association with childhood obesity problems. Based on two previous systematic reviews it can be concluded that children raised in authoritative households ate more healthily and authoritative parenting was associated with a healthy BMI.[94,95] Sleddens et al. investigated the associations between parenting style and children’s weight-related outcomes, and reported that children raised by authoritative parents have healthier weight-related outcomes than children raised by parents have other parenting styles.[94] Berge et al. also agreed and reported that authoritative parenting style is associated with better outcomes in terms of child obesity and dietary intakes.[96] Collins et al. reported in a recent review study that authoritarian parenting style has influences on pressuring a child to eat and using restrictive food parenting practices.[97] Authoritative parenting style has influences on parental monitoring of child food intake. Indulgent parenting style has negative association with parenting monitoring.[97] Other studies report that authoritative style was positively associated with parental attempts to get the child to eat dairy, fruit, and vegetables.[98]

2.4 Methods for Assessing Parenting Influences

Many research efforts have focused on the association between parenting influences and children’s diet, revealing that parents are impotent in shaping children’s

dietary intakes.[99] Researchers use validated tools to assess the home environment and parenting influences to study their impacts on children's dietary intakes. Following paragraphs discuss the tools for assessing food parenting practices and parenting styles.

2.4.1 Food Parenting Practices Assessment Tools

In recent years, there has been a rapid increase in development of instruments to measure food parenting practices. A review paper of methods to assess parental feeding practices identified 21 tools on parental feeding practices published between 1983 and 2010.[100] Another systematic review of the literature by Vaughn et al. identified 71 existing measures of food parenting practices and assessed the quality of their development.[101] Even though large numbers of food parenting practices assessment tools were developed, but these instruments often use different scales, measure different constructs, and few have demonstrated solid development methods.[101] Examples of validated measures for food parenting practices assessments are discussed as follows:

Child Feeding Questionnaire (CFQ). For more than 15 years, most research about parental feeding practices relied on the CFQ, which is a self-reported questionnaire including 31 items to assess parental perceptions and concerns related to their child's weight status, their responsibility for child's food intake, as well as parental use of restriction, monitoring, and pressure to eat.[102] The CFQ was originally designed for use in parents of pre-school children, however, subsequent validation studies extended its use to parents of children in early and even late adolescence.[103] Most of these studies examined specific age groups, for example, child age ranges 2-5 years[104,105] or 6-11 years[106,107].

Comprehensive Feeding Practices Questionnaire (CFPQ). CFPQ is another popular questionnaire, which is a psychometrically valid scale assessing a more complete

range of behaviors related to feeding practices. This instrument was developed by Musher-Eizenman and Holub in 2007.[108,109] The CFPQ is a self-report instrument composed by 49 items distributed over 12 factors, with responses to be given on a 5-point Likert scale by parents of 2- to 8-year-old children[109], and it has been widely used and validated in several countries.[108,110,111]

Home Self-Administered Tool for Environmental Assessment of Activity and Diet (HomeSTEAD). The HomeSTEAD is a newly developed instrument developed by Vaughn et al.[112] in 2016 to provide a comprehensive evaluation of home environmental factors thought to influence children's diet and physical activity. The final instrument captures five *Coercive Control* practices (16 items), seven *Autonomy Support* practices (24 items), and 12 *Structure* practices (46 items). All scales demonstrated good reliability and validity.[112]

Comprehensive Home Environment Survey (CHES). The CHES is a reliable and validated comprehensive measurement related to home environment and parenting behaviors, developed by Courtney and colleagues (2014).[113] It is a self-reported tool that is used to evaluate the home environment (i.e., the home food environment, the home physical activity environment, and the home media environment) as it relates to childhood obesity.[113] The original CHES had 18 subscales such as *Fruit, Juice, and Vegetable Availability*, *Fat and Sweets Availability*, *Fruit and Vegetable Accessibility*, *Role Model Diet*, and *Parental Policies to Support Healthy Eating*.[113] Large numbers of items in this comprehensive tool related to food parenting practices, however, were not identified. The original version of CHES was used in this dissertation and recategorization was made to this instrument.

2.4.2 Parenting Styles Assessment Tools

The commonly used typological approach in parenting research is based on the work of Baumrind and later Maccoby and Martin, who described parenting style as a function of two dimensions of parental behavior—the extent to which parents are responsive to their children's needs and controlling on their children's behaviors.[114] The authors Kremers and colleagues provided an overview of all instruments to assess general parenting style that have been applied in the field of behavioral nutrition and physical activity.[56] In total, they identified 19 instruments for parenting styles assessment. However, despite the availability of a large number of instruments, comprehensive measurement tools assessing the apparent broad range of parenting constructs are currently lacking.[56]

Parenting Style Inventory (PSI). PSI-I was developed by Nancy Darling and Laurence Steinberg (1993), having three subscales—demandingness, emotional responsiveness, and psychological autonomy-granting—with five items each in maternal parenting style.[114] Although initial reliability tests in samples of high school seniors and college students yielded acceptable levels of reliability, tests of the measure in a population of 7th graders were more problematic and showed a strong, positive skew. Because of these limitation, a revision of the measure was undertaken.[114] Authors Darling and Toyokawa developed PSI-II to increase the internal consistency and the variability of the items while maintaining the conceptual clarity of the constructs and the short format.[115] This five point Likert type scale has three dimensions, autonomy granting, demandingness and responsiveness; twelve items in each dimensions. The tool has adequate internal consistency, variability, and predictive validity.[115]

***Parenting Dimensions Inventory-Short Version* (*PDI-S*).** PDI-S was developed by Power et al.[116] The PDI-S is a 30-item parent-report measure of several parenting domains, including parental restrictiveness, nurturance, responsiveness, control, and consistency.[116] Items are rated on 3- and 6-point rating scales.[116] Based on the procedures used by Slater and Power, the PDI-S scale scores are computed by averaging responses to the items making up the scale.[117] In this study, two scales of the PDI-S including nurturance and type of control will be used to classify parents into Maccoby and Martin's four parenting styles.[117,118] After calculating the scores of nurturance and type of control, median splits will be conducted on each scale and defined the parenting styles as four major parenting styles: authoritative (high on both nurturance and amount of control), authoritarian (low on nurturance and high on amount of control), indulgent (high on nurturance and low on amount of control), and uninvolved (low on both nurturance and amount of control).[118]

2.5 Current Study

In recent years, the diets of preschool children have become a major focus for preventing excess weight gain. As this period is marked by the formation of dietary preferences and behaviors that may track into later stages of life, the preschool years have particular importance for diet.[27] The 2015-2020 Dietary Guidelines for Americans stated that across the U.S., children's average intake of foods from the food groups are far from amounts recommended in the Healthy U.S.-Style Eating Pattern.[21] Preschool children have low intakes of vegetables compared to the recommendation, and higher intakes of added sugars, saturated fats, and sodium than limit.[21] These evidence highlight the need for targeting preschool children to prevent childhood obesity. Understanding the factors

related to the dietary behaviors or intakes in preschool children would be highly helpful in developing early and effective intervention programs to prevent childhood obesity.

Parenting influences were important factors targeted in childhood obesity programs.[93] Examining both general parenting styles and specific parenting practices for their roles in children dietary behaviors related to childhood obesity problems might have more benefits by revealing which specific parenting aspects more influential.[27] In this research, we focused on early childhood years during which children develop dietary behaviors that prevail in later stages of life, and are more susceptible to parental influences. Moreover, we examined the roles of both parenting styles and parenting practices in dietary intakes of preschool children.

Much research efforts have shown the relationship between parenting styles or parenting practices and children dietary behaviors. However, to the best of our knowledge, no known study focused on the role of parental influences in both parents and children dietary intakes. This research addressed this gap by examining the impacts of parenting styles (four styles—authoritative, authoritarian, indulgent, and uninvolved) and food parenting practices (three constructs—structure, coercive control, and autonomy support) on both parents and children dietary intakes (including energy intakes, nutrient intakes, and food group intakes) using comprehensive measurements.

REFERENCES

1. National Institutes of Health. The practical guide: the identification, evaluation and treatment of overweight and obesity in adults. Available at: https://www.nhlbi.nih.gov/files/docs/guidelines/prctgd_c.pdf. Accessed January 10, 2018.
2. Ogden CL, Flegal KM. Changes in terminology for childhood overweight and obesity. *Natl Health Stat Report.* 2010(25):1-5.
3. May AL, Kuklina EV, Yoon PW. Prevalence of cardiovascular disease risk factors among US adolescents, 1999-2008. *Pediatrics.* 2012;129(6):1035-1041.
4. Lloyd LJ, Langley-Evans SC, McMullen S. Childhood obesity and risk of the adult metabolic syndrome: a systematic review. *Int J Obes (Lond).* 2012;36(1):1-11.
5. Halfon N, Larson K, Slusser W. Associations between obesity and comorbid mental health, developmental, and physical health conditions in a nationally representative sample of US children aged 10 to 17. *Acad Pediatr.* 2013;13(1):6-13.
6. Van Geel M, Vedder P, Tanilon J. Are overweight and obese youths more often bullied by their peers? A meta-analysis on the correlation between weight status and bullying. *Int J Obes (Lond).* 2014;38(10):1263-1267.
7. Griffiths LJ, Parsons TJ, Hill AJ. Self-esteem and quality of life in obese children and adolescents: a systematic review. *Int J Pediatr Obes.* 2010;5(4):282-304.
8. Singh AS, Mulder C, Twisk JW, van Mechelen W, Chinapaw MJ. Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obes Rev.* 2008;9(5):474-488.

9. Fryar CD, Carroll MD, Ogden CL. Prevalence of overweight and obesity among children and adolescents aged 2-19 years: United States, 1963-1965 through 2013-2014. Available at: https://www.cdc.gov/nchs/data/hestat/obesity_child_13_14/obesity_child_13_14.htm. Accessed January 20, 2018.

10. Hales CM, Carroll MD, Fryar CD, Ogden CL. Prevalence of obesity among adults and youth: United States, 2015-2016. *NCHS Data Brief.* 2017(288):1-8.

11. U.S. Department of Health and Human Services. Nutrition and weight status. Healthy People 2030 website. Available at: https://health.gov/healthypeople/objectives-and-data/browse-objectives/overweight-and-obesity/reduce-proportion-children-and-adolescents-obesity-nws-04. Accessed October 10, 2020.

12. Ogden CL, Carroll MD, Lawman HG, et al. Trends in obesity prevalence among children and adolescents in the United States, 1988-1994 through 2013-2014. *Jama.* 2016;315(21):2292-2299.

13. Cunningham SA, Kramer MR, Narayan KM. Incidence of childhood obesity in the United States. *N Engl J Med.* 2014;370(5):403-411.

14. Janssen I, Katzmarzyk PT, Srinivasan SR, et al. Utility of childhood BMI in the prediction of adulthood disease: comparison of national and international references. *Obes Res.* 2005;13(6):1106-1115.

15. Tran MK, Krueger PM, McCormick E, Davidson A, Main DS. Body mass transitions through childhood and early adolescence: a multistate life table approach. *Am J Epidemiol.* 2016;183(7):643-649.

16. Evensen E, Wilsgaard T, Furberg AS, Skeie G. Tracking of overweight and obesity from early childhood to adolescence in a population-based cohort - the Tromsø Study, Fit Futures. *BMC Pediatr.* 2016;16:64. doi:10.1186/s12887-016-0599-5.

17. Ward ZJ, Long MW, Resch SC, Giles CM, Cradock AL, Gortmaker SL. Simulation of growth trajectories of childhood obesity into adulthood. *N Engl J Med.* 2017;377(22):2145-2153.

18. Newby PK. Are dietary intakes and eating behaviors related to childhood obesity? A comprehensive review of the evidence. *J Law Med Ethics.* 2007;35(1):35-60.

19. Williams C. Resource 1: children's dietary intakes. Dietary Guidelines website. Available at: https://www.dietaryguidelines.gov/sites/default/files/2019-05/Children%27s%20Dietary%20Intake.pdf. Accessed January 10, 2018.

20. U.S. Department of Agriculture. MyPlate Plan. ChooseMyPlate website. Available at: https://www.choosemyplate.gov/resources/MyPlatePlan. Accessed August 18, 2020.

21. U.S. Department of Agriculture. 2015-2020 Dietary Guidelines for Americans. Dietary Guidelines website. Available at: http://health.gov/dietaryguidelines/2015/guidelines/. Accessed January 10, 2018.

22. Britten P, Cleveland LE, Koegel KL, Kuczynski KJ, Nickols-Richardson SM. Updated U.S. Department of Agriculture Food Patterns meet goals of the 2010 dietary guidelines. *J Acad Nutr Diet.* 2012;112(10):1648-1655.

23. U.S. Department of Agriculture. Average daily food group intakes by age-sex groups, compared to ranges of recommended intake. Dietary Guidelines website.

Available at: https://health.gov/our-work/food-nutrition/2015-2020-dietary-guidelines/guidelines/chapter-2/a-closer-look-at-current-intakes-and-recommended-shifts/#figure-2-3-average-daily-food-group-intakes-by-age-sex-groups-co. Accessed February 20, 2018.

24. Dietary Guidelines Advisory Committee. 2015 Dietary Guidelines Advisory Committee Report. Available at: https://health.gov/sites/default/files/2019-09/Scientific-Report-of-the-2015-Dietary-Guidelines-Advisory-Committee.pdf. Accessed January 10, 2018.

25. Ambrosini GL. Childhood dietary patterns and later obesity: a review of the evidence. *Proc Nutr Soc.* 2014;73(1):137-146.

26. Perez-Escamilla R, Obbagy JE, Altman JM, et al. Dietary energy density and body weight in adults and children: a systematic review. *J Acad Nutr Diet.* 2012;112(5):671-684.

27. Ford CN, Poti JM, Ng SW, Popkin BM. SSB taxes and diet quality in US preschoolers: estimated changes in the 2010 Healthy Eating Index. *Pediatr Obes.* 2017;12(2):146-154.

28. Bowman SA, Clemens JC, Friday JE, Lynch KL, Moshfegh AJ. Food Patterns Equivalents Database 2013-14: methodology and user guide. Available at: https://www.ars.usda.gov/ARSUserFiles/80400530/pdf/fped/FPED_1314.pdf. Accessed January 20, 2018.

29. National Cancer Institute. Usual dietary intakes: food intakes, U.S. population, 2007-10. Epidemiology and Genomics Research Program website. Available at: https://epi.grants.cancer.gov/diet/usualintakes/. Accessed January 20, 2018.

30. Olukotun O, Seal N. A systematic review of dietary assessment tools for children age 11 years and younger. *ICAN: Infant, Child, & Adolescent Nutrition.* 2015;7(3):139-147.

31. National Cancer Institute. Methodology-NCS dietary assessment literature review. Epidemiology and Genomics Research Program website. Available at: https://epi.grants.cancer.gov/past-initiatives/assess_wc/review/about/methodology.html. Accessed January 20, 2018.

32. Birch LL, Johnson SL, Andresen G, Peters JC, Schulte MC. The variability of young children's energy intake. *N Engl J Med.* 1991;324(4):232-235.

33. Hertzler AA, Bowens J, Hull S. Preschoolers' reporting of food habits. *J Am Diet Assoc.* 1993;93(10):1159-1161.

34. Stein AD, Shea S, Basch CE, Contento IR, Zybert P. Variability and tracking of nutrient intakes of preschool children based on multiple administrations of the 24-hour dietary recall. *Am J Epidemiol.* 1991;134(12):1427-1437.

35. Stein AD, Shea S, Basch CE, Contento IR, Zybert P. Consistency of the Willett semiquantitative food frequency questionnaire and 24-hour dietary recalls in estimating nutrient intakes of preschool children. *Am J Epidemiol.* 1992;135(6):667-677.

36. Thompson FE, Byers T. Dietary assessment resource manual. *J Nutr.* 1994;124(11 Suppl):2245S-2317S.

37. Davies PS, Coward WA, Gregory J, White A, Mills A. Total energy expenditure and energy intake in the pre-school child: a comparison. *Br J Nutr.* 1994;72(1):13-20.

38. Harbottle L, Duggan MB. Use of the PETRA scale in a weighed inventory study of British Asian children: methodological considerations *Hum Nutr Appl Nutr.* 1994;7(4):275–281.

39. Montgomery C, Reilly JJ, Jackson DM, et al. Validation of energy intake by 24-hour multiple pass recall: comparison with total energy expenditure in children aged 5-7 years. *Br J Nutr.* 2005;93(5):671-676.

40. Johnson RK, Driscoll P, Goran MI. Comparison of multiple-pass 24-hour recall estimates of energy intake with total energy expenditure determined by the doubly labeled water method in young children. *J Am Diet Assoc.* 1996;96(11):1140-1144.

41. Klesges RC, Klesges LM, Brown G, Frank GC. Validation of the 24-hour dietary recall in preschool children. *J Am Diet Assoc.* 1987;87(10):1383-1385.

42. Iannotti RJ, Zuckerman AE, Blyer EM, O'Brien RW, Finn J, Spillman DM. Comparison of dietary intake methods with young children. *Psychol Rep.* 1994;74(3 Pt 1):883-889.

43. Subar AF, Thompson FE, Kipnis V, et al. Comparative validation of the Block, Willett, and National Cancer Institute food frequency questionnaires : the Eating at America's Table Study. *Am J Epidemiol.* 2001;154(12):1089-1099.

44. Subar AF. Developing dietary assessment tools. *J Am Diet Assoc.* 2004;104(5):769-770.

45. Harvard T.H. Chan School of Public Health Nutrition Department's file download site. Available at: https://regepi.bwh.harvard.edu/health/nutrition.html. Accessed December 11, 2016.

46. Watts V, Rockett H, Baer H, Leppert J, Colditz G. Assessing diet quality in a population of low-income pregnant women: a comparison between Native Americans and whites. *Matern Child Health J.* 2007;11(2):127-136.

47. Kaskoun MC, Johnson RK, Goran MI. Comparison of energy intake by semiquantitative food-frequency questionnaire with total energy expenditure by the doubly labeled water method in young children. *Am J Clin Nutr.* 1994;60(1):43-47.

48. Treiber FA, Leonard SB, Frank G, et al. Dietary assessment instruments for preschool children: reliability of parental responses to the 24-hour recall and a food frequency questionnaire. *J Am Diet Assoc.* 1990;90(6):814-820.

49. Parrish LA, Marshall JA, Krebs NF, Rewers M, Norris JM. Validation of a food frequency questionnaire in preschool children. *Epidemiology.* 2003;14(2):213-217.

50. Blum RE, Wei EK, Rockett HR, et al. Validation of a food frequency questionnaire in Native American and Caucasian children 1 to 5 years of age. *Matern Child Health J.* 1999;3(3):167-172.

51. Institute of Medicine (U.S.) Committee on Dietary Risk Assessment in the WIC Program. Dietary risk assessment in the WIC program. Available at: https://www.ncbi.nlm.nih.gov/books/NBK220567/. Accessed January 10, 2018.

52. Swinburn B, Egger G, Raza F. Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. *Prev Med.* 1999;29(6 Pt 1):563-570.

53. Couch SC, Glanz K, Zhou C, Sallis JF, Saelens BE. Home food environment in relation to children's diet quality and weight status. *J Acad Nutr Diet.* 2014;114(10):1569-1579.e1561.

54. Scaglioni S, Arrizza C, Vecchi F, Tedeschi S. Determinants of children's eating behavior. *Am J Clin Nutr.* 2011;94(6 Suppl):2006s-2011s.

55. Agras WS, Kraemer HC, Berkowitz RI, Hammer LD. Influence of early feeding style on adiposity at 6 years of age. *J Pediatr.* 1990;116(5):805-809.

56. Kremers S, Sleddens E, Gerards S, et al. General and food-specific parenting: measures and interplay. *Child Obes.* 2013;9 Suppl:S22-S31.

57. Gerards SM, Kremers SP. The role of food parenting skills and the home food environment in children's weight gain and obesity. *Curr Obes Rep.* 2015;4(1):30-36.

58. Shutts K, Kinzler KD, DeJesus JM. Understanding infants' and children's social learning about foods: previous research and new prospects. *Dev Psychol.* 2013;49(3):419-425.

59. Frankel LA, O'Connor TM, Chen T-A, Nicklas T, Power TG, Hughes SO. Parents' perceptions of preschool children's ability to regulate eating. Feeding style differences. *Appetite.* 2014;76:166-174.

60. Larsen JK, Hermans RCJ, Sleddens EFC, Engels RCME, Fisher JO, Kremers SPJ. How parental dietary behavior and food parenting practices affect children's dietary behavior. Interacting sources of influence? *Appetite.* 2015;89:246-257.

61. Vaughn AE, Ward DS, Fisher JO, et al. Fundamental constructs in food parenting practices: a content map to guide future research. *Nutr Rev.* 2016;74(2):98-117.

62. Conger RD. Commentary on Grolnick and Pomerantz, "Issues and challenges in studying parental control: toward a new conceptualization". *Child Dev Perspect.* 2009;3(3):173-175.

63. Benton D. Role of parents in the determination of the food preferences of children and the development of obesity. *Int J Obes Relat Metab Disord.* 2004;28(7):858-869.

64. Birch LL. Development of food preferences. *Annu Rev Nutr.* 1999;19:41-62.

65. Birch LL, Marlin DW. I don't like it; I never tried it: effects of exposure on two-year-old children's food preferences. *Appetite.* 1982;3(4):353-360.

66. Pliner P. The effects of mere exposure on liking for edible substances. *Appetite.* 1982;3(3):283-290.

67. Anzman-Frasca S, Savage JS, Marini ME, Fisher JO, Birch LL. Repeated exposure and associative conditioning promote preschool children's liking of vegetables. *Appetite.* 2012;58(2):543-553.

68. Hausner H, Olsen A, Moller P. Mere exposure and flavour-flavour learning increase 2-3 year-old children's acceptance of a novel vegetable. *Appetite.* 2012;58(3):1152-1159.

69. Wardle J, Cooke LJ, Gibson EL, Sapochnik M, Sheiham A, Lawson M. Increasing children's acceptance of vegetables; a randomized trial of parent-led exposure. *Appetite.* 2003;40(2):155-162.

70. Sutherland LA, Beavers DP, Kupper LL, Bernhardt AM, Heatherton T, Dalton MA. Like parent, like child: child food and beverage choices during role playing. *Arch Pediatr Adolesc Med.* 2008;162(11):1063-1069.

71. Harper LV, Sanders KM. The effect of adults' eating on young children's acceptance of unfamiliar foods. *J Exp Child Psychol.* 1975;20(2):206-214.

72. Johannsen DL, Johannsen NM, Specker BL. Influence of parents' eating behaviors and child feeding practices on children's weight status. *Obesity (Silver Spring).* 2006;14(3):431-439.

73. Fisher JO, Mitchell DC, Smiciklas-Wright H, Birch LL. Parental influences on young girls' fruit and vegetable, micronutrient, and fat intakes. *J Am Diet Assoc.* 2002;102(1):58-64.

74. Birch LL, Zimmerman SI, Hind H. The influence of social-affective context on the formation of children's food preferences. *Child Dev.* 1980;51(3):856-861.

75. Addessi E, Galloway AT, Visalberghi E, Birch LL. Specific social influences on the acceptance of novel foods in 2-5-year-old children. *Appetite.* 2005;45(3):264-271.

76. Hendy HM, Raudenbush B. Effectiveness of teacher modeling to encourage food acceptance in preschool children. *Appetite.* 2000;34(1):61-76.

77. Epstein LH, Dearing KK, Handley EA, Roemmich JN, Paluch RA. Relationship of mother and child food purchases as a function of price: a pilot study. *Appetite.* 2006;47(1):115-118.

78. Patrick H, Nicklas TA. A review of family and social determinants of children's eating patterns and diet quality. *J Am Coll Nutr.* 2005;24(2):83-92.

79. Campbell KJ, Crawford DA, Salmon J, Carver A, Garnett SP, Baur LA. Associations between the home food environment and obesity-promoting eating behaviors in adolescence. *Obesity (Silver Spring).* 2007;15(3):719-730.

80. Birch LL, Fisher JO, Davison KK. Learning to overeat: maternal use of restrictive feeding practices promotes girls' eating in the absence of hunger. *Am J Clin Nutr.* 2003;78(2):215-220.

81. Fisher JO, Birch LL. Restricting access to foods and children's eating. *Appetite.* 1999;32(3):405-419.

82. Ventura AK, Worobey J. Early influences on the development of food preferences. *Curr Biol.* 2013;23(9):R401-408.

83. Anez E, Remington A, Wardle J, Cooke L. The impact of instrumental feeding on children's responses to taste exposure. *J Hum Nutr Diet.* 2013;26(5):415-420.

84. Rodenburg G, Kremers SP, Oenema A, van de Mheen D. Associations of parental feeding styles with child snacking behaviour and weight in the context of general parenting. *Public Health Nutr.* 2014;17(5):960-969.

85. McGowan L, Croker H, Wardle J, Cooke LJ. Environmental and individual determinants of core and non-core food and drink intake in preschool-aged children in the United Kingdom. *Eur J Clin Nutr.* 2012;66(3):322-328.

86. Remington A, Anez E, Croker H, Wardle J, Cooke L. Increasing food acceptance in the home setting: a randomized controlled trial of parent-administered taste exposure with incentives. *Am J Clin Nutr.* 2012;95(1):72-77.

87. Cooke LJ, Chambers LC, Anez EV, et al. Eating for pleasure or profit: the effect of incentives on children's enjoyment of vegetables. *Psychol Sci.* 2011;22(2):190-196.

88. Cooke LJ, Chambers LC, Anez EV, Wardle J. Facilitating or undermining? The effect of reward on food acceptance. A narrative review. *Appetite.* 2011;57(2):493-497.

89. Vereecken CA, Keukelier E, Maes L. Influence of mother's educational level on food parenting practices and food habits of young children. *Appetite.* 2004;43(1):93-103.

90. Zeinstra GG, Koelen MA, Kok FJ, van der Laan N, de Graaf C. Parental child-feeding strategies in relation to Dutch children's fruit and vegetable intake. *Public Health Nutr.* 2010;13(6):787-796.

91. Vereecken C, Haerens L, De Bourdeaudhuij I, Maes L. The relationship between children's home food environment and dietary patterns in childhood and adolescence. *Public Health Nutr.* 2010;13(10a):1729-1735.

92. Van Der Horst K, Sleddens EFC. Parenting styles, feeding styles and food-related parenting practices in relation to toddlers' eating styles: a cluster-analytic approach. *PLoS One.* 2017;12(5):e0178149. doi:10.1371/journal.pone.0178149.

93. Melis Yavuz H, Selcuk B. Predictors of obesity and overweight in preschoolers: the role of parenting styles and feeding practices. *Appetite.* 2018;120:491-499.

94. Sleddens EFC, Gerards SMPL, Thijs C, De Vries NK, Kremers SPJ. General parenting, childhood overweight and obesity-inducing behaviors: a review. *Int J Pediatr Obes.* 2011;6(2-2):E12-E27.

95. Shloim N, Edelson LR, Martin N, Hetherington MM. Parenting styles, feeding styles, feeding practices, and weight status in 4-12 year-old children: a systematic review of the literature. *Front Psychol.* 2015;6:1849. doi:10.3389/fpsyg.2015.01849.

96. Berge JM. A review of familial correlates of child and adolescent obesity: what has the 21st century taught us so far? *Int J Adolesc Med Health.* 2009;21(4):457-483.

97. Collins C, Duncanson K, Burrows T. A systematic review investigating associations between parenting style and child feeding behaviours. *J Hum Nutr Diet.* 2014;27(6):557-568.

98. Patrick H, Nicklas TA, Hughes SO, Morales M. The benefits of authoritative feeding style: caregiver feeding styles and children's food consumption patterns. *Appetite.* 2005;44(2):243-249.

99. Gevers DW, Kremers SP, de Vries NK, van Assema P. Clarifying concepts of food parenting practices. A Delphi study with an application to snacking behavior. *Appetite.* 2014;79:51-57.

100. De Lauzon-Guillain B, Oliveira A, Charles MA, et al. A review of methods to assess parental feeding practices and preschool children's eating behavior: the need for further development of tools. *J Acad Nutr Diet.* 2012;112(10):1578-1602, 1602.e1571-1578.

101. Vaughn AE, Tabak RG, Bryant MJ, Ward DS. Measuring parent food practices: a systematic review of existing measures and examination of instruments. *Int J Behav Nutr Phys Act.* 2013;10. doi:10.1186/1479-5868-10-61.

102. Schmidt R, Richter R, Brauhardt A, Hiemisch A, Kiess W, Hilbert A. Parental feeding practices in families with children aged 2-13 years: psychometric properties and child age-specific norms of the German version of the Child Feeding Questionnaire (CFQ). *Appetite.* 2017;109:154-164.

103. Johnson SL, Birch LL. Parents' and children's adiposity and eating style. *Pediatrics.* 1994;94(5):653-661.

104. Boles RE, Nelson TD, Chamberlin LA, et al. Confirmatory factor analysis of the child feeding questionnaire among low-income African American families of preschool children. *Appetite.* 2010;54(2):402-405.

105. Kong A, Vijayasiri G, Fitzgibbon ML, Schiffer LA, Campbell RT. Confirmatory factor analysis and measurement invariance of the child feeding questionnaire in low-income Hispanic and African-American mothers with preschool-age children. *Appetite.* 2015;90:16-22.

106. Birch LL, Fisher JO, Grimm-Thomas K, Markey CN, Sawyer R, Johnson SL. Confirmatory factor analysis of the child feeding questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. *Appetite.* 2001;36(3):201-210.

107. Camci N, Bas M, Buyukkaragoz AH. The psychometric properties of the child feeding questionnaire (CFQ) in Turkey. *Appetite.* 2014;78:49-54.

108. Piccoli AB, Neiva-Silva L, Mosmann CP, Musher-Eizenman D, Pellanda LC. Adolescents' perception of parental feeding practices: adaptation and validation of the comprehensive feeding practices questionnaire for Brazilian adolescents-The CFPQ-Teen. *PLoS One.* 2017;12(11):e0187041. doi:10.1371/journal.pone.0187041.

109. Musher-Eizenman D, Holub S. Comprehensive feeding practices questionnaire: validation of a new measure of parental feeding practices. *J Pediatr Psychol.* 2007;32(8):960-972.

110. Musher-Eizenman DR, de Lauzon-Guillain B, Holub SC, Leporc E, Charles MA. Child and parent characteristics related to parental feeding practices. A cross-cultural examination in the US and France. *Appetite.* 2009;52(1):89-95.

111. Melbye EL, Ogaard T, Overby NC. Validation of the comprehensive feeding practices questionnaire with parents of 10-to-12-year-olds. *BMC Med Res Methodol.* 2011;11. doi:10.1186/1471-2288-11-113.

112. Vaughn AE, Dearth-Wesley T, Tabak RG, Bryant M, Ward DS. Development of a comprehensive assessment of food parenting practices: the home self-administered tool for environmental assessment of activity and diet family food practices survey. *J Acad Nutr Diet.* 2017;117(2):214-227.

113. Pinard CA, Yaroch AL, Hart MH, Serrano EL, McFerren MM, Estabrooks PA. The validity and reliability of the comprehensive home environment survey (CHES). *Health Promot Pract.* 2014;15(1):109-117.

114. Abdul Gafoor K, Kurukkan A. Construction and validation of scale of parenting style. *Guru Journal of Behavioral and Social Sciences.* 2014;2(4):315-323.

115. Darling N, Toyokawa T. Construction and validation of the parenting style inventory II (PSI-II). Available at: https://www2.oberlin.edu/faculty/ndarling/lab/psiii.pdf. Accessed January 10, 2018.

116. Shapiro DN, Waljee J, Buchman S, Ranganathan K, Warshcausky S. Gender views and relationships in families of children with craniofacial differences. *Cleft Palate Craniofac J*. 2018;55(2):189-195.

117. Power TG. Parenting dimensions inventory-short version (PDI-S): a research manual. Unpublished manuscript. Washington State University; 2002.

118. Maccoby EE, Martin JA. Socialization in the context of the family: parent-child interaction. In: *Handbook of Child Psychology: Socialization, Personality, and Social Development.* 4th ed. Chichester, New York: Wiley; 1983:1-101.

CHAPTER 3

FACTOR ANALYSIS TO IDENTIFY FOOD PARENTING PRACTICES FROM COMPREHENSIVE HOME ENVIRONMENT SURVEY (CHES) AMONG PARENTS OF PRESCHOOL CHILDREN

3.1 Introduction

While childhood obesity prevention strategies of the past focused on education and individual behavior modification,[1] a growing body of evidence suggests that dietary behaviors, which develop during infancy and early childhood, are largely influenced by home environments and parenting pratices.[2,3] The home environment plays a particularly important role in shaping children's dietary behaviors. Parents, as key gatekeepers, strongly influence the home environment through their behaviors.[4] Food parenting practices are specific parental behaviors intended to influence children's dietary intake or dietary behaviors.[5] Empirical studies indicate food parenting practices are crucial in explaining child eating behaviors and weight status.[2,6-8] For example, parents can have a great influence on their children's practices by controlling availability and accessibility of foods, meal and snack routines, providing rules and limits on eating behaviors, and using food to control negative emotions.[4,9]

In recent years, researchers have used validated tools to assess the home environment and, specifically, food parenting practices, to study their impact on the dietary intake of children. A review paper of methods to assess parental feeding practices identified different tools on parental feeding practices published between 1983 and 2010.[10] Another systematic review of the literature identified existing measures of food

parenting practices and assessed the quality of their development.[11] Large numbers of assessment tools were developed to evaluate food parenting practices, however, these instruments often measure a variety of different components of parenting practices, or only assess one or two components. They use inconsistent terminology or lack clear definitions to describe food parenting behaviors, or fail to provide a comprehensive evaluation of food parenting practices.[4] In order to advance our understanding of how the home environment and parents' behaviors influence children's dietary intakes, there is a need for a comprehensive measurement of food parenting practices.

With the introduction of the Comprehensive Home Environment Survey (CHES)[12], the measurement of home environment and parenting practices was broadened. This comprehensive questionnaire was designed to measure the impact of home environment and parenting behaviors on children's physical activity and food.[12] CHES is a validated and reliable measure, which displayed adequate internal consistency (Cronbach's alpha $\geqslant 0.74$), high test-retest reliability ($r \geqslant 0.73$) and interrater reliability ($r \geqslant 0.42$), as well as showed construct validity by relating to a previous measure of the home environment.[12] The original CHES had over 100 items reflecting 18 factors, for example, *Fruit, Juice, and Vegetable Availability*, *Fat and Sweets Availability*, *Fruit and Vegetable Accessibility*, *Role Model Diet*, and *Parental Policies to Support Healthy Eating*. Large numbers of items in original CHES were related to food parenting practices, however, were not identified as such. To identify items and factors of food parenting practices as well as decrease the responding burden, the further investigation of the CHES is needed.

Therefore, the purpose of this study was conducting exploratory factor analysis to the original existing home environment assessment—CHES[12], to identify and evaluate modified factor structures about food parenting practices. By identifying alternative factor structures, we expect the refined CHES to provide a comprehensive measurement of food parenting practices.

3.2 Methods

This study was a secondary data analysis of the *iGrow Readers* program clinical trial conducted in 2016, which was an educational curriculum aiming to teach 3-5 year old children the benefits of making healthy decisions involving nutrition and physical activity. Institutional Review Board (IRB) approval, child assent, and parental consent were obtained in accordance with the policy statements of the Human Subjects Committee at South Dakota State University.

3.2.1 Participants

Children aged 3-5 year old and their parents were recruited from preschools/daycare centers in South Dakota, Minnesota, and Nebraska. To qualify for recruitment, preschools/daycare centers needed to meet the following selection criteria: 1) have at least two classrooms with 3-5 year old children, and 2) each classroom needed to have separate teachers. In total, 14 preschools and daycare centers met the selection criteria and agreed to participate in the study. From the 14 participating preschools and daycare centers, 293 parent/child dyads were recruited via email and with flyers describing individual eligibility and benefits of participation.

3.2.2 Data Collection

The parent completed the CHES questionnaire that included demographic questions and questions about the home environment (e.g., home food environment). The survey instructions reminded participants to select responses that best reflected what they actually do, think, and feel. All data were collected in 2016.

3.2.3 Selected Items for Food Parenting Practices

To modify the original CHES, a content map[4] of food parenting practices was used as a framework to help select items from CHES and guide identification of relevant constructs. This comprehensive content map developed by Vaughn and colleagues in 2016, details three food parenting practice constructs—*Structure*, *Coercive Control*, and *Autonomy Support*—and highlights specific subconstructs within each of the three food parenting practice constructs.[4] (Vaughn's content map was shown in Figure 3.1).

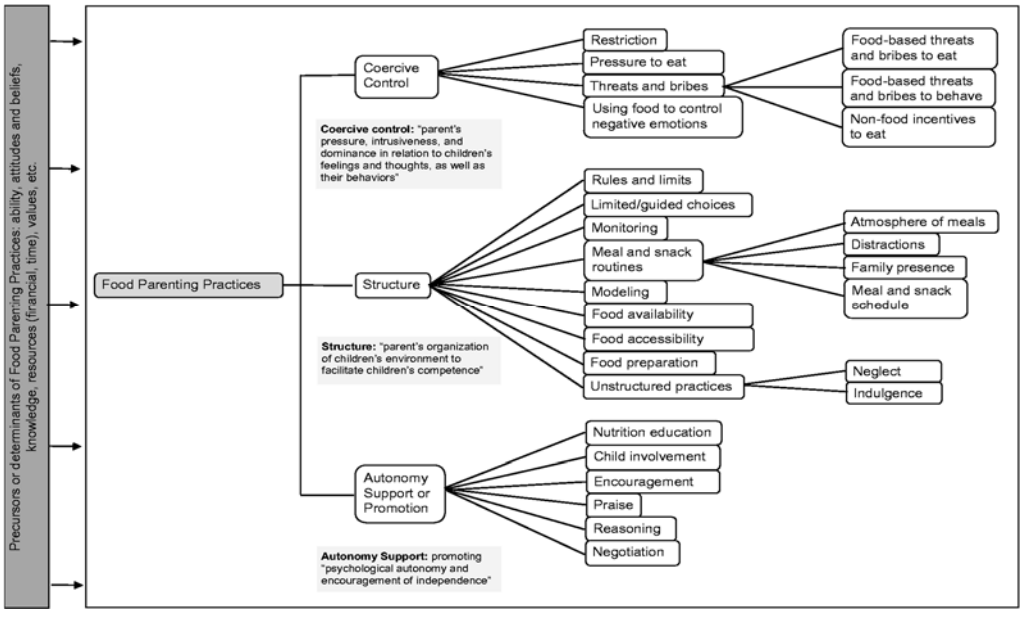

Figure 3.1 Content Map of Food Parenting Practices. From "Fundamental constructs in food parenting practices: a content map to guide future research" by Vaughn AE, Ward DS, Fisher JO, et al., 2016, Nutrition Review, Volume 74, Issue 2, Pages 98-117. Reprinted with permission of Oxford University Press.

The first step of refined CHES is item generation through experts' review. Items pertaining to food parenting practices and the home food environment were identified from the original CHES questionnaire. The Vaughn's comprehensive content map guided the sorting of items into three broad constructs of food parenting practices.[4] Selected items from the original CHES were reviewed by four nutrition education content experts (BC, KK, CC, and LM)[1] and one early childhood expert (MB)[2] from South Dakota State University and then categorized into the relevant parenting practice construct according to the content map. For example, item "How often does your family eat fruits and vegetables that you have grown?" from original CHES was categorized as "*Structure*" construct of food parenting practice; item "How often did you use food as a reward for your child?" from original CHES was categorized as "*Coercive Control*" construct; and item "How often did you prepare meals with your child?" was categorized as "*Autonomy Support*" construct. Experts provided feedback and suggestions about items relevance and intention.[13] The selection of items was refined based on this feedback.

The original CHES items have different responses options, for example, 5-point response scales with 1 being "never" to 5 being "always". For analytic purposes, all response scores were converted to a scale ranging from 0-1, including reversed coding when necessary. For example, the original 5-point response scales "never = 1, rarely = 2, sometimes = 3, frequently = 4, always = 5" were recoded as "never = 0, rarely = 0.25, sometimes = 0.5, frequently = 0.75, always = 1".

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[2] Mary Bowne, EdD.

Two *Structure* items measuring fruits, juice and vegetables availability and sweets and fats availability were recreated by compositing scores using the frequency of individual food items. A composite score for item "How often did you have the fruits, vegetables, and juices in your house?" was calculated by averaging the individual items "How often did you have the following fruits (17 items)/vegetables (24 items)/juices (6 items) in your house?" A composite score for item "How often did you have the sweets and fats in your house?" was calculated by averaging the individual items "How often did you have the following snack items (7 items)/drinks (3 items)/sweets or dessert foods (6 items) in your house?"

At the end of this stage, a total of 65 items selected from original CHES[14] were assigned to food parenting practice constructs including *Structure* (42 items), *Coercive Control* (17 items), and *Autonomy Support* (6 items). Appendix 3.1 shows these selected 65 items.

3.2.4 Statistical Analysis

After selected items from the original CHES and categorized into one of the parenting practice constructs, exploratory factor analysis were used to identify potential food parenting practices factors (subconstructs) for each construct.[15]

Before the exploratory factor analysis completed, preliminary review of data was conducted to determine if dataset is suitable for factor analysis.[15] First, the patterned relationship among variables was checked. Variables that have a large number of low or high correlation coefficients were removed as low correlation coefficients ($r < \pm 0.30$) indicate a lack of patterned relationship and high correlation coefficients ($r \geq \pm 0.9$) may indicate multicollinearity.[15] Then the *determinant of the matrix of correlation* score

(above 0.00001) was checked to confirm the absence of multicollinearity.[15] Second, two tests were conducted to confirm that the dataset is suitable for exploratory factor analysis: *the Bartlett's Test of Sphericity* (significant level of $p < 0.05$) indicating the data has patterned relationships; and the *Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy* (KMO > 0.50) indicating the data is suitable for exploratory factor analysis.[15]

After the preliminary interpretation, the exploratory factor analysis was undertaken for each construct. The factor extraction used principal components analysis and varimax was employed for factor rotation. Factor solutions were evaluated by total variance explained index (e.g., initial eigenvalues, extraction sums of squared loadings) and scree plot.[15] Items with low rotated factor loading (< 0.40) were removed; then factor analysis were repeated.[16] If an item had a rotated factor loading ≥ 0.40 on multiple factors (subconstructs), the item was included in the factor with the higher factor loading.[17] Finally, factors for each construct were identified. For each factor (subconstruct), experts examined and reviewed the multiple versions of reduced factors and items, and several criteria were considered when deciding which items to be retained in the final factors.[16] Criteria included factor loadings of each item (items with higher factor loadings were preferred to include)[16], the comparison of the internal consistency of reduced factors (alpha > 0.70 were preferred to include)[16], and if factors and items were consistent with the literature.

Internal consistency for all factors was analyzed using a correlation matrix and by calculating Cronbach's alpha (alpha > 0.70 presents an acceptable internal consistency).[18] Preliminary interpretation, exploratory factor analysis, and Cronbach's alpha analysis were performed in SPSS version 24 (IBM Corp., Armonk, NY, 2016).

Factor scores were calculated by averaging the contributing item scores using Stata release 14 (StataCorp LP., College Station, TX, 2015). Spearman correlations and the significance level (alpha = 0.05) were calculated to assess the associations between identified factors.

3.3 Results

3.3.1 Participant Characteristics

The final sample used in this study, with complete original CHES data, consisted of 172 parents (one parent per family) with an average age of 34.6 years old (SD = 5.26). The demographics are reported in Table 3.1. Parents in this study were predominately mothers (83.1%). The majority were white (91.8%) and not Hispanic or Latino (97.6%). The majority had a family income greater than $50,000 (80.2%), full time working outside the home (82.4%), and a bachelor's degree or higher (78.4%).

Table 3.1 Demographic Characteristics of Parents (n=172)

Variable	Category	N[a]	%
Parent Gender Role	Mother	143	83.1%
	Father	29	16.9%
Race	White	156	91.8%
	American Indian/Alaskan Native	1	0.6%
	Asian	8	4.7%
	Black or African American	3	1.8%
	Mixed race	1	0.6%
	Other	1	0.6%
Ethnicity	Hispanic or Latino	4	2.4%
	Not Hispanic or Latino	165	97.6%
Family Income	Less than $10,000	2	1.2%
	$10,000-19,000	2	1.2%
	$20,000-50,000	30	17.4%
	$50,000-100,000	70	40.7%
	Greater than $100,000	68	39.5%
Occupation	Full time working outside the home	140	82.4%
	Part time working outside the home	15	8.8%
	Working From home for a salary	4	2.4%
	Stay at home mom/dad	11	6.5%
Education Level	High school or less	22	12.9%
	Associate's degree	15	8.8%
	Bachelor's degree	75	43.9%
	Graduate degree	59	34.5%

[a] Not all numbers may add up due to parents skipping.

3.3.2 Exploratory Factor Analysis

The preliminary review of data indicates the datasets were suitable for factor analysis on items from each food parenting practice construct. *The Bartlett's Test of Sphericity* (significant level of $p < 0.05$) indicated the datasets had patterned relationships among variables; and the *KMO Measure of Sampling Adequacy* (KMO > 0.5) indicated the data was suitable for factor analysis on items from *Structure* (KMO = 0.76), *Coercive Control* (KMO = 0.71), and *Autonomy Support* (KMO = 0.53).

Following the preliminary interpretation, the factor analysis identified 10 factors and retained 40 of the 65 items, including 4 factors (21 items) within *Structure*, 4 factors (14 items) within *Coercive Contro*l, and 2 factors (5 items) within *Autonomy Support*. Table 3.2, Table 3.3, and Table 3.4 present the final items, factor loadings and internal consistency (Cronbach's alpha) for *Structure*, *Coercive Control*, and *Autonomy Support*, respectively. Deleted items for each construct by factor analysis are available in the supplemental materials (Appendix 3.2).

Structure. The *Structure* included non-coercive parenting practices that organize the children's environment and facilitate children's eating competence. Results from the factor analysis shown in Table 3.2 identified four factors as follows: 1) *Meal and Snack Routines* (6 items), which assesses the parent-created behaviors about the location, timing, atmosphere, presence of family members, and presence/absence of distractions during meal and snack time. 2) *Modeling* (7 items), which assesses how a parent actively demonstrates healthy and unhealthy eating behaviors to their children. 3) *Rules and Limits* (6 items), which assesses how a parent sets clear expectations about what, when, where, and how much the child should eat. 4) *Healthy Food Availability and Accessibility*

(2 items), which assesses the presence of healthy foods that a parent brings into the home and how easy or difficult it is for the child to access healthy foods in the home.

Three factors had more than three items and acceptable internal consistency (Cronbach's alpha ≥ 0.70). The *Healthy Food Availability and Accessibility* had a low alpha value, but it was still retained after experts' review because of its importance. Within *Structure*, there were the movements of four items which are described as follows: 1) "How often did your child see you eat while watching television, reading or working?" from *Meal and Snack Routines* (factor loading = 0.60) into *Modeling* (factor loading = 0.40); 2) "How often did you eat healthy meals or snacks while your child was around?" from *Healthy Food Availability and Accessibility* (factor loading = 0.66) into *Modeling* (factor loading = 0.30); 3) "Do you have the following food rules in your home... no sweet snacks?" from *Healthy Food availability and Accessibility* (factor loading = 0.62) into *Rules and Limits* (factor loading = 0.16); 4) "Do you have the following food rules in your home... no dessert except fruit?" from *Healthy Food Availability and Accessibility* (factor loading = 0.46) into *Rules and Limits* (factor loading = 0.28).

The movements of these items were reviewed by experts and the described movements to respective subconstructs were completed based on the rationale that these moves allowed the scales to be more consistent with how these parenting practices have been captured in the literature.[16,19-21] A total of 21 items such as "How often did you have sweets and fats in your house?" were deleted from factor analysis for *Structure*. Deleted items are available in supplement materials (Appendix 3.2).

Table 3.2 Food Parenting Practices Exploratory Factor Analysis for *Structure*

Scale Names and Items	Factor Loading	Internal Consistency
Meal and Snack Routines		0.74
• How many days of the week does your family sit at a table and eat dinner together?[a]	0.80	
• Does your family eat dinner while watching television?[b]	0.77	
• How often does your child eat in from of the TV?[c] (R)[d]	0.63	
• How often does your family eat a least one meal together each day?[e]	0.62	
• How often did you eat dinner with your child?[f]	0.57	
• How often did you have regularly scheduled meals and snacks with your family?[f]	0.55	
Modeling		0.73
• How often did your child see you eat when you were bored?[g] (R)[d]	0.86	
• How often did your child see you eat when you were angry or in a bad or sad mood?[g] (R)[d]	0.80	
• How often did you eat unhealthy snacks around your children?[g] (R)[d]	0.59	
• How often did your child see you eat late in the evening or at night?[g] (R)[d]	0.52	
• How often did you avoid buying sweets and chips or salty snacks and bringing them into the house?[f]	0.40	
• How often did your child see you eat while watching television, reading, or working?[g] (R)[d]	0.40	
• How often did you eat healthy meals or snacks while your child was around? ("healthy" defined as fruits, vegetables, lean meats, whole grains etc.)[f]	0.30	
Rules and Limits		0.70
Do you have the following food rules in your home...		
• How many snacks is your child allowed to eat?[h] (R)[d]	0.78	
• When to snack?[h] (R)[d]	0.77	
• Which snacks to eat?[h] (R)[d]	0.74	
• How many servings of fruit and vegetables your child should eat?[h] (R)[d]	0.51	
• No sweet snacks?[h] (R)[d]	0.16	
• No dessert except fruit?[h] (R)[d]	0.28	
Healthy Food Availability and Accessibility		0.46
• How often did you have the fruits, vegetables, and juices in your house?[f]	0.71	
• Based on the past 30 days, thinking about where you like to store food, please circle the appropriate response…fruits and vegetables in a place where they could be seen and easily reached.[f]	0.53	

Note: For Structure, higher responding scores reflect greater use of positive structure practices.
[a] Response options: one day or less = 0, 2 days = 0.17, 3 days = 0.34, 4 days = 0.51, 5 days = 0.68, 6 days = 0.85, and 7 days = 1.
[b] Response options: yes = 0 and no = 1.
[c] Response options: never = 1, 1 time or less per week = 0.75, 2-3 times per week = 0.5, 4-5 times per week = 0.25, and everyday = 0.
[d] (R) = items that reversed the coding.
[e] Response options: almost never = 0, sometimes = 0.33, often = 0.67, and almost always = 1.
[f] Response options: never = 0, rarely = 0.25, sometimes = 0.5, frequently = 0.75, and always = 1.
[g] Response options: never = 1, rarely = 0.75, sometimes = 0.5, frequently = 0.25, and always = 0.
[h] Response options: yes = 1 and no = 0.

Coercive Control. *Coercive Control* included specific parenting-centered feeding practices which have negative impacts on children's eating behaviors. Results in Table 3.3 shows identified 4 factors within *Coercive Control*: 1) *Weight Concerns* (4 items), which assesses how a parent enforces parent-centered limits on eating behaviors about the child's weight concerns or control. 2) *Restriction* (4 items), which assesses how a parent enforces parent-centered limits on the food choices or opportunities for the child to consume those foods. 3) *Pressure to Eat* (4 items), which assesses how a parent insists or demands the child to eat more foods. 4) *Threats and Bribes* (2 items), which assesses how a parent uses foods as enticements to shape or manage child's behaviors. Analysis of the factor loadings indicated that all final items from *Coercive Control* factors met key criteria (factor loading ≥ 0.40).

Three of the *Coercive Control* factors had more than three items and acceptable internal consistency ($\alpha \geq 0.70$). The *Coercive Control* factor—*Threats and Bribes* had two items and low reliability ($\alpha < 0.7$). This scale was still retained after experts reviewed and deemed as important *Coercive Control* practices.

Table 3.3 Food Parenting Practices Exploratory Factor Analysis for *Coercive Control*

Scale Names and Items	Factor Loading	Internal Consistency
Weight Concerns		0.79
• How concerned are you about your child having to diet to maintain a desirable weight?[a]	0.91	
• How concerned are you about your child becoming overweight?[a]	0.88	
• How concerned are you about your child eating too much when you are not around him/her?[a]	0.78	
• How much do you agree/disagree? I have to be sure that my child does not eat too much.[b]	0.59	
Restriction		0.75
How much do you agree/disagree?		
• I intentionally keep some foods out of my child's reach.[b]	0.80	
• If I did not guide or regulate my child's eating, he/she would eat too many junk foods.[b]	0.77	
• I have to be sure that my child does not eat too many sweets.[b]	0.77	
• I have to be sure that my child does not eat too much of his/her favorite foods.[b]	0.57	
Pressure to Eat		0.75
How much do you agree/disagree?		
• I have to be especially careful to make sure my child eats enough.[b]	0.86	
• If I did not guide or regulate my child's eating, he/she would eat much less than he/she should.[b]	0.80	
• If my child says "I am not hungry" I try to get him/her to eat anyway.[b]	0.70	
• My child should always eat all of the food on his/her plate.[b]	0.61	
Threats and Bribes		0.28
• How often did you use food as a reward for your child?[c]	0.81	
• How often did you use food as a punishment for your child?[c]	0.56	

Note: For *Coercive Control* which are negative behaviors, higher responding scores reflect greater use of those practices.

[a] Response options: unconcerned = 0, a little concerned = 0.25, concerned = 0.5, fairly concerned = 0.75, and very concerned = 1.

[b] Response options: disagree = 0, slightly disagree = 0.25, neutral = 0.5, slightly agree = 0.75, and agree = 1.

[c] Response options: never = 0, rarely = 0.25, sometimes = 0.5, frequently = 0.75, and always = 1.

Autonomy Support. *Autonomy Support* included parenting practices providing children choices and exploration regarding food choices or eating behaviors at an age-appropriate independent level. This study identified two factors within *Autonomy Support* (Table 3.4) as follows: 1) *Child Involvement: Planning Meals* (2 items), which assesses how a parent actively involves the child during planning meals. 2) *Child Involvement: Shopping* (3 items), which assesses how a parent actively involves the child during shopping. One item "Do you buy snacks or sugary cereal upon your child's request?" was moved from *Child Involvement: Planning Meals* (factor loading = 0.44) to *Child Involvement: Shopping* (factor loading = 0.05). Movement of this item was reviewed by experts and deemed to be consistent with the categories of parenting practices in the literature.[16] With the limited item numbers, even though two *Autonomy Support* factors in this study had low reliability (alpha < 0.7), these factors were still retained after experts reviewed as they were deemed to be important *Autonomy Support* practices.

Table 3.4 Food Parenting Practices Exploratory Factor Analysis for *Autonomy Support*

Scale Names and Items	Factor Loading	Internal Consistency
Child Involvement: Planning Meals		0.60
• How often did you plan meals/menus with your child?[a]	0.79	
• How often did you prepare meals with your child?[a]	0.78	
Child Involvement: Shopping		0.30
• How often do you take your child with your grocery shopping?[a]	0.71	
• Do you buy fruits and vegetables upon your child's request?[b]	0.85	
• Do you buy snacks or sugary cereal upon your child's request?[c] (R)[d]	0.05	

Note: For *Autonomy Support*, higher responding scores reflect greater child control for positive practices while lower scores reflect greater parent control.
[a] Response options: never = 0, rarely = 0.25, sometimes = 0.5, frequently = 0.75, and always = 1.
[b] Response options: not at all = 0, rarely = 0.25, sometimes = 0.5, quite a bit = 0.75, and very much = 1.
[c] Response options: not at all = 1, rarely = 0.75, sometimes = 0.5, quite a bit = 0.25, and very much = 0.
[d] (R)=items that reversed the coding.

Associations Between Identified Factors. Results of Spearman correlations generally suggested that identified factors differentiated between similar and dissimilar behaviors (Table 3.5). For *Structure* construct, *Meal and Snack Routines*, *Modeling*, *Rules and Limits*, and *Healthy Food Availability and Accessibility* were positively correlated with each another (r = 0.15 - 0.36). *Modeling* was negatively correlated with *Threats and Bribes* (r = 0.28). *Rules and Limits* were positively correlated with two *Coercive Control* factors: *Restriction* (r = 0.17) and *Pressure to Eat* (r = 0.17). For *Coercive Control*, *Weight Concerns* and *Restriction* were positively correlated (r = 0.57). For *Autonomy Support*, *Child Involvement: Shopping* was positively correlated with *Structure* scales (r = 0.17 - 0.34) and *Child Involvement: Planning Meals* (r = 0.18).

Table 3.5 Spearman Correlation Assessing Associations Between Identified Food Parenting Practices Factors

		1	2	3	4	5	6	7	8	9
1	Meal and Snack Routines									
2	Modeling	0.36*								
3	Rules and Limits	0.23*	0.21*							
4	Healthy Food Availability and Accessibility	0.34*	0.23*	0.15*						
5	Weight Concerns	-0.14	-0.11	0.10	-0.13					
6	Restriction	0.00	-0.02	0.17*	-0.05	0.57*				
7	Pressure to Eat	0.03	-0.09	0.17*	-0.02	0.09	0.12			
8	Threats and Bribes	-0.12	-0.28*	-0.10	-0.12	0.09	0.02	0.06		
9	Child Involvement: Planning Meals	0.10	0.06	0.12	0.12	0.08	-0.08	-0.01	-0.01	
10	Child Involvement: Shopping	0.30*	0.17*	0.23*	0.34*	-0.12	-0.02	0.08	0.03	0.18*

* $p < 0.05$.

3.4 Discussion

The purpose of this study was to conduct an exploratory factor analysis of the original existing home environment assessment—CHES, to identify and evaluate modified factor structures about food parenting practices[12]. By identifying alternative factor structures, the refined CHES provided a comprehensive measurement of food parenting practices. The exploratory factor analysis revealed 40 items that identified 10 food parenting practices factors (subconstructs) under three broad constructs; 4 subconstructs (21 items) within *Structure*, 4 subconstructs (14 items) within *Coercive Control*, and 2 subconstructs (5 items) within *Autonomy Support*.

Following the guidance of the content map of food parenting practices, the factor analysis results of this study highlighted the specific subconstructs within each of three food parenting practice constructs—*Structure*, *Coercive Control*, and *Autonomy Support*. Within *Structure*, three of the four identified factors were very similar to subconstructs in Vaughn's original model—*Meal and Snack Routines*, *Modeling*, and *Rules and Limits*. *Meal and Snack Routines* in existing measures typically capture aspects such as presence of family members (e.g., eating together with family),[4,22] the presence/absence of distractions during meals and snacks (e.g., watching TV),[23] the location and timing of meals and snacks,[16,24] or the atmosphere of meals (e.g., having pleasant time during meals).[16,23,25] This study identified 6 items focusing on frequency eating together as a family and the presence of distractions while eating. *Modeling* captures aspects such as eating healthy foods or having healthy eating behaviors in front of children, or showing enthusiasm about eating healthy foods.[26,27] A recent literature review indicated that parental modeling includes not only intentional demonstration of healthy behaviors, but

also unintentional exhibition of unhealthy behaviors in front of children.[4] This review identified 7 items addressing both healthy and unhealthy behaviors that parents display in front of children. The assessment of unhealthy modeling used reverse-scored items about how often unhealthy eating behaviors are seen by children and avoiding unhealthy eating behaviors in front of children. *Rules and Limits* focuses on a variety of issues around children's eating, such as what (e.g., types of foods are allowed or limited),[28] when (e.g., appropriate time or special occasions),[28] where (e.g., specific places that meals and snacks can be taken),[29] and how much (e.g., expectations for eating healthy foods, or limits of eating unhealthy foods) the children should eat which are expected by their parents.[29] Our study identified 6 dichotomous items focused on rules and limits in home environment. Other subconstructs from Vaughn's model (e.g., *Monitoring*, *Limited/Guided Choices*, or *Food Preparation*) within the *Structure* construct were not identified by this study because related items were reduced by factor analysis. However, the results successfully identified four key *Structure* substructure of parenting practices for future research on healthy eating behaviors and weight control of children.

Within *Coercive Control*, this study successfully captured three major subconstructs in Vaughn's original model: *Restriction*, *Pressure to Eat*, and *Threats and Bribes*. *Restriction* is parent-centered rather than child-centered. *Restriction* is defined as enforcing limits on the food choices or opportunities for the child to consume those foods. *Restriction* addresses coercive practices, which involve little reasoning, negotiation, or opportunity for children to make a choice (e.g., "I have to be sure that my child does not eat too many high-fat/high-sugar foods" or "If I did not guide or regulate my child's eating, he/ she would eat too many junk foods").[4,30] The most studied feeding

practice is that of *Restriction*.[17] Most studies suggested that *Restriction* has a negative impact on children's healthy diet and behaviors.[4] However, parents may use *Restriction* as a simple method to limit the consumption of unhealthy foods for children,[31-33] and *Restriction* might be both a useful and harmful practice to control children's weight.[34] Therefore, *Restriction* is an impactful practice, and researchers should work to better understand its overall impact.

Pressure to Eat can be defined as parents pressuring children to eat more foods,[4] using practices such as insisting the child clean the plate (e.g., "My child has to finish his/her plate"),[35] or providing repeated prompts to eat foods (e.g., "My child has to eat even if he/she is not hungry").[4,36] Negative associations between *Pressure to Eat* and desirable eating patterns and child's weight status have been studied.[3,17] *Threats and Bribes* are classified as three types in Vaughn's content map: food-based threats and bribes to eat (e.g., "I use puddings as a bribe to get my child to eat his/her main course"),[37] food based threats and bribes to behave (e.g., "In order to get my child to behave him/herself, I promise him/her something to eat")[37], and nonfood-based incentives to eat.[4] Similar to Vaughn's study, the results from our study identified two items on *Threats and Bribes* addressing how frequently parents use food as a reward/punishment for their children.

Within *Autonomy Support*, our study identified one subconstruct that was reported in Vaughn's original model—*Child Involvement*, and split items into two factors—*Child Involvement: Planning Meals* (2 items) and *Child Involvement: Shopping* (3 items). The items identified in this study involved grocery shopping and meal planning, including the frequency that parents have children planning meals and shopping together, as well as

asking children's opinions about what foods to buy. Few items were identified within *Autonomy Support* by this study, this may be limited by the original CHES including less components related to *Autonomy Support* of food parenting practices. This is consistent with the fact that few existing surveys assess child involvement and only capture few items.[4]

After factor analysis in this study, there were the movements of items from identified factors to other factors within *Structure* and *Autonomy Support* constructs. The movements of these items were reviewed by experts and these moves allowed the subconstructs to be more consistent with how these parenting practices have been captured in the existing measures. For example, the movements of two items "How often did your child see you eat while watching television, reading or working?" and "How often did you eat healthy meals or snacks while your child was around?" into *Modeling* were consistent with items "Eat while watching TV/reading" and "Eat healthy snacks" within *Healthy Eating Parental Role Modelling* scale from the Home Environment Survey[19] and item "My child sees me eating healthy snacks" within *Modelling of healthy eating* scale from Child and Family Health Study[20]. The movements of items "Do you have the following food rules in your home... no sweet snacks?" and "Do you have the following food rules in your home... no dessert except fruit?" into *Rules and Limits* were consistent with item "Are there rules at home about which snacks the child is allowed to eat?" from Family Food Rules Questionnaire[21].

The majority of identified subconstructs in this study had moderate to high internal consistency (alpha ≥ 0.60). However, a somewhat lower alpha for internal consistency was noted for *Healthy Food Availability and Accessibility*, *Threats and*

Bribes, and *Child Involvement: Shopping*. Because of the limited item numbers related to these areas selected from original CHES and few existing studies focused on these areas, further work may be needed to include relevant items for these subconstructs to test the internal consistency.

Additional evaluations were conducted by examining associations between identified factors in this study. Spearman correlation results indicated healthful practices like *Meal and Snack Routines*, *Modeling*, *Rules and Limits*, *Healthy Food Availability and Accessibility*, and *Child Involvement* were positively correlated with one another, and unhealthful practices like *Restriction* and *Weight Concerns* were also inter-related. *Rules and Limits* (practices that associated with healthy behaviors) had weak correlations ($r < 0.3$)[38] with *Restriction* and *Pressure to Eat* (practices that associated with unhealthy behaviors). Such correlations have been reported previously.[39] This could be because *Rules and Limits* and *Restriction* have the similarity in enforcing parent-centered limits on a child's access of foods.[4] But *Rules and Limits* is focusing on noncoercive practices and *Restriction* is more focusing on coercive practices. The distinction between coercive and noncoercive types of restriction may help to better understand these practices.[4]

3.4.1 Limitation and Strengths

Limitations to this study are important to acknowledge. The results in refined CHES identified more factors and items within *Structure* construct and less in *Autonomy Support*, which is consistent with Vaughn's content map that *Structure* construct contains more subconstructs than other two constructs. The explanation that this paper identified more factors and items within *Structure* construct may be related to the fact that CHES was not specifically designed to assess parenting practices, but does include more

components under *Structure* in its design. In addition, when selecting items before factor analysis, using a content map may make certain assumptions about grouping items and influence the identification of factors. Experts reviews on items and factors for final decision may also lead to some bias. For future research, confirmatory factor analysis in a larger sample may be needed.

One of the study strengths was using a comprehensive theoretical framework which has clear structure and definitions on food parenting practices to help select items from original CHES and guide identification of relevant constructs.[4] In addition, identification of the final factors using exploratory factor analysis and experts review to reduce factors to make the results more efficient and interpretable. Furthermore, the results of this study will provide a comprehensive measurement that create an opportunity for future work based on food parenting practices to support children's healthy eating behaviors.

3.4.2 Implications for Research and Practice

Overall, this study provides preliminary support for identifying and evaluating modified factor structures about food parenting practices from an existing assessment in a sample of parents of preschool-aged children. By identifying alternative factor structures, it was expected the refined CHES to provide a comprehensive measurement of food parenting practices. Future research can build on this preliminary work to improve the measurement properties of the food parenting practices, examine its application to other populations and predict child eating behaviors. (The results in this study were used in the Chapter 5 to explore the relationship between food parenting practices and children's dietary intakes.)

REFERENCES

1. Swinburn B, Egger G, Raza F. Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. *Prev Med.* 1999;29(6 Pt 1):563-570.
2. Couch SC, Glanz K, Zhou C, Sallis JF, Saelens BE. Home food environment in relation to children's diet quality and weight status. *J Acad Nutr Diet.* 2014;114(10):1569-1579.e1561.
3. Scaglioni S, Arrizza C, Vecchi F, Tedeschi S. Determinants of children's eating behavior. *Am J Clin Nutr.* 2011;94(6 Suppl):2006s-2011s.
4. Vaughn AE, Ward DS, Fisher JO, et al. Fundamental constructs in food parenting practices: a content map to guide future research. *Nutr Rev.* 2016;74(2):98-117.
5. Gerards SM, Kremers SP. The role of food parenting skills and the home food environment in children's weight gain and obesity. *Curr Obes Rep.* 2015;4(1):30-36.
6. Shutts K, Kinzler KD, DeJesus JM. Understanding infants' and children's social learning about foods: previous research and new prospects. *Dev Psychol.* 2013;49(3):419-425.
7. Frankel LA, O'Connor TM, Chen T-A, Nicklas T, Power TG, Hughes SO. Parents' perceptions of preschool children's ability to regulate eating. Feeding style differences. *Appetite.* 2014;76:166-174.
8. Larsen JK, Hermans RCJ, Sleddens EFC, Engels RCME, Fisher JO, Kremers SPJ. How parental dietary behavior and food parenting practices affect children's dietary behavior. Interacting sources of influence? *Appetite.* 2015;89:246-257.

9. Kremers S, Sleddens E, Gerards S, et al. General and food-specific parenting: measures and interplay. *Child Obes.* 2013;9 Suppl:S22-S31.

10. De Lauzon-Guillain B, Oliveira A, Charles MA, et al. A review of methods to assess parental feeding practices and preschool children's eating behavior: the need for further development of tools. *J Acad Nutr Diet.* 2012;112(10):1578-1602, 1602.e1571-1578.

11. Vaughn AE, Tabak RG, Bryant MJ, Ward DS. Measuring parent food practices: a systematic review of existing measures and examination of instruments. *Int J Behav Nutr Phys Act.* 2013;10:61. doi:10.1186/1479-5868-10-61.

12. Pinard CA, Yaroch AL, Hart MH, Serrano EL, McFerren MM, Estabrooks PA. The validity and reliability of the comprehensive home environment survey (CHES). *Health Promot Pract.* 2014;15(1):109-117.

13. Creswell JW. *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research.* Boston: Pearson; 2012.

14. Robert CA. The home environment and childhood obesity. Unpublished manuscript. Virginia Tech; 2010.

15. Yong AG, Pearce S. A beginner’s guide to factor analysis: focusing on exploratory factor analysis. *Tutor Quant Methods Psychol.* 2013;9(2):79-94.

16. Vaughn AE, Dearth-Wesley T, Tabak RG, Bryant M, Ward DS. Development of a comprehensive assessment of food parenting practices: the home self-administered tool for environmental assessment of activity and diet family food practices survey. *J Acad Nutr Diet.* 2017;117(2):214-227.

17. Haszard JJ, Williams SM, Dawson AM, Skidmore PM, Taylor RW. Factor analysis of the comprehensive feeding practices questionnaire in a large sample of children. *Appetite.* 2013;62:110-118.

18. Taber KS. The use of cronbach's alpha when developing and reporting research instruments in science education. *Res Sci Educ.* 2018;48(6):1273-1296.

19. Gattshall ML, Shoup JA, Marshall JA, Crane LA, Estabrooks PA. Validation of a survey instrument to assess home environments for physical activity and healthy eating in overweight children. *Int J Behav Nutr Phys Act.* 2008;5:3. doi:10.1186/1479-5868-5-3.

20. Gregory JE, Paxton SJ, Brozovic AM. Maternal feeding practices predict fruit and vegetable consumption in young children. Results of a 12-month longitudinal study. *Appetite.* 2011;57(1):167-172.

21. Van Assema P, Glanz K, Martens M, Brug J. Differences between parents' and adolescents' perceptions of family food rules and availability. *J Nutr Educ Behav.* 2007;39(2):84-89.

22. Fulkerson JA, Story M, Neumark-Sztainer D, Rydell S. Family meals: perceptions of benefits and challenges among parents of 8- to 10-year-old children. *J Am Diet Assoc.* 2008;108(4):706-709.

23. Boutelle KN, Birnbaum AS, Lytle LA, Murray DM, Story M. Associations between perceived family meal environment and parent intake of fruit, vegetables, and fat. *J Nutr Educ Behav.* 2003;35(1):24-29.

24. Ross LT, Hill EM. The family unpredictability scale: reliability and validity. *J Marriage Fam.* 2000;62(2):549-562.

25. Davies WH, Ackerman LK, Davies CM, Vannatta K, Noll RB. About Your Child's Eating: factor structure and psychometric properties of a feeding relationship measure. *Eat Behav.* 2007;8(4):457-463.

26. Musher-Eizenman D, Holub S. Comprehensive feeding practices questionnaire: validation of a new measure of parental feeding practices. *J Pediatr Psychol.* 2007;32(8):960-972.

27. Tibbs T, Haire-Joshu D, Schechtman KB, et al. The relationship between parental modeling, eating patterns, and dietary intake among African-American parents. *J Am Diet Assoc.* 2001;101(5):535-541.

28. De Bourdeaudhuij I. Family food rules and healthy eating in adolescents. *J Health Psychol.* 1997;2(1):45-56.

29. Lopez NV, Ayala GX, Corder K, et al. Parent support and parent-mediated behaviors are associated with children's sugary beverage consumption. *J Acad Nutr Diet.* 2012;112(4):541-547.

30. Birch LL, Fisher JO, Grimm-Thomas K, Markey CN, Sawyer R, Johnson SL. Confirmatory factor analysis of the child feeding questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. *Appetite.* 2001;36(3):201-210.

31. Ogden J, Cordey P, Cutler L, Thomas H. Parental restriction and children's diets. The chocolate coin and Easter egg experiments. *Appetite.* 2013;61(1):36-44.

32. Jansen E, Mulkens S, Emond Y, Jansen A. From the garden of eden to the land of plenty. Restriction of fruit and sweets intake leads to increased fruit and sweets consumption in children. *Appetite.* 2008;51(3):570-575.

33. Jansen PW, Roza SJ, Jaddoe VW, et al. Children's eating behavior, feeding practices of parents and weight problems in early childhood: results from the population-based Generation R Study. *Int J Behav Nutr Phys Act.* 2012;9:130. doi:10.1186/1479-5868-9-130.

34. Campbell K, Andrianopoulos N, Hesketh K, et al. Parental use of restrictive feeding practices and child BMI z-score. A 3-year prospective cohort study. *Appetite.* 2010;55(1):84-88.

35. Vereecken C, Legiest E, De Bourdeaudhuij I, Maes L. Associations between general parenting styles and specific food-related parenting practices and children's food consumption. *Am J Health Promot.* 2009;23(4):233-240.

36. Vereecken CA, Keukelier E, Maes L. Influence of mother's educational level on food parenting practices and food habits of young children. *Appetite.* 2004;43(1):93-103.

37. Wardle J, Sanderson S, Guthrie CA, Rapoport L, Plomin R. Parental feeding style and the inter-generational transmission of obesity risk. *Obes Res.* 2002;10(6):453-462.

38. Cohen J. *Statistical Power Analysis for the Behavioral Sciences.* 2nd ed. New York: Routledge; 1988.

39. Saltzman JA, Balantekin KN, Musaad S, Bost KK, Fiese BH. Longitudinal factor analysis of the comprehensive feeding practices questionnaire among parents of preschool-aged children. *Appetite.* 2018;129:94-102.

Appendix 3.1 Selected Items from Original CHES

Selected Items from Original CHES		Original Response Scale in CHES	Converted Scale Ranging from 0-1
Structure			
1	Which of these statements best describes the food eaten in your household in the last 12 months?	[1] Often we don't have enough to eat [2] Sometimes we don't have enough to eat [3] Enough to eat but not always what we want [4] Always have enough to eat and the kinds we want	[0] Often we don't have enough to eat [0.33] Sometimes we don't have enough to eat [0.67] Enough to eat but not always what we want [1] Always have enough to eat and the kinds we want
2	How often during the last 12 months have you been hungry because your family couldn't afford more food?	[1] Almost every month [2] Some months, but not every month [3] Only 1-2 months [4] I have not been hungry for this reason	[0] Almost every month [0.33] Some months, but not every month [0.67] Only 1-2 months [1] I have not been hungry for this reason
3	How often did you have the following fruits/vegetables/vegetables/Juices in your house?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always
4*	How often did you have the following snack items/drinks (boxed, canned, powered)/sweets or dessert foods in your house?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[1] Never [0.75] Rarely [0.5] Sometimes [0.25] Frequently [0] Always
5*	Think about who prepares the food in your home, which of the following best indicates your role?	[1] Food Prep is primarily my responsibility [2] I prep food sometimes but isn't primarily my role [3] I share food prep equally with another member [4] I rarely prep food in our house	[1] Food Prep is primarily my responsibility [0.67] I prep food sometimes but isn't primarily my role [0.33] I share food prep equally with another member [0] I rarely prep food in our house
6	Fruits and vegetables in a place where they could be seen and easily reached	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always
7*	Avoid buying sweets and chips or salty snacks and bringing them into the house?	[1] Yes [2] No	[1] Yes [0] No
8	How often does your family eat fruits and vegetables that you have grown?	[1] Not at all [2] Rarely [3] Some of the time [4] Most of the time [5] All of the time	[0] Not at all [0.25] Rarely [0.5] Some of the time [0.75] Most of the time [1] All of the time
9	How Often did you...Eat Healthy Meals or snacks while your child was around? ("healthy" defined as fruits, vegetables, lean meats, whole grains etc.)	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always
10*	How Often did you...Eat unhealthy snacks around your children?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[1] Never [0.75] Rarely [0.5] Sometimes [0.25] Frequently [0] Always
11*	How Often did you...Drink sugared drinks or non-diet soda around your children?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[1] Never [0.75] Rarely [0.5] Sometimes [0.25] Frequently [0] Always

Selected Items from Original CHES		Original Response Scale in CHES	Converted Scale Ranging from 0-1
12	How Often did you...Avoid going to cafes or restaurants with your children which sell unhealthy foods?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always
13	How Often did you...Avoid buying sweets and chips or salty snacks and bringing them into the house?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always
14	How Often did you...Not buy foods that you would like because you do not want your children to have them?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always
15*	How Often did your child see you...Eat while standing?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[1] Never [0.75] Rarely [0.5] Sometimes [0.25] Frequently [0] Always
16*	How Often did your child see you...Eat straight from the pot/pan/bowl?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[1] Never [0.75] Rarely [0.5] Sometimes [0.25] Frequently [0] Always
17*	How Often did your child see you...Eat while watching television, reading or working?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[1] Never [0.75] Rarely [0.5] Sometimes [0.25] Frequently [0] Always
18*	How Often did your child see you…Eat when you were bored?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[1] Never [0.75] Rarely [0.5] Sometimes [0.25] Frequently [0] Always
19*	How Often did your child see you…Eat when you were angry or in a bad or sad mood?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[1] Never [0.75] Rarely [0.5] Sometimes [0.25] Frequently [0] Always
20*	How Often did your child see you…Eat late in the evening or at night?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[1] Never [0.75] Rarely [0.5] Sometimes [0.25] Frequently [0] Always
21*	How Often did your child see you…Eat while driving	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[1] Never [0.75] Rarely [0.5] Sometimes [0.25] Frequently [0] Always
22	How often did you...Eat breakfast with your child?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always
23	How often did you...Eat dinner with your child?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always
24	How often did you...Offer healthy snacks when your child was hungry?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always

Selected Items from Original CHES		Original Response Scale in CHES	Converted Scale Ranging from 0-1
25	How many days of the week do your family sit at a table and eat dinner together?	[1] One day or less [2] 2 days [3] 3 days [4] 4 days [5] 5 days [6] 6 days [7] 7 days	[0] One day or less [0.17] 2 days [0.34] 3 days [0.51] 4 days [0.68] 5 days [0.85] 6 days [1] 7 days
26	How often did you...Have regularly scheduled meals and snacks with your family?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always
27*	Does your family eat dinner while watching television?	[1] Yes [2] No	[0] Yes [1] No
28*	How often does your child eat breakfast?	[1] Almost never [2] Sometimes [3] Often [4] Almost always	[0] Almost never [0.33] Sometimes [0.67] Often [1] Almost always
29*	How often does your family eat a least one meal together each day?	[1] Almost never [2] Sometimes [3] Often [4] Almost always	[0] Almost never [0.33] Sometimes [0.67] Often [1] Almost always
30*	How often does your child eat in from of the TV?	[1] Never [2] 1 Time or less per week [3] 2-3 times per week [4] 4-5 times per week [5] Everyday	[1] Never [0.75] 1 Time or less per week [0.5] 2-3 times per week [0.25] 4-5 times per week [0] Everyday
31*	How often did you...Allow your child eat snacks or sweets without permission?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[1] Never [0.75] Rarely [0.5] Sometimes [0.25] Frequently [0] Always
32*	How often did you...Allow your child to take soft drinks whenever he/she wants?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[1] Never [0.75] Rarely [0.5] Sometimes [0.25] Frequently [0] Always
33*	How often did you...Give your child something else if they did not like what was prepared?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[1] Never [0.75] Rarely [0.5] Sometimes [0.25] Frequently [0] Always
34*	Do you have the following food rules in your home...How many servings of fruit and vegetables your child should eat?	[1] Yes [2] No	[1] Yes [0] No
35*	Do you have the following food rules in your home...How many snacks is your child allowed to eat?	[1] Yes [2] No	[1] Yes [0] No
36*	Do you have the following food rules in your home...When to snack?	[1] Yes [2] No	[1] Yes [0] No
37*	Do you have the following food rules in your home...Which snacks to eat?	[1] Yes [2] No	[1] Yes [0] No
38*	Do you have the following food rules in your home...No second helpings at meals?	[1] Yes [2] No	[1] Yes [0] No
39*	Do you have the following food rules in your home...Limited portion sizes at meals?	[1] Yes [2] No	[1] Yes [0] No
40*	Do you have the following food rules in your home...No dessert except fruit?	[1] Yes [2] No	[1] Yes [0] No
41*	Do you have the following food rules in your home...No sweet snacks?	[1] Yes [2] No	[1] Yes [0] No
42*	Can the child get a soda without help or permission of an adult?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[1] Never [0.75] Rarely [0.5] Sometimes [0.25] Frequently [0] Always

Selected Items from Original CHES		Original Response Scale in CHES	Converted Scale Ranging from 0-1
Coercive Control			
43	How concerned are you...About your child eating too much when you are not around him/her?	[1] Unconcerned [2] A little concerned [3] Concerned [4] Fairly Concerned [5] Very Concerned	[0] Unconcerned [0.25] A little concerned [0.5] Concerned [0.75] Fairly Concerned [1] Very Concerned
44	How concerned are you...About your child having to diet to maintain a desirable weight?	[1] Unconcerned [2] A little concerned [3] Concerned [4] Fairly Concerned [5] Very Concerned	[0] Unconcerned [0.25] A little concerned [0.5] Concerned [0.75] Fairly Concerned [1] Very Concerned
45	How concerned are you...Are you about your child becoming overweight?	[1] Unconcerned [2] A little concerned [3] Concerned [4] Fairly Concerned [5] Very Concerned	[0] Unconcerned [0.25] A little concerned [0.5] Concerned [0.75] Fairly Concerned [1] Very Concerned
46	How much do you agree/disagree? I have to be sure that my child does not eat too many sweets	[1] Disagree [2] Slightly Disagree [3] Neutral [4] Slightly Agree [5] Agree	[0] Disagree [0.25] Slightly Disagree [0.5] Neutral [0.75] Slightly Agree [1] Agree
47	How much do you agree/disagree? I have to be sure that my child does not eat too much	[1] Disagree [2] Slightly Disagree [3] Neutral [4] Slightly Agree [5] Agree	[0] Disagree [0.25] Slightly Disagree [0.5] Neutral [0.75] Slightly Agree [1] Agree
48	How much do you agree/disagree? I have to be sure that my child does not eat too much of his/her favorite foods	[1] Disagree [2] Slightly Disagree [3] Neutral [4] Slightly Agree [5] Agree	[0] Disagree [0.25] Slightly Disagree [0.5] Neutral [0.75] Slightly Agree [1] Agree
49	How much do you agree/disagree? I intentionally keep some foods out of my child's reach	[1] Disagree [2] Slightly Disagree [3] Neutral [4] Slightly Agree [5] Agree	[0] Disagree [0.25] Slightly Disagree [0.5] Neutral [0.75] Slightly Agree [1] Agree
50	How much do you agree/disagree? If I did not guide or regulate my child's eating he/she would eat too many junk foods	[1] Disagree [2] Slightly Disagree [3] Neutral [4] Slightly Agree [5] Agree	[0] Disagree [0.25] Slightly Disagree [0.5] Neutral [0.75] Slightly Agree [1] Agree
51	How much do you agree/disagree? If I did not guide or regulate my child's eating he/she would eat too many of his/her favorite foods	[1] Disagree [2] Slightly Disagree [3] Neutral [4] Slightly Agree [5] Agree	[0] Disagree [0.25] Slightly Disagree [0.5] Neutral [0.75] Slightly Agree [1] Agree
52*	Do you restrict how much your child eats potato chips, cookies, and candy?	[1] Yes [2] No	[1] Yes [0] No
53	How often did you...Use food as a reward for your child?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always
54	How often did you…Use food as a punishment for your child?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always
55	Do you use food as a reward for good behavior?	[1] Yes [2] No	[1] Yes [0] No
56	My child should always eat all of the food on his/her plate	[1] Disagree [2] Slightly Disagree [3] Neutral [4] Slightly Agree [5] Agree	[0] Disagree 0.25] Slightly Disagree [0.5] Neutral [0.75] Slightly Agree [1] Agree

Selected Items from Original CHES		Original Response Scale in CHES	Converted Scale Ranging from 0-1
57	I have to be especially careful to make sure my child eats enough	[1] Disagree [2] Slightly Disagree [3] Neutral [4] Slightly Agree [5] Agree	[0] Disagree 0.25] Slightly Disagree [0.5] Neutral [0.75] Slightly Agree [1] Agree
58	If my child says "I am not hungry" I try to get him/her to eat anyway	[1] Disagree [2] Slightly Disagree [3] Neutral [4] Slightly Agree [5] Agree	[0] Disagree 0.25] Slightly Disagree [0.5] Neutral [0.75] Slightly Agree [1] Agree
59	If I did not guide or regulate my child's eating he/she would eat much less than he/she should	[1] Disagree [2] Slightly Disagree [3] Neutral [4] Slightly Agree [5] Agree	[0] Disagree 0.25] Slightly Disagree [0.5] Neutral [0.75] Slightly Agree [1] Agree
Autonomy Support			
60	How often do you take your child with you grocery shopping?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always
61	How often did you...Prepare meals with your child?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always
62	How often did you...Plan meals/menus with your child?	[1] Never [2] Rarely [3] Sometimes [4] Frequently [5] Always	[0] Never [0.25] Rarely [0.5] Sometimes [0.75] Frequently [1] Always
63	Do you buy food upon your child's request? Fruits and vegetables:	[1] Not at all [2] Rarely [3] Sometimes [4] Quite a bit [5] Very much	[0] Not at all [0.25] Rarely [0.5] Sometimes [0.75] Quite a bit [1] Very much
64*	Do you buy food upon your child's request? Snacks or sugary cereal:	[1] Not at all [2] Rarely [3] Sometimes [4] Quite a bit [5] Very much	[1] Not at all [0.75] Rarely [0.5] Sometimes [0.2] Quite a bit [0] Very much
65	When it is mealtime and your child is not hungry what would you usually do?	[1] Suggest child sit down at the table but not eat [2] Suggest child eat later [3] Suggest child sit down at table but eat less [4] Convince child to eat a full meal w/ family [5] It never happens, child is always hungry	[0] Suggest child sit down at the table but not eat [0.25] Suggest child eat later [0.5] Suggest child sit down at table but eat less [0.75] Convince child to eat a full meal w/ family [1] It never happens, child is always hungry

Note: * shows items that reversed the coding. For *Structure*, higher responding scores reflect greater use of positive structure practices; for *Coercive Control* which are negative behaviors, higher responding scores reflect greater use of those practices; for *Autonomy Support*, higher responding scores reflect greater child control for positive practices while lower scores reflect greater parent control.

Source: Robert CA. The home environment and childhood obesity. Unpublished manuscript. Virginia Tech; 2010.

Appendix 3.2 Items Removed from Exploratory Factor Analysis

Construct Names and Items

Structure

- How often did you have sweets and fats in your house?[a] (R)[b]
- Which of these statements best describes the food eaten in your household in the last 12 months?[c]
- How often during the last 12 months have you been hungry because your family couldn't afford more food?[d]
- Think about who prepares the food in your home, which of the following best indicates your role?[e] (R)[b]
- Do you have the following food rules in your home...avoid buying sweets and chips or salty snacks and bringing them into the house?[f] (R)[b]
- Do you have the following food rules in your home...limited portion sizes at meals?[f] (R)[b]
- Do you have the following food rules in your home...no second helpings at meals?[f] (R)[b]
- How often did you…avoid going to cafes or restaurants with your children which sell unhealthy foods?[g]
- How often did you…eat breakfast with your child?[g]
- How often did you…not buy foods that you would like because you do not want your children to have them?[g]
- How often did you…drink sugared drinks or non-diet soda around your children?[h] (R)[b]
- How often did you…offer healthy snacks when your child was hungry?[g]
- How often did you…allow your child eat snacks or sweets without permission?[h] (R)[b]
- How often did you…give your child something else if they did not like what was prepared?[h] (R)[b]
- How often did you…allow your child to take soft drinks whenever he/she wants?[h] (R)[b]
- How often did your child see you…eat while driving?[h] (R)[b]
- How often did your child see you…eat straight from the pot/pan/bowl?[h] (R)[b]
- How often did your child see you…eat while standing?[h] (R)[b]
- How often did your child see you…how often does your family eat fruits and vegetables that you have grown?[i]
- How often did your child see you…how often does your child eat breakfast?[j]
- How often did your child see you…can the child get a soda without help or permission of an adult?[h] (R)[b]

Coercive Control

- Do you use food as a reward for good behavior?[f] (R)[b]
- If I did not guide or regulate my child's eating he/she would eat too many of his/her favorite foods.[k]
- Do you restrict how much your child eats potato chips, cookies, and candy?[f] (R)[b]

Autonomy Support

- When it is mealtime and your child is not hungry what would you usually do?[l]

[a] Response options: never = 0, rarely = 0.75, sometimes = 0.5, frequently = 0.25, always = 0; [b] (R) = items that reversed the coding; [c] Response options: often we don't have enough to eat = 0, sometimes we don't have enough to eat = 0.33, enough to eat but not always what we want = 0.67, always have enough to eat and the kinds we want = 1; [d] Response options: almost every month = 0, some months, but not every month = 0.33, only 1-2 months = 0.67, I have not been hungry for this reason = 1; [e] Response options: food prep is primarily my responsibility = 1, I prep food sometimes but isn't primarily my role = 0.67, share food prep equally with another member = 0.33, I rarely prep food in our house = 0; [f] Response options: yes = 1, no = 0; [g] Response options: never = 0, rarely = 0.25, sometimes = 0.5, frequently = 0.75, always = 1; [h] Response options: never = 1, rarely = 0.75, sometimes = 0.5, frequently =0.25, always = 0; [i] Response options: not at all = 0, rarely = 0.25, some of the time = 0.5, most of the time = 0.75, all of the time = 1; [j] Response options: almost never = 0, sometimes = 0.33, often = 0.67, almost always = 1; [k] Response options: disagree = 0, slightly disagree = 0.25, neutral =0.5, slightly agree = 0.75, agree = 1; [l] Response options: suggest child sit down at the table but not eat = 0, suggest child eat later = 0.25, suggest child sit down at table but eat less = 0.5, convince child to eat a full meal with family = 0.75, it never happens, child is always hungry = 1.

Appendix 3.3 Reuse Permission for Content Map of Food Parenting Practices

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CHAPTER 4

PARENTING STYLES AND DIETARY INTAKES OF PRESCHOOLERS AND THEIR PARENTS

4.1 Introduction

The prevalence of childhood overweight and obesity continues as a significant health risk for children. Further, children's diet plays a key role that related to childhood obesity.[1] It is important to examine and understand the factors that influence young children's diet. It is thought that children's dietary intake is more malleable in early childhood than later in life.[2-4]

Parents play an important role in the socialization of eating behaviors in young children.[5] For preschoolers, parents are usually the primary determinants of the types and amount of food children eat.[6] Children's dietary intakes could be influenced by their parents in general parenting approach, often evaluated in terms of parenting styles.[7] Parenting style or general parenting refers to the parenting across situations and reflects the emotional climate in which children are raised.[8] The four commonly recognized parenting styles were conceptualized by Maccoby and Martin in 1983, which were traditionally categorized by a combination of the two underlying dimensions of parents' responsiveness and demandingness toward their children.[8-10] Responsiveness (or warmth, involvement, and nurturance) means parents' responds to their child's needs; and demandingness (or behavioral control, restrictiveness) means parents' control toward their children.[8-10] Cross-tabulating these two dimensions divides general parenting into four different parenting styles, characterizing 1) authoritative styles as parents who are

both demanding and responsive, 2) authoritarian styles as parents who are demanding but low responsive, 3) indulgent styles as parents who are responsive but low demanding, and 4) uninvolved styles as parents who are neither demanding nor responsive.[8-10]

Previous studies have shown that parenting styles have important influences on children's dietary behaviors and children's weight status.[11-15] Authoritative and authoritarian styles have been widely investigated in relation to childhood obesity.[11] These two parenting styles have been found to be associate with children's self-regulatory skills.[11] High levels of parental control were reported to limit children's ability to control themselves over various situations (e.g., eating), and has association with childhood obesity problems. Based on two previous systematic reviews it can be concluded that children raised in authoritative households ate more healthily and authoritative parenting was associated with a healthy BMI.[12,13] Sleddens et al. investigated the associations between parenting style and children's weight-related outcomes, and reported that children raised by authoritative parents have healthier weight-related outcomes than children raised by parents have other parenting styles.[12] Berge et al. also agreed and reported that authoritative parenting style is associated with better outcomes in terms of child obesity and dietary intakes.[16] Other studies report that authoritative style was positively associated with parental attempts to get the child to eat dairy, fruit, and vegetables.[17] Collins et al. reported in a recent review study that authoritarian parenting style has influences on pressuring a child to eat and using restrictive food parenting practices.[15] Indulgent parenting style has association with less parenting monitoring,[15] less optimal child eating behaviors and higher weight status.[5]

Even though the relationship between parenting styles and child eating has been explored, to our knowledge, limited research is focused on the preschool age children. Preschool age is a critical development period for adopting healthy behaviors because eating habits and preferences established during this time are likely to continue through childhood and into adulthood.[14] Thus there is a need to target this particular age group. To better understand the relationship between parental influences and child health outcomes, it is crucial to identify the potential impact of parenting styles on dietary intakes of pre-school children.

Most of current studies regarding parenting styles and diet assessed only the specific foods, such as fruit and vegetable.[14] Although investigation of specific foods would be expected related to overall dietary intakes, a more comprehensive assessment for dietary intakes including essential macronutrient and micronutrient intakes from foods as well as food group intakes is likely necessary to better understand the dietary consumption and health outcomes.

In addition, limited research explored the interactions between parenting styles and parental dietary behaviors. One previous study reported an interaction between parental dietary intake and the general parenting context in explaining children's fruit consumption.[18] Examining the interactions between parental dietary behaviors and parenting styles may reveal important insights into how parents influence the home food environment and, subsequently, shape children's dietary behaviors.[7]

Therefore, the purpose of this study was to identify the associations between parenting styles and dietary intakes (including nutrients and food group intakes) of preschool-aged children and their parents. Figure 4.1 illustrated the model assessed in this

study. Specifically, it was hypothesized that the authoritative parenting style would be related to healthier children's/parents' dietary intakes (e.g., protein, selected nutrients, fruits, and vegetables) or less unhealthy dietary intakes (e.g., sweets and fats) than the other three parenting styles. This study also had an exploratory aim to examine the interactions between preschoolers and parental dietary intakes in the context of parenting styles.

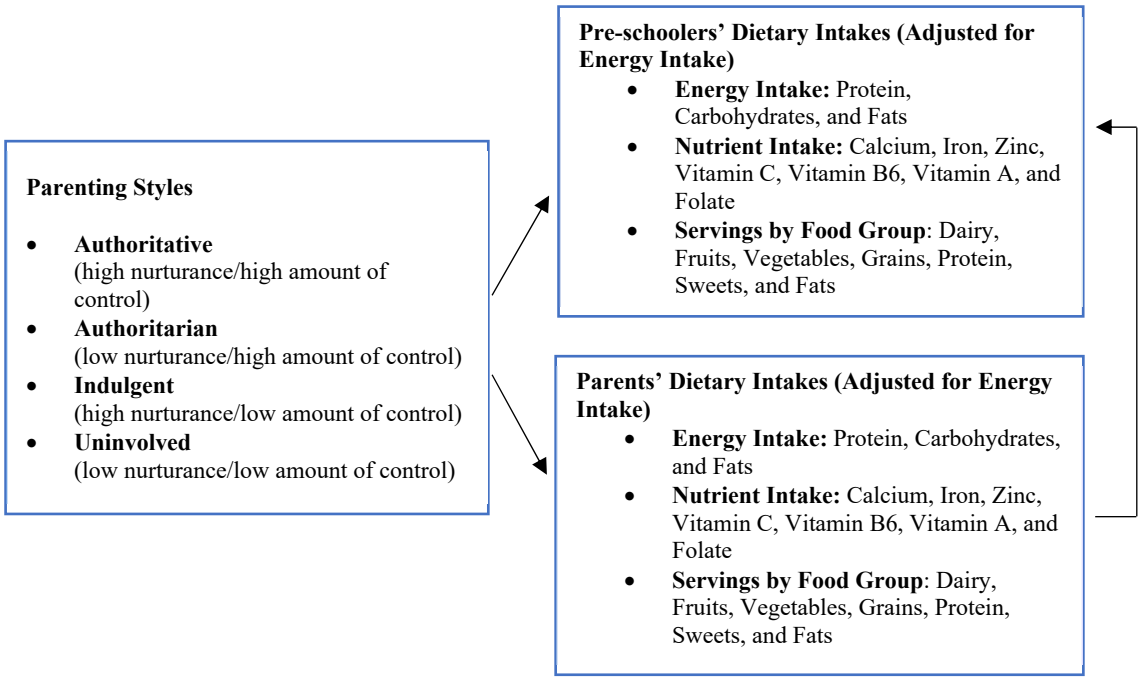

Figure 4.1 Current Study Model of Parenting Styles and Preschoolers'/Parents' Dietary Intakes

4.2 Methods

This study was a part of the *iGrow* Readers program conducted in 2016. IRB approval, subject assent, and parental consent were obtained in accordance with the policy statements of the Human Subjects Committee at South Dakota State University.

4.2.1 Participants

Children aged 3-5 years old and their parents were recruited from preschools/daycare centers in South Dakota, Minnesota, and Nebraska. To qualify for recruitment, preschools/daycare centers needed to meet the following selection criteria: 1) have at least two classrooms with 3-5 years old, and 2) each classroom needed to have separate teachers. In total, 14 preschools and daycare centers met the selection criteria and agreed to participate in the study. From the 14 participating preschools and daycare centers, 293 parent/child dyads were recruited via email and with flyers describing individual eligibility and benefits of participation.

4.2.2 Data Measurements

Demographic Information. Demographic information regarding age, race, household income, and education were self-reported by parents. Height and weight of children and parents were measured in duplicate by trained research assistants to the nearest 0.1cm and 0.1kg respectively. Parent BMI categories and Child BMI-for-age percentiles were calculated according to Centers for Disease Control and Prevention guidelines.[19,20] Four BMI categories for adult were determined including underweight (< 18.5), normal (≥ 18.5-25), overweight (≥ 25-30), and obese (≥ 30).[19] Child underweight

(< 5th), normal (≥ 5th-85th), overweight (≥ 85th-95th), and obesity (≥ 95th) were categorized using age- and sex-specific percentile for BMI.[20]

Measures of Dietary Intakes. Dietary information was collected for parents and their children using the Harvard Service Food Frequency Questionnaire (HSFFQ). The HSFFQ was adapted from the questionnaires developed by Willett et al., and was designed to assess diet intake over the past four weeks.[21] The HSFFQ has been validated for the assessment of nutrient intakes among adults[22,23] and among children 1 to 5 years of age.[24] The questionnaire lists different food items and asks the number of times the food was consumed during the past 4 weeks. This questionnaire consists of 87 food items for adults (86 food items for children) and 9 questions about food habits, supplements and services.[21,25]

The HSFFQ was completed by caregivers on behalf of their children. Each parent completed one food frequency questionnaire about themselves, and another one about their child. *The HSFFQ User's Manual*[26] was used for guiding the HSFFQ analysis. In general, portion size in gram weight assigned to each food item on the HSFFQ are derived from national data.[26,27] Nutrient data per 100 gm portion for the food items were derived from the HSFFQ and estimated using the Harvard nutrient database.[27] Daily nutrients intakes from the HSFFQ were computed by converting the food frequency to a daily number of servings to each food item, multiplying this by the nutrient content for the assigned weight, and summing the value for all foods.[26] Food groups (dairy, fruits, vegetables, grains, protein, sweets, and fats) were determined by the HSFFQ.[26] Complete instructions are shown in the supplemental materials (Appendix 4.1).

The HSFFQ provided dietary intakes results regarding: 1) daily nutrient intakes (vitamin A, vitamin C, calcium, zinc, folate, iron, protein, and vitamin B6); 2) daily calorie intakes and sources (carbohydrates, protein, fats); 3) daily mean servings by food groups (meat, bread/cereal, milk, vegetables, fruit, sweets and fats). The "selected nutrient intakes" (result 1 above) and "calorie intakes and sources" (result 2 above) were calculated from the frequency reported and the nutrients in the corresponding serving of food. "Mean servings by food group" (result 3) was a direct reporting of the number of servings that the participants reported. [26]

Measures of Parenting Style. Parenting style was assessed using the Parenting Dimensions Inventory-Short Version (PDI-S) completed by parents at baseline. The PDI is a self-administered parenting instrument that assesses parental support, parental control, and structure for general parenting.[28] Compared with original PDI survey, the short version retains the most reliable and valid components and can be used for preschoolers.[28] The PDI-S assess parenting dimensions including nurturance and amount of control.[28] In this study, two dimensions of the PDI-S including nurturance (6 items) and amount of control (5 items) were used to classify parents into Maccoby and Martin's four parenting styles.[10,28] The dimension scores were computed by averaging responses to the items making up the dimension.[28] After calculating the dimension scores of nurturance and amount of control, median splits were conducted on each dimension and defined the parenting styles as four major parenting styles: 1) authoritative (high on both nurturance and amount of control), 2) authoritarian (low on nurturance and high on amount of control), 3) indulgent (high on nurturance and low on amount of control), and

4) uninvolved (low on both nurturance and amount of control).[6,10] (Appendix 4.2 shows the dimensions and items of the PDI-S used in this study).

4.2.3 Statistical Analysis

All data were prepared in Microsoft Access database files and imported into Stata Statistical Software: Release 14 (StataCorp, 2015). If siblings were included in the study, one child was randomly chosen for the data analysis. All statistics analyses were conducted by Stata Statistical Software: Release 14 (StataCorp, 2015).

Parents were categorized into 4 parenting style groups by conducting a cross-classification of high and low median scores on the parent dimensions of nurturance and amount of control. Chi-square tests were used to examine differences in parents and children' demographic information by parenting style.

Nutrition measurements estimated daily dietary intakes for children/parents from the HSFFQ regarding: 1) average daily energy, macronutrient, and nutrient intake and 2) average daily number of servings by food group. Average daily energy, macronutrient and selected micronutrient intake was calculated from all food frequency questionnaires for each participant. The selected micronutrients examined were calcium, iron, zinc, vitamin C, vitamin B6, vitamin A, and folate. In order to examine the diet quality of the participants, nutrient density was reported. Nutrient density was determined using the average of daily intake of nutrients per 1000 kcal intake. Average daily number of servings from each food group were calculated from all food frequency questionnaire for each participant. Food groups determined by HSFFQ were dairy, fruits, vegetables, grains, protein, sweets, and fats. In order to examine the diet quality of the participants, the number of servings from each of the seven food groups were adjusted for energy

intake (servings of food groups per 1000 kcal of total energy consumed). For example, if a participant consumed 3 servings of fruits and 2000 kcal of total energy intake per day, then the adjusted servings of fruits was 3/2000 * 1000 = 1.5 servings/1000 kcal per day.

Kruskal-Wallis test were performed to examine whether dietary intakes of children and parents differed between the four parenting styles. *Post hoc* tests - Dunn's tests were used to detail specific differences between the four types of parenting style.[29,30]

In order to examine the overall association between children's/parents' food group intakes and parenting styles, multiple linear regression analyses were performed.[31] In each regression model, parenting styles and parents' daily food group intake (servings/1000 kcal) were the predictors for corresponding children's food group intake (servings/1000 kcal). For example, parenting styles and parents' daily fruits intake (servings/1000 kcal) were the predictors for children's daily fruits intake (servings/1000 kcal). Models were adjusted for child gender and child BMI percentile, so that the confounding effects could be reduced. A significance level of 0.05 was applied for all analysis.

4.3 Results

4.3.1 Participant Characteristics

Of the 293 recruited, 218 parent participants completed the food frequency questionnaire and PDI-S survey. The characteristics of the parents and children are shown in Table 4.1, which presents data from the overall sample as well as by each parenting style. Parents were predominately mothers (82.3%), 30 to 39 years (68.7%), and white (91.9%). Parents had BMIs considered normal/underweight (46.5%), overweight (27.7%), and obese (25.8%). The majority had a household income greater

than $60,000 (75.9%) and a bachelor's degree or higher (75.2%). Regarding the 218 child participants, 47.7% were boys and 52.3% were girls; 47.3% were 3 years, 41.3% were 4 years, and 11.5% were 5 years. The majority were white (88.0%) and had a normal/underweight BMI (81.0%).

Overall, 37.6% parents in this study were authoritative parenting style, 34.9% were authoritarian, 16.1% were indulgent, and 11.5% were uninvolved. The chi-square test suggests that there are significant differences for parent race ($p = 0.039$) among parenting styles.

Table 4.1 Frequency of Parents and Children Demographic Information According to Parenting Style (n=218)

Variable, N[a] (%)	Overall[b]	Authoritative[c]	Authoritarian[c]	Indulgent[c]	Uninvolved[c]	Chi-square test: (p Value)
Overall Sample	218 (100.0)	82 (37.6)	76 (34.9)	35 (16.1)	25 (11.5)	
Parent Gender Role						0.545
Mother	177 (82.3)	70 (39.6)	58 (32.8)	27 (15.3)	22 (12.4)	
Father	38 (17.7)	12 (31.6)	15 (39.5)	8 (21.1)	3 (7.9)	
Parent Age						0.428
< 30 years	35 (16.4)	16 (45.7)	13 (37.1)	4 (11.4)	2 (5.7)	
30 to 39 years	147 (68.7)	54 (36.7)	47 (32.0)	28 (19.1)	18 (12.2)	
≥ 40 years	32 (15.0)	10 (31.3)	15 (46.9)	3 (9.4)	4 (12.5)	
Parent BMI						0.855
Normal/underweight	101 (46.5)	38 (37.6)	35 (34.7)	18 (17.8)	10 (9.9)	
Overweight	60 (27.7)	25 (41.7)	21 (35.0)	9 (15.0)	5 (8.3)	
Obese	56 (25.8)	19 (33.9)	20 (35.7)	8 (14.3)	9 (16.1)	
Parent Race						**0.039***
White	193 (91.9)	77 (39.9)	66 (34.2)	30 (15.5)	20 (10.4)	
Black	3 (1.4)	1 (33.3)	1 (33.3)	1 (33.3)	0	
American Indian	1 (0.5)	0	0	0	1 (100.0)	
Asian	11 (5.2)	0	4 (36.4)	3 (27.3)	4 (36.4)	
Other	2 (1.0)	1 (50.0)	0	1 (50.0)	0	
Household Income						0.861
Less than $60,000	52 (24.1)	22 (42.3)	17 (32.7)	7 (13.5)	6 (11.5)	
$60,000 or greater	164 (75.9)	60 (36.6)	58 (35.4)	28 (17.1)	18 (11.0)	
Parent Education						0.270
High School or less	29 (13.4)	12 (41.4)	14 (48.3)	1 (3.5)	2 (6.9)	
Associate's degree	25 (11.5)	8 (32.0)	11 (44.0)	5 (20.0)	1 (4.0)	
Bachelor's degree	93 (42.9)	37 (39.8)	31 (33.3)	15 (16.1)	10 (10.8)	
Graduate degree	70 (32.3)	24 (34.3)	20 (28.6)	14 (20.0)	12 (17.1)	

Table 4.1 *continued*

Variable, N[a] (%)	Overall[b]	Authoritative[c]	Authoritarian[c]	Indulgent[c]	Uninvolved[c]	Chi-square test: (p Value)
Child Gender						0.358
Boy	104 (47.7)	36 (34.6)	35 (33.7)	17 (16.4)	16 (15.4)	
Girl	114 (52.3)	46 (40.4)	41 (36.0)	18 (15.8)	9 (7.9)	
Child Age						0.400
3 Years	103 (47.3)	44 (42.7)	38 (36.9)	13 (12.6)	8 (7.8)	
4 Years	90 (41.3)	30 (33.3)	28 (31.1)	18 (20.0)	14 (15.6)	
5 Years	25 (11.5)	8 (32.0)	10 (40.0)	4 (16.0)	3 (12.0)	
Child Race						0.220
White	183 (88.0)	72 (39.3)	67 (36.6)	25 (13.7)	19 (10.4)	
Black	3 (1.4)	1 (33.3)	1 (33.3)	1 (33.3)	0	
American Indian	1 (0.5)	0	1 (100.0)	0	0	
Asian	8 (3.9)	0	3 (37.5)	2 (25.0)	3 (37.5)	
Other	13 (6.3)	5 (38.5)	2 (15.4)	4 (30.8)	2 (15.4)	
Child BMI Percentile						0.320
Normal/underweight	175 (81.0)	69 (39.4)	60 (34.3)	25 (14.3)	21 (12.0)	
Overweight	23 (10.7)	7 (30.4)	8 (34.8)	4 (17.4)	4 (17.4)	
Obese	18 (8.3)	6 (33.3)	6 (33.3)	6 (33.3)	0	

* $p < 0.05$.
[a] Not all numbers may add up due to parents skipping.
[b] % = column percentage.
[c] % = row percentage.

4.3.2 Children/Parents Dietary Intakes by Parenting Styles

Differences in children/parents daily dietary intakes by four parenting styles were shown in Table 4.2 and Table 4.3. For children, significant parenting style differences were observed for consumption of vitamin C (mg/1000 kcal) and fruits (servings/1000 kcal). Children of authoritative parents had higher vitamin C intakes than children of authoritarian parents ($p < 0.05$). In addition, children of authoritative parents also had higher fruits intakes than children of authoritarian parents ($p < 0.05$) and indulgent parents ($p < 0.01$). For parents, significant parenting style differences were observed for consumption of calcium (mg/1000 kcal), dairy (servings/1000 kcal), and vegetables (servings/1000 kcal). Consumption of calcium and dairy had similar results, which was authoritarian parents had higher intakes than authoritative ($p < 0.05$) and uninvolved parents ($p < 0.01$), while indulgent parents had higher intakes than uninvolved parents ($p < 0.05$). Regarding to consumption of vegetables, uninvolved parents had higher intakes than authoritative ($p < 0.01$) and authoritarian parents ($p < 0.01$).

Table 4.2 Differences in Daily Dietary Intakes by Four Parenting Styles for Children

Children Daily Dietary Intakes	Authoritative (At)		Authoritarian (Ar)		Indulgent (In)		Uninvolved (Un)		Kruskal-Wallis test (p Value)	*post hoc* test: Dunn's test
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Calorie (kcal)	1672.16	601.84	1710.97	724.12	1893.95	928.80	1511.36	461.21	0.333	
Calorie Sources										
Protein, %kcal	15.76	2.00	15.72	1.76	16.43	2.11	16.18	2.14	0.219	
Carbohydrates, %kcal	51.19	5.68	49.67	5.41	49.05	6.19	48.99	4.84	0.110	
Fats, %kcal	34.19	3.93	35.67	4.26	35.41	4.48	35.67	3.31	0.085	
Macronutrients Intake/1000 kcal										
Protein (g)	39.41	5.01	39.29	4.41	41.07	5.27	40.45	5.34	0.219	
Carbohydrates (g)	127.98	14.19	124.17	13.52	122.62	15.48	122.48	12.10	0.110	
Fats (g)	37.99	4.36	39.63	4.73	39.34	4.98	39.64	3.67	0.085	
Selected Nutrients Intake/1000 kcal										
Calcium (mg)	634.67	159.19	664.65	153.01	709.60	186.16	640.15	180.37	0.089	
Iron (mg)	5.02	0.78	4.96	0.72	5.17	1.00	5.19	0.79	0.210	
Zinc (mg)	5.64	0.95	5.64	0.80	5.90	0.98	5.67	0.99	0.685	
Vitamin C (mg)	43.36	23.69	33.83	20.06	37.11	20.08	37.17	15.56	**0.032***	At > Ar**
Vitamin B6 (mg)	0.77	0.12	0.72	0.12	0.76	0.13	0.73	0.11	0.148	
Vitamin A (mcg)	338.27	86.06	347.90	102.00	388.54	107.51	389.09	152.30	0.072	
Folate (mcg)	208.34	38.91	204.31	37.84	213.47	39.96	216.76	39.35	0.421	
Food Group Intake (servings/1000 kcal)										
Dairy	2.32	0.82	2.49	0.79	2.64	0.92	2.35	0.95	0.173	
Fruits	2.07	0.90	1.73	0.75	1.61	0.78	1.77	0.83	**0.022***	At > Ar*, At > In**
Vegetables	1.49	0.77	1.43	1.02	1.64	0.93	1.71	0.77	0.063	
Grains	1.87	0.58	1.87	0.53	1.97	0.53	1.89	0.57	0.758	
Protein	1.22	0.46	1.18	0.37	1.25	0.47	1.39	0.54	0.257	
Sweets	0.97	0.46	1.03	0.48	0.90	0.43	0.93	0.47	0.628	
Fats	1.82	0.45	1.96	0.82	1.81	0.61	1.94	0.65	0.894	

*$p < 0.05$, **$p < 0.01$.

Table 4.3 Differences in Daily Dietary Intakes by Four Parenting Styles for Parents

Parents Daily Dietary Intakes	Authoritative (At)		Authoritarian (Ar)		Indulgent (In)		Uninvolved (Un)		Kruskal-Wallis test (p Value[a])	*post hoc* test: Dunn's test
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**		
Calorie (kcal)	1847.29	943.97	1931.11	819.17	2105.18	997.99	1722.34	622.83	0.242	
Calorie Sources										
Protein, %kcal	17.12	3.11	17.02	2.22	17.21	2.60	16.82	2.65	0.991	
Carbohydrates, %kcal	46.16	6.92	45.97	6.34	47.94	7.05	47.56	4.68	0.444	
Fats, %kcal	37.32	4.99	37.46	5.25	35.33	5.47	36.41	4.05	0.211	
Macronutrients Intake/1000 kcal										
Protein (g)	42.81	7.76	42.55	5.54	43.02	6.51	42.05	6.63	0.991	
Fats (g)	41.47	5.55	41.62	5.84	39.26	6.08	40.45	4.50	0.211	
Carbohydrates (g)	115.39	17.31	114.92	15.84	119.84	17.63	118.90	11.70	0.444	
Selected Nutrients Intake/1000 kcal										
Calcium (mg)	521.53	159.56	580.06	186.07	579.71	187.69	483.02	108.05	**0.032***	At < Ar*, Ar > Un** In > Un*
Iron (mg)	5.67	0.85	5.59	1.06	5.81	1.19	5.99	0.92	0.414	
Zinc (mg)	6.07	1.00	6.06	0.97	6.06	1.04	5.93	1.12	0.918	
Vitamin C (mg)	47.50	28.52	40.86	20.24	46.88	24.59	51.85	22.82	0.129	
Vitamin B6 (mg)	0.89	0.19	0.86	0.17	0.90	0.20	0.92	0.20	0.553	
Vitamin A (mcg)	441.20	205.85	464.14	229.66	551.71	297.54	549.71	379.11	0.225	
Folate (mcg)	227.55	42.09	223.96	54.57	231.87	58.44	244.69	48.76	0.240	
Food Group Intake (servings/1000 kcal)										
Dairy	1.09	0.53	1.31	0.64	1.25	0.62	0.94	0.39	**0.018***	At < Ar*, Ar > Un** In > Un*
Fruits	1.24	0.73	1.05	0.57	1.15	0.70	1.21	0.58	0.460	
Vegetables	1.85	1.04	1.89	1.23	2.08	1.20	2.37	0.94	**0.039***	At < Un**, Ar < Un**
Grains	1.28	0.51	1.39	0.53	1.48	0.61	1.35	0.35	0.213	
Protein	1.32	0.52	1.26	0.42	1.27	0.43	1.28	0.36	0.893	
Sweets	1.00	0.64	1.01	0.65	0.92	0.68	1.21	0.72	0.333	
Fats	1.95	0.63	1.89	0.73	1.69	0.60	1.95	0.71	0.195	

*p < 0.05, **p < 0.01.

4.3.3 Multiple Regression Models for Children's Daily Food Group Intake

Table 4.4 shows the multiple regression models for children's daily food group intake. Models were adjusted for child gender and child BMI percentile, parenting styles and parents' daily food group intake (servings/1000 kcal) were the predictors for corresponding children's food group intake (servings/1000 kcal). The results presented that all parents' daily food group (including fruits, vegetables, sweets, fats, dairy, grain, and protein) intakes were positively associated with corresponding children's food group intakes (all $p < 0.001$). Furthermore, children of authoritarian parents (coef. = -0.26, $p=0.040$) and indulgent parents (coef. = -0.40, $p = 0.012$) predicted less fruits consumption compared to children of authoritative parents. In addition, children of uninvolved parents (coef. = 0.19, $p = 0.036$) predicted more protein consumption compared to children with authoritative parents. No significant associations between parenting styles and other children's daily food group intakes were found.

Table 4.4 Multiple Regression Models for Children's Daily Food Group Intake

Variables	Children's Daily Food Group Intake (servings/1000 kcal)													
	Fruits[a]		**Vegetables[a]**		**Sweets[a]**		**Fats[a]**		**Dairy[a]**		**Grain[a]**		**Protein[a]**	
	coef.[c]	p Value	coef.	p Value	coef.	p Value	coef.	p Value	coef.	p Value	coef.	p Value	coef.	p Value
Parental Daily Food Group Intake (servings/ 1000 kcal)[b]	0.44	**< 0.001***	0.35	**< 0.001***	0.17	**< 0.001***	0.49	**< 0.001***	0.44	**< 0.001***	0.43	**< 0.001***	0.41	**< 0.001***
Parenting Style														
Authoritative	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Authoritarian	-0.26	**0.040***	-0.06	0.620	0.04	0.526	0.17	0.062	0.07	0.589	-0.04	0.579	-0.01	0.859
Indulgent	-0.40	**0.012***	0.13	0.436	-0.11	0.196	0.10	0.387	0.23	0.158	0.03	0.784	0.07	0.364
Uninvolved	-0.26	0.140	0.05	0.795	-0.06	0.536	0.12	0.346	0.10	0.602	-0.05	0.637	0.19	**0.036***
N	216		216		216		216		216		216		216	
R-squared	0.1807		0.2409		0.1561		0.2792		0.1175		0.2219		0.2416	
p Value	**< 0.001***		**< 0.001***		**< 0.001***		**< 0.001***		**< 0.001***		**< 0.001***		**< 0.001***	

* $p < 0.05$.

[a] Results from separate regression models for each independent variable, adjusted for child gender and child BMI percentile.

[b] In each regression model, parental daily food group intake (servings/ 1000 kcal) was the predictor for the corresponding children food group intake (servings/1000 kcal). For example, parental daily fruits intake (servings/1000 kcal) was the predictor for children daily fruits intake (servings/1000 kcal).

[c] coef. = estimated coefficients.

4.4 Discussion

This study examined the relationship between general parenting styles and dietary intakes of preschool-aged children and their parents. Overall, the main findings of this study indicate no significant differences were seen for most assessed children's and parental dietary nutrients and food group intakes between authoritative parenting style and other three parenting styles. Children's food group intakes were positively associated with corresponding parental food group intakes, moreover, authoritative parents predicted more child fruits consumption.

For preschooler dietary intakes, no significant differences were seen for most assessed children's dietary nutrients and food group intakes between authoritative parenting style and other three parenting styles, except children of authoritative parents had higher intakes of vitamin C and fruits intakes than children of authoritarian and indulgent parents. The results found here for the authoritative parenting style compared to authoritarian parenting style is consistent with our hypothesis and previous research, which found fruit consumption to be higher among children with authoritative parents.[14,32] The results for the authoritative parenting style compared to indulgent parenting style is consistent with previous studies on feeding style and dietary quality, which found higher consumption of low-nutrient-dense foods and poor fruit and vegetables consumption were reported among children of indulgent parents.[33,34] A system review reported that an authoritative parenting style is not only important for a healthier dietary intakes, but also important for a better child outcomes (e.g., school achievement and social adjustment).[1] Therefore, future interventions could target toward modifying or achieving authoritative parenting style, as parenting styles have been shown to be

malleable.[35] This may not only improve the dietary intakes of preschool children, but also benefit overall child outcomes.[1]

For parental dietary intakes, no significant differences were seen for most assessed parental dietary nutrients and food group intakes between authoritative parenting style and other three parenting styles. The exception is authoritarian parents were seen had higher intakes of calcium and dairy than authoritative and uninvolved parents, while indulgent parents had higher intakes than uninvolved parents. Another unexpected result was found that regarding to consumption of vegetables, uninvolved parents had higher intakes than authoritative and authoritarian parents. These findings were not consistent with hypothesis, it might because that there are other factors need to be considered. With very limited previous research on the relationship between parenting styles and parental dietary intakes, it is still questionable if parenting styles have as much relevance to parental dietary intakes. Further research would be needed to explore the interactive effects between parents own dietary intakes and their parenting styles.

In addition, this study had an exploratory aim to examine the interactions between preschoolers and parental dietary intakes in the context of parenting styles. Previous studies have reported that parent-child correspondence in the intakes of healthy and unhealthy foods and drinks.[18,36-38] However, these association between parental and child dietary intakes were studied in an isolated perspective by examining the direct relationship.[18] Our study had an insight into the potential interactions between parental and child dietary intakes with a higher-level context (i.e., parenting style). We found parents' daily food group (including fruits, vegetables, sweets, fats, dairy, grain, and protein) intakes were positively associated with corresponding children's food group

intakes, moreover, authoritative parents predicted more child fruits consumption. This might indicate greater similarity in parent-children dietary composition and greater similarity when more meals are eaten together by parents and children. Although this correlational work has demonstrated that parents' dietary intake might influence children's dietary intake, these studies cannot be used to infer causality.[7] But improving parental dietary intakes may be a useful approach for promoting child dietary intakes.[18] Interventions focused on improving parental dietary intakes may become more effective if parents regard themselves as a role model, and realize the importance of a positive parental role model for their child's healthy diet.[18] Additionally, our study provides the evidence that parental factors (i.e., parenting style) can function as a contextual factor and influence the relationship between parental and child dietary intakes, which need attention in future studies.[12] Furthermore, the processes how parents impact their children's dietary intakes by their own intakes and influences still needs more investigation work.

In our data, general parenting style did not contribute to most assessed children's dietary nutrients and food group intakes, except fruit consumption. This result is consistent with a previous study that the role of general parenting style in the prediction of children's dietary intake was minimal.[39] This might be because of general parenting style as operationalized in the study is too broadly defined and therefore insensitive to differences in dietary habits.[39] And our study only targeted parenting styles and any consequent impact on nutrition related outcomes. There is potential for future studies to examine combination of other parental dietary behaviors with a parenting style.[15] Larsen et al. suggested that the general parenting context, particularly the consistency with which

practices are being performed, may moderate the effect of good parenting practices on child outcomes.[7] Which means general parenting style is regarded as "emotional climate" context that moderates the relationships between specific parenting behaviors (e.g., food parenting practices) and child outcomes.[7] Therefore, it is important for the future work to integrate both general parenting and food parenting practices to improve the understanding the complex process of parent-child interactions and dietary behaviors.

4.4.1 Limitation and Strength

Limitations to this study are important to acknowledge. Parent-reported data were used to assess general parenting style and dietary intakes, and this could have resulted in a reporting bias. Food frequency survey was used to assess the intakes of nutrients. Overreporting or underreporting may exist and can affect the usefulness of the collected dietary data.[40] In addition, the sample population in this study were limited to preschool children (one child from one parent) and the majority of parents were mothers, had higher household income and education level compared to the state population.[41] This may limit the generalizability to different age groups of children or a larger level population.

One of the study strengths is the age group assessed since preschool age is an important developmental period for adopting healthy eating habits. In addition, this study provides a comprehensive dietary intakes result including energy intakes, nutrient intakes, and food groups intakes through a validated dietary measurement tool. Furthermore, this study linked both parental and children's data, which is added to the study's strength.

4.4.2 Implications for Research and Practice

The result from this study reported that authoritative parents predicted more preschool children's fruits consumption. This result provide evidence for the benefits of authoritative parenting style and suggested that future interventions to increase preschool children's fruit consumption could target toward increasing caregivers' authoritative behaviors.

Additionally, the results of this study showed the role of general parenting style in the prediction of more components of preschool children's and parental dietary intakes (e.g., macronutrient and micronutrient intakes, and food group intakes expect fruit) was weak, however, children's food group intakes was associated with corresponding parental food group intakes. These findings suggested that integrating both general parenting and other parental dietary behaviors (e.g., food parenting practices and parental diet) is important for future research to improve the understanding the complex process of parent-child interactions and dietary behaviors. If separate research areas of parenting style and parental dietary behaviors can be combined and relationships evaluated, the implications for practice could be large. Similarly, future intervention programs should link both parental dietary behaviors and general parenting to increase the effectiveness of the interventions. An extension of this research would be to investigate whether parenting style or parental dietary behaviors can be used through specific interventions to improve preschool children's dietary behaviors and diet quality.

REFERENCES

1. Burnett AJ, Lamb KE, McCann J, Worsley A, Lacy KE. Parenting styles and the dietary intake of pre-school children: a systematic review. *Psychol Health.* 2020:1-20. doi:10.1080/08870446.2020.1743842.
2. Adair LS, Popkin BM. Are child eating patterns being transformed globally? *Obes Res.* 2005;13(7):1281-1299.
3. Birch LL, Ventura AK. Preventing childhood obesity: what works? *Int J Obes (Lond).* 2009;33 Suppl 1:S74-S81.
4. Carnell S, Cooke L, Cheng R, Robbins A, Wardle J. Parental feeding behaviours and motivations. A qualitative study in mothers of UK pre-schoolers. *Appetite.* 2011;57(3):665-673.
5. Papaioannou MA, Cross MB, Power TG, et al. Feeding style differences in food parenting practices associated with fruit and vegetable intake in children from low-income families. *J Nutr Educ Behav.* 2013;45(6):643-651.
6. Wang L, Van De Gaar VM, Jansen W, Mieloo CL, Van Grieken A, Raat H. Feeding styles, parenting styles and snacking behaviour in children attending primary schools in multiethnic neighbourhoods: a cross-sectional study. *BMJ Open.* 2017;7(7):e015495. doi:10.1136/bmjopen-2016-015495.
7. Larsen JK, Hermans RC, Sleddens EF, Engels RC, Fisher JO, Kremers SP. How parental dietary behavior and food parenting practices affect children's dietary behavior. Interacting sources of influence? *Appetite.* 2015;89:246-257.

8. Gerards SM, Kremers SP. The role of food parenting skills and the home food environment in children's weight gain and obesity. *Curr Obes Rep.* 2015;4(1):30-36.

9. Van Der Horst K, Sleddens EFC. Parenting styles, feeding styles and food-related parenting practices in relation to toddlers' eating styles: a cluster-analytic approach. *PLoS One.* 2017;12(5):e0178149. doi:10.1371/journal.pone.0178149.

10. Maccoby E, Martin J. Socialization in the context of the family: parent-child interaction. In: *Handbook of Child Psychology: Socialization, Personality, and Social Development.* 4th ed. Chichester, New York: Wiley; 1983:1-101.

11. Melis Yavuz H, Selcuk B. Predictors of obesity and overweight in preschoolers: the role of parenting styles and feeding practices. *Appetite.* 2018;120:491-499.

12. Sleddens EFC, Gerards SMPL, Thijs C, De Vries NK, Kremers SPJ. General parenting, childhood overweight and obesity-inducing behaviors: a review. *Int J Pediatr Obes.* 2011;6(2-2):E12-E27.

13. Shloim N, Edelson LR, Martin N, Hetherington MM. Parenting styles, feeding styles, feeding practices, and weight status in 4-12 year-old children: a systematic review of the literature. *Front Psychol.* 2015;6:1849. doi:10.3389/fpsyg.2015.01849.

14. Arlinghaus KR, Vollrath K, Hernandez DC, et al. Authoritative parent feeding style is associated with better child dietary quality at dinner among low-income minority families. *Am J Clin Nutr.* 2018;108(4):730-736.

15. Collins C, Duncanson K, Burrows T. A systematic review investigating associations between parenting style and child feeding behaviours. *J Hum Nutr Diet.* 2014;27(6):557-568.

16. Berge JM. A review of familial correlates of child and adolescent obesity: what has the 21st century taught us so far? *Int J Adolesc Med Health.* 2009;21(4):457-483.

17. Patrick H, Nicklas TA, Hughes SO, Morales M. The benefits of authoritative feeding style: caregiver feeding styles and children's food consumption patterns. *Appetite.* 2005;44(2):243-249.

18. Rodenburg G, Oenema A, Kremers SP, Van de Mheen D. Parental and child fruit consumption in the context of general parenting, parental education and ethnic background. *Appetite.* 2012;58(1):364-372.

19. National Institutes of Health. The practical guide: the identification, evaluation and treatment of overweight and obesity in adults. Available at: https://www.nhlbi.nih.gov/files/docs/guidelines/prctgd_c.pdf. Accessed January 10, 2018.

20. Barlow SE. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics.* 2007;120(Supplement 4):S164-S192.

21. Watts V, Rockett H, Baer H, Leppert J, Colditz G. Assessing diet quality in a population of low-income pregnant women: a comparison between Native Americans and whites. *Matern Child Health J.* 2007;11(2):127-136.

22. Baer HJ, Blum RE, Rockett HR, et al. Use of a food frequency questionnaire in American Indian and Caucasian pregnant women: a validation study. *BMC Public Health.* 2005;5. doi:10.1186/1471-2458-5-135.

23. Wei EK, Gardner J, Field AE, Rosner BA, Colditz GA, Suitor CW. Validity of a food frequency questionnaire in assessing nutrient intakes of low-income pregnant women. *Matern Child Health J.* 1999;3(4):241-246.

24. Blum RE, Wei EK, Rockett HR, et al. Validation of a food frequency questionnaire in Native American and Caucasian children 1 to 5 years of age. *Matern Child Health J.* 1999;3(3):167-172.

25. Harvard T.H. Chan School of Public Health Nutrition Department's file download site. Available at: https://regepi.bwh.harvard.edu/health/nutrition.html. Accessed December 11, 2016.

26. Colditz G. Dietary intake and health outcomes: final report. U.S. Department of Agriculture, Economic Research Service. Available at: https://naldc.nal.usda.gov/download/32818/PDF. Accessed December 11, 2016.

27. Suitor CJ, Gardner J, Willett WC. A comparison of food frequency and diet recall methods in studies of nutrient intake of low-income pregnant women. *J Am Diet Assoc.* 1989;89(12):1786-1794.

28. Power TG. Parenting dimensions inventory-short version (PDI-S): a research manual. Unpublished manuscript. Washington State University; 2002.

29. Vollmer RL, Adamsons K, Foster JS, Mobley AR. Association of fathers' feeding practices and feeding style on preschool age children's diet quality, eating behavior and body mass index. *Appetite.* 2015;89:274-281.

30. Pearson N, Atkin AJ, Biddle SJ, Gorely T, Edwardson C. Parenting styles, family structure and adolescent dietary behaviour. *Public Health Nutr.* 2010;13(8):1245-1253.

31. Mondal PR, Biswas S, Bose K. Gender discrimination in undernutrition with mediating factors among Bengalee school children from Eastern India. *Homo.* 2012;63(2):126-135.

32. Blissett J. Relationships between parenting style, feeding style and feeding practices and fruit and vegetable consumption in early childhood. *Appetite.* 2011;57(3):826-831.

33. Hennessy E, Hughes SO, Goldberg JP, Hyatt RR, Economos CD. Permissive parental feeding behavior is associated with an increase in intake of low-nutrient-dense foods among American children living in rural communities. *J Acad Nutr Diet.* 2012;112(1):142-148.

34. Hoerr SL, Hughes SO, Fisher JO, Nicklas TA, Liu Y, Shewchuk RM. Associations among parental feeding styles and children's food intake in families with limited incomes. *Int J Behav Nutr Phys Act.* 2009;6(1):55.

35. Zhang W, Wei X, Ji L, Chen L, Deater-Deckard K. Reconsidering parenting in Chinese culture: subtypes, stability, and change of maternal parenting style during early adolescence. *J Youth Adolesc.* 2017;46(5):1117-1136.

36. Wroten KC, O'Neil CE, Stuff JE, Liu Y, Nicklas TA. Resemblance of dietary intakes of snacks, sweets, fruit, and vegetables among mother-child dyads from low income families. *Appetite.* 2012;59(2):316-323.

37. Zuercher JL, Wagstaff DA, Kranz S. Associations of food group and nutrient intake, diet quality, and meal sizes between adults and children in the same household: a cross-sectional analysis of U.S. households. *Nutr J.* 2011;10:131.

38. Sonneville KR, Rifas-Shiman SL, Kleinman KP, Gortmaker SL, Gillman MW, Taveras EM. Associations of obesogenic behaviors in mothers and obese children participating in a randomized trial. *Obesity (Silver Spring).* 2012;20(7):1449-1454.

39. Vereecken C, Legiest E, De Bourdeaudhuij I, Maes L. Associations between general parenting styles and specific food-related parenting practices and children's food consumption. *Am J Health Promot.* 2009;23(4):233-240.

40. Fleary SA, Ettienne R. The relationship between food parenting practices, parental diet and their adolescents' diet. *Appetite.* 2019;135:79-85.

41. U.S. Census Bureau data. QuickFacts: South Dakota; Minnesota; Nebraska. U.S. Census Bureau website. Available at: https://www.census.gov/quickfacts/fact/table/SD,MN,NE/AGE135218. Accessed June 4, 2020.

42. What's in the foods you eat search tool. U.S. Department of Agriculture website. Available at: https://reedir.arsnet.usda.gov/codesearchwebapp/(S(z2vxwy1lgtfuvqjyz43troym))/CodeSearch.aspx. Accessed December 11, 2016.

Appendix 4.1 Step to Step Instructions for HSFFQ Analysis

1) Convert food frequencies to daily servings by using "88GP frequency factors" download from HSFFQ website **(Appendix 4.1-A).**[25] For example, if a child participant stated eating an apple a day, the mean servings per day would be 1.0. Food groups (meat, bread/cereal, milk, vegetables, fruit, sweets and fats) were determined by the HSFFQ **(Appendix 4.1-B)** (*The HSFFQ User's Manual* Page F-8).[26] The servings of food items from the same group were added to the sum of "Mean Servings per Day Reported by Food Group".

2) Convert food frequencies to food amount (g/day) for each food item. *The HSFFQ User's Manual Page E-48* provided portion size in gram weight assigned to each food item on the HSFFQ **(Appendix 4.1-C).**[26] Portion size assigned weights of women were used for adult participants, and portion size assigned weights of 3-5 years children were used for child participants. Then food weight in gram for each food item was calculated by multiplying "daily number of servings to each food item" by "portion size in gram weight assigned to foods". For example, if a child participant stated eating an apple a day, the mean servings per day would be 1.0, the portion size in gram weight assigned to apple from **Appendix 4.1-C** was 124 g/serving, then the mean food weight per day to apple would be 1.0 * 124 = 124g.

For the food items on the HSFFQ whose the portion sizes were not given in the **Appendix 4.1-C**, using "What's In the Foods You Eat" search tool[42] to find measure weights for one serving size directly. These food items include "Fruit cocktail", "Zucchini", "Popcorn or pretzels", "Beer, wine, wine cooler, mixed drink or liquor", "Tacos, burritos", "Fried Chicken, chicken nuggets", "Other chicken or turkey", "Butter

(not margarine)" and "Margarine". The final portion size in gram weight assigned to each food item on the HSFFQ used in this study were presented in **Appendix 4.1-D**. In this way we were able to calculate amounts of food consumption per day for participants of this study.

3) Nutrient data per 100 gm portion for the food items were derived from the HSFFQ and estimated using the Harvard nutrient database.[25] **Appendix 4.1-E** presents the nutrient data for food items on the HSFFQ used in this study. Daily nutrients intakes from the HSFFQ were computed by converting the food frequency to a daily number of servings to each food item, multiplying this by the nutrient content for the assigned weight, and summing the value for all foods. The current version of the HSFFQ estimates seven micronutrients: calcium, iron, zinc, vitamin C, vitamin B6, vitamin A, and folate. Total calories, protein, carbohydrates, and fats intakes were calculated in the same way. Since carbohydrates and protein each provide 4 calories per gram, and fat contains 9 calories in each gram, then daily calorie sources (protein, carbohydrates, and fats) were reported.

The HSFFQ provided dietary intakes results regarding: 1) daily nutrient intakes (vitamin A, vitamin C, calcium, zinc, folate, iron, protein, and vitamin B6); 2) daily calorie intakes and sources (carbohydrates, protein, fats); 3) daily mean servings by food groups (meat, bread/cereal, milk, vegetables, fruit, sweets and fats).

Result 3 "mean servings by food group" was a direct reporting of the number of servings that the participants reported. The Result 1 "selected nutrient intakes" and Result 2 "calorie intakes and sources" were calculated from the frequency reported and the nutrients in the corresponding serving of food.[26]

Appendix 4.1-A How to Calculate the Number of Servings of Food Group per Day?

How do I calculate the number of servings of fruits or vegetables per day?

If you would like to calculate the number of servings of any food grouping, you must sum the daily frequencies reported for the foods you select to represent your group. The frequency weights for the 88GP, 80outGP and the 97GP are listed below.

Example: 88GP servings of fruit per day
Participant reports:
Raisins 1-3 per month
Apple 1 per day
Orange 2-4 per week
Other fruit juices 2-3 times per day

Frequency factors:
Raisins – 0.08
Apple – 1.0
Oranges – 0.43
Other fruit juices – 2.5

Sum frequency factors: 0.08 + 1.0 + 0.08 + 2.5 = 3.66 servings per day of fruits

**********88GP frequency factors: **********

ffwgt1	0; never (default value for no answer)
ffwgt2	0.08; 1-3/month
ffwgt3	0.14; 1/week
ffwgt4	0.43; 2-4/week
ffwgt5	0.8; 5-6/week
ffwgt6	1.0; 1/day
ffwgt7	2.5; 2-3/day
ffwgt8	4.5; 4-5/day
ffwgt9	6.0; 6/day

Source: Harvard T.H. Chan School of Public Health Nutrition Department's file download site. Available at: https://regepi.bwh.harvard.edu/health/nutrition.html. Accessed December 11, 2016.

Appendix 4.1-B Food Groups Determined by HSFFQ

meat=hamburg, hotdog, bologna, tuna, baked beans, other bean, liver, fr chicken, other chicken, pork, beef, fr fish, other fish and egg.

brdcer=crackers, rice, spaghetti, pizza, macaroni and cheese, bread, hot cereal, cold cereal, pancakes, english muffin, biscuits and cornbread.

milks=milk, cheese, pizza, pudding, yogurt, and macaroni and cheese.

veg=corn, peas, tomato, peppers, carrots, broccoli, green beans, spinach, greens, mixed vegetables, squash, zucchini, french fries, potatoes, sweet potatoes, coleslaw, okra, brussel, sprouts, lettuce, salad, and vegetable soup.

fruit=wic juice, oj, juice, orange, banana, apple, grapes, peaches, strawberr, melon, watermelon, pineapple, raisins,&apricots

vitc=oj, orange, strawberries, melon, and broccoli.

vita=melon, carrots, spinach, greens, squash, sweet potatoes, liver, and pumpkin pie.

sweet=hot choc, pudding, ice cream, fruit drinks, cookies, cake, pies, jello, chocolate, candy, sweet roll, pancake, donut, and soda.

fats=ice cream, cheese, mayo, chips, cookies, cake, pies, chocolate, coldcut, nuts, pb, bu, marg, fr chicken, fr fish, sausage, bacon ,donut, hotdogs and sweet roll.

Source: *The HSFFQ User's Manual* Page F-8: Colditz G. Dietary intake and health outcomes: final report. U.S. Department of Agriculture, Economic Research Service. Available at: https://naldc.nal.usda.gov/download/32818/PDF. Accessed December 11, 2016.

Appendix 4.1-C Portion Size in Gram Weight Assigned to Foods on the HSFFQ

TABLE 2
FOOD PORTION SIZE IN GRAM WEIGHT ASSIGNED TO FOODS ON THE HSFFQ

Food Name	Portion Size		
	Women	Children 1-2 years	Children 3-5 years
Milk	270	183	183
Hot Chocolate	28	28	28
Cheese, plain, in sandwiches	28	21	21
Yogurt	198	117	117
Ice Cream	90	67	67
Pudding	119	80	120
Orange	122	131	131
Orange juice	217	124	155
Apple juice	255	186	186
Kool Aid, other fruit drinks	270	124	155
Banana	102	91	102
Apple or applesauce	138	105	124
Grapes	75	75	75
Peaches	166	123	149
Strawberries	47	47	47
Cantaloupe	127	68	68
Watermelon	440	120	120
Pineapple	80	47	47
Raisins	28	14	28
Corn	83	42	64
Peas	52	42	42
Tomatoes	62	31	31
Peppers	18	9	9
Carrots	70	29	29
Broccoli	70	46	46
Green beans	40	35	35
Spinach	70	27	27
Greens	72	27	27
Squash, orange or winter	156	49	60
French fries, fried potatoes	115	42	51
Potatoes	99	72	80
Sweet potatoes or yams	70	49	60
Cabbage or coleslaw	67	33	41
Lettuce salad	55	37	37
Salad dressing or mayonnaise	15	5	12
Chips (potato, corn, others)	42	13	20
Nuts	15	15	15
Cookies or brownies	25	22	22
Cake or cupcake	66	30	30
Pie (pumpkin,etc.)	140	37	37
Other pie	112	66	66
Jello	90	90	90
Chocolate candy	32	18	27
Other candy	15	18	18
Tea	180	120	120
Soft drinks	246	124	186
Sugar-free soft drinks	246	124	186
Baked beans or chili beans	128	83	128
Other dried beans, peas	85	58	58
Rice	113	87	87
Spaghetti or other pasta	310	192	227
Pizza	140	72	77
Macaroni and cheese	168	121	168

TABLE 2
FOOD PORTION SIZE IN GRAM WEIGHT ASSIGNED TO FOODS ON THE HSFFQ

Food Name	Portion Size		
	Women	Children 1-2 years	Children 3-5 years
Hot dogs	44	44	44
Hamburgers	121	72	105
Canned tuna	60	49	49
Cold cuts	28	28	28
Peanut butter	16	16	16
Bread, toast, or rolls	25	25	25
Pork chops	84	39	56
Steak or roast beef	108	56	56
Fish	85	48	56
Liver	84	42	42
Sausage	54	28	28
Bacon	16	16	16
Hot cereal or grits	180	154	234
Cold breakfast cereal	28	21	30
Doughnut	43	38	43
Sweet roll or muffin	57	44	58
Pancake	33	33	33
English muffin or bagel	50	25	25
Biscuit	28	25	32
Cornbread or tortillas	56	51	56
Vegetable soup	270	122	244
Other soup	217	122	241
Crackers	15	12	12
Eggs	46	59	66
Mixed vegetables	116	89	69

Source: *The HSFFQ User's Manual* Page E-48: Colditz G. Dietary intake and health outcomes: final report. U.S. Department of Agriculture, Economic Research Service. Available at: https://naldc.nal.usda.gov/download/32818/PDF. Accessed December 11, 2016.

Appendix 4.1-D Portion Size in Gram Weight Assigned to Foods on the HSFFQ Used in This Study

Food item on the HSFFQ	Portion size in gram weight assigned to food item	
	Children 3-5 years	Adult
Milk	183	270
Hot Chocolate	28	28
Cheese, plain or in sandwiches	21	28
Yogurt	117	198
Ice cream (cones, sandwiches, sundaes)	67	90
Pudding	120	119
Orange juice or grapefruit juice	155	217
Other juice	186	255
Fruit drinks (Hi-C, Kool-aid, lemonade, sportsdrink)	155	270
Banana	102	102
Peaches	149	166
*Fruit cocktail, mixed fruit	117	149
Orange or Grapefruit	131	122
Apple or pear	124	138
Applesauce	124	138
Grapes	75	75
Strawberries	47	47
Melon (Cantaloupe)	68	127
Pineapple	47	80
Raisins or prunes	28	28
Corn	64	83
Peas	42	52
Tomatoes, tomato sauce, salsa	31	62
Peppers (green, red, hot)	9	18
Carrots	29	70
Broccoli	46	70
Green beans	35	40
Spinach	27	70
Greens(mustard,turnip,kale)	27	72
Mixed vegetables	69	116
Squash, orange or winter	60	156
*Zucchini, yellow squash	60	156
French Fries, fried potatoes	51	115
Potato (baked, boiled, or mashed)	80	99
Sweet potatoes or yams	60	70
Cabbage, coleslaw or cauliflower	41	67
Lettuce salad	37	55
Salad dressing	12	15
Mayonnaise	12	15
Chips (potato, corn, others)	20	42
*Popcorn or pretzels	20	42
Crackers	12	15
Nuts	15	15
Cookies or brownies	22	25

Food item on the HSFFQ	Portion size in gram weight assigned to food item	
	Children 3-5 years	Adult
Cake or cupcake	30	66
Pie	37	140
Jello	90	90
Chocolate or candy bar	27	32
Other candy (not chocolate)	18	15
Coffee or tea	120	180
Soda, soft drink, pop (not sugar free)	186	246
Soda, soft drink, pop (sugar free)	186	246
Beer,wine,wine cooler, mixed drink or liquor	.	116
Beans(baked, chili, or other)	128	128
Rice	87	113
Spaghetti or other pasta	227	310
Pizza	77	140
*Tacos, burritos	77	140
Macaroni and cheese	168	168
Hot dog	44	44
Sausage	28	54
Hamburger (prepared any way)	105	121
Canned Tuna	49	60
Fried fish, fish sticks	56	85
Other fish	56	85
Cold Cuts (baloney, ham, salami)	28	28
*Fried Chicken, chicken nuggets	56	85
*Other chicken or turkey	56	108
Pork or ham	56	84
Roast beef or steak	56	108
Liver, organ meats	42	84
Peanut butter	16	16
Bread (slice) toast, roll, or pita	25	25
*Butter (not margarine)	7	7
*Margarine	7	7
Vegetable Soup	244	270
Other soup	241	217
Cornbread or tortillas	56	56
Eggs	66	46
Bacon	16	16
Hot cereal or grits	234	180
Cold breakfast Cereal	30	28
Donut, fry bread	43	43
Sweet roll or muffin	58	57
Pancake, waffle, or French toast	33	33
English muffin or bagel	25	50
Biscuit	32	28

Note: Food items with * means whose the portion sizes were not given in the original *HSFFQ User's Manual*, then using "What's In the Foods You Eat" search tool to find measure weights for one serving size directly.

Appendix 4.1-E Nutrient Data for Food Items on the HSFFQ Used in This Study

Food item	Amount (g)	Total Calories (kcal)	Protein (gm)	Total Fat (gm)	Carbs (gm)	Calcium (mg)	Iron (mg)	Zinc (mg)	Vitamin C (mg)	Vitamin B6 (mg)	Vitamin A (mcg)	Folate (mcg)
Milk	100	61	3.2	3.2	4.8	113	0.03	0.37	0	0.04	46	5
Hot Chocolate	100	398	6.7	9.7	83.7	66.5	1.19	1.46	0.2	0.11	1	6
Cheese, plain or in sandwiches	100	368.5	18.1	31.2	4.2	1045	0.63	2.49	0	0.05	283.6	8
Yogurt	100	102	4.4	1.1	19	210	0.07	0.74	0.7	0.04	61.8	9
Ice cream (cones, sandwiches, sundaes)	100	207	3.5	11	23.6	128	0.09	0.69	0.6	0.05	117.6	5
Pudding	100	122.4	2	3.6	21.4	102	0.37	0.31	0	0.02	0	3
Orange juice or grapefruit juice	100	45	0.7	0.1	10.8	9	0.1	0.05	38.9	0.04	5	44
Other juice	100	46	0.1	0.1	11.3	8	0.12	0.02	0.9	0.02	0	0
Fruit drinks (Hi-C, Kool-aid, lemonade, sportsdrink)	100	35	0	0	9	16	0.05	0.02	11.2	0	0	0
Banana	100	89	1.1	0.3	22.8	5	0.26	0.15	8.7	0.37	3	20
Peaches	100	74	0.4	0.1	19.9	3	0.27	0.09	2.8	0.02	17	3
Fruit cocktail, mixed fruit	100	73	0.4	0.1	18.9	6	0.29	0.08	1.9	0.05	10	3
Orange or Grapefruit	100	47	0.9	0.1	11.8	40	0.1	0.07	53.2	0.06	11	30
Apple or pear	100	52	0.3	0.2	13.8	6	0.12	0.04	4.6	0.04	3	3
Applesauce	100	68	0.2	0.2	17.5	3	0.12	0.03	1.7	0.03	0.3	1
Grapes	100	69	0.7	0.2	18.1	10	0.36	0.07	3.2	0.09	3	2
Strawberries	100	32	0.7	0.3	7.7	16	0.41	0.14	58.8	0.05	1	24
Melon (Cantaloupe)	100	34	0.8	0.2	8.2	9	0.21	0.18	36.7	0.07	169	21
Pineapple	100	78	0.3	0.1	20.2	14	0.38	0.12	7.4	0.07	1	5
Raisins or prunes	100	299	3.1	0.5	79.2	50	1.88	0.22	2.3	0.17	0	5
Corn	100	81	2.5	0.7	19.3	3	0.47	0.63	3.5	0.1	10	35
Peas	100	78	5.2	0.3	14.3	24	1.52	0.67	9.9	0.11	105	59
Tomatoes, tomato sauce, salsa	100	18	0.9	0.2	3.9	10	0.27	0.17	13.7	0.08	42	15
Peppers (green, red, hot)	100	20	0.9	0.2	4.6	10	0.34	0.13	80.4	0.22	18	10
Carrots	100	35	0.8	0.2	8.2	30	0.34	0.2	3.6	0.15	852	14
Broccoli	100	35	2.4	0.4	7.2	40	0.67	0.45	64.9	0.2	77	108
Green beans	100	28	1.5	0.2	6.4	42	0.66	0.24	4.1	0.06	28	23
Spinach	100	23	3	0.3	3.8	136	3.57	0.76	9.8	0.24	524	146
Greens(mustard,turnip,kale)	100	28	1.9	0.4	5.6	72	0.9	0.24	41	0.14	681	13
Mixed vegetables	100	65	2.9	0.2	13.1	25	0.82	0.49	3.2	0.07	214	19

Food item	Amount (g)	Total Calories (kcal)	Protein (gm)	Total Fat (gm)	Carbs (gm)	Calcium (mg)	Iron (mg)	Zinc (mg)	Vitamin C (mg)	Vitamin B6 (mg)	Vitamin A (mcg)	Folate (mcg)
Squash, orange or winter	100	37	0.9	0.3	8.9	22	0.44	0.22	9.6	0.16	349.4	20
Zucchini, yellow squash	100	15	1.1	0.4	2.7	18	0.37	0.33	12.9	0.08	56	28
French Fries, fried potatoes	100	314.6	3.9	15.1	40.1	13	1.07	0.77	4	0.35	0	30
Potato (baked, boiled, or mashed)	100	100	2.1	0.1	23.3	5	0.41	0.33	15.1	0.32	0	12
Sweet potatoes or yams	100	108	1.3	0.3	25.4	17	0.95	0.16	10.8	0.06	458	8
Lettuce salad	100	14	0.9	0.1	3	18	0.41	0.15	2.8	0.04	25	29
Salad dressing	100	240	0.4	21.1	12.1	13	0.26	0.07	0.4	0.06	1.8	0
Mayonnaise	100	680	1	74.8	0.6	8	0.21	0.15	0	0.01	15.7	5
Chips (potato, corn, others)	100	547.5	7.2	36.4	53.5	0	1.28	0.95	21.5	0.2	1.7	84
Popcorn or pretzels	100	550.8	7.7	33	55.7	20.8	1.91	2.2	0.1	0.29	18.3	15
Crackers	100	421	9.5	8.9	74.3	21	5.13	0.82	0	0.06	0	221.9
Nuts	100	607	20	54	21	117	2.61	3.36	0.5	0.35	0.2	83
Cookies or brownies	100	474	5.1	23.3	63.9	26	3.2	0.65	0	0.03	0	69.3
Cake or cupcake	100	379	3.2	17.8	55.4	32	2.03	0.42	0	0	34.3	31.8
Pie	100	258.1	2.4	12.5	34.5	32.9	0.98	0.24	1.8	0.04	1.4	65.7
Jello	100	62	1.2	0	14.2	3	0.02	0.01	0	0	0	1
Chocolate or candy bar	100	535	7.7	29.7	59.4	189	2.35	2.3	0	0.04	59	11
Other candy (not chocolate)	100	394	0	0.2	62.9	3	0.3	0.01	0	0	0	0
Coffee or tea	100	1	0.1	0	0	2	0.01	0.02	0	0	0	2
Soda, soft drink, pop (not sugar free)	100	37	0.1	0	9.6	2	0.11	0.02	0	0	0	0
Soda, soft drink, pop (sugar free)	100	0.1	0	0	0	4	0.04	0	0	0	0	0
Beans(baked, chili, or other)	100	106	5.2	1.5	20	53	1.7	1.46	2	0.06	0.1	36
Rice	100	130	2.7	0.3	28.2	10	1.2	0.49	0	0.09	0	96.5
Spaghetti or other pasta	100	158	5.8	0.9	30.9	7	1.28	0.51	0	0.05	0	119.2
Pizza	100	266.6	12.5	11.3	29	262.5	1.65	1.35	2.4	0.12	65.5	96.9
Tacos, burritos	100	216	9.1	11.2	20	106	1.43	1.56	0.2	0.07	18.8	56.8
Macaroni and cheese	100	192.3	5.8	9	22.4	96.7	0.7	0.67	0	0.05	69.5	81.8
Hot dog	100	313	11.2	27.8	3.7	13	1.25	2.06	0	0.19	0	10
Sausage	100	339	19.4	28.4	0	13	1.36	2.08	0.7	0.33	12	3
Hamburger (prepared any way)	100	271	25.8	17.8	0	24	2.48	6.25	0	0.37	0	10
Canned Tuna	100	187	16	9.3	9.4	17	1	0.56	2.2	0.08	24.4	8
Fried fish, fish sticks	100	249	11	13.2	21.2	26	1.01	0.48	0	0.05	25	49.8
Other fish	100	105	22.8	0.9	0	14	0.49	0.58	1	0.28	14	8
Cold Cuts (baloney, ham, salami)	100	308	15.2	24.6	5.5	85	1.21	2.3	0.8	0.3	25	6

Food item	Amount (g)	Total Calories (kcal)	Protein (gm)	Total Fat (gm)	Carbs (gm)	Calcium (mg)	Iron (mg)	Zinc (mg)	Vitamin C (mg)	Vitamin B6 (mg)	Vitamin A (mcg)	Folate (mcg)
Fried Chicken, chicken nuggets	100	269	28.6	14.9	3.2	17	1.38	2.04	0	0.41	27	11.1
Other chicken or turkey	100	190	28.9	7.4	0	15	1.21	2.1	0	0.47	16	6
Pork or ham	100	222	24.4	13	0	28	0.68	2.15	0	0.64	2	0
Roast beef or steak	100	264	26.4	16.8	0	19	1.69	4.75	0	0.55	0	8
Liver, organ meats	100	175	26.5	4.7	5.2	6	6.17	5.23	0.7	1.03	7744	260
Peanut butter	100	588	25.1	50.4	19.6	43	1.87	2.91	0	0.54	0	74
Bread (slice) toast, roll, or pita	100	265	9.1	3.2	49.1	260	3.59	0.84	0	0.09	0	171.2
Butter (not margarine)	100	717	0.9	81.1	0.1	24	0.02	0.09	0	0	684	3
Margarine	100	0	0	0	0	0	0	0	0	0	0	0
Vegetable Soup	100	31	2.2	0.8	4.1	8	0.45	0.62	1	0.03	38.8	4
Other soup	100	25	1.3	0.9	3	6	0.66	0.16	0	0.02	15.2	12.2
Cornbread or tortillas	100	290.3	6	10.2	45.6	114.8	1.71	0.56	0.1	0.07	41.1	114.2
Eggs	100	143	12.6	9.5	0.7	56	1.75	1.29	0	0.17	160	47
Hot cereal or grits	100	71	2.5	1.5	12	9	0.9	1	0	0	0	6
Cold breakfast Cereal	100	379	13.1	6.5	67.7	52	4.25	3.64	0	0.1	0	32
Donut, fry bread	100	441.5	4.2	27	48	78.4	1.55	0.35	0	0.03	7.8	80.9
Sweet roll or muffin	100	371.1	4.9	16	52.8	46	1.36	0.52	0	0.07	5.5	130.4
Pancake, waffle, or French toast	100	227	6.4	9.7	28.3	219	1.8	0.56	0.3	0.18	53.2	56.2
English muffin or bagel	100	227	8.9	1.7	44.2	163	4	1.05	1.8	0.05	0	133.5
Biscuit	100	316.2	5.7	13.6	43.3	25.4	2.36	0.4	0.1	0.03	0.8	142.5

Note: Vitamin B6 = Pyridoxine; Vitamin A = Retinol Activity Equivalents; Folate = Dietary Folate Equivalents.
Source: Harvard T.H. Chan School of Public Health Nutrition Department's file download site. Available at: https://regepi.bwh.harvard.edu/health/nutrition.html. Accessed December 11, 2016.

Appendix 4.2 The Dimensions and Items of the PDI-S Survey Used in This Study

Dimensions	Section	Items	Scoring Key
Nurturance	I	*The following statements represent matters of interest and concern to some parents. Not all parents feel the same way about them. Circle the number which most closely applies to you and your child.* 1) I encourage my child to talk about his or her troubles.[a] 4) My child and I have warm intimate moments together.[a] 7) I encourage my child to be curious, to explore, and to question things.[a] 9) I find it interesting and educational to be with my child for long periods.[a] 10) I make sure my child knows that I appreciate what he or she tries to accomplish.[a] 12) I respect my child's opinion and encourage him/her to express it.[a]	The dimension scores were computed by averaging responses to the items making up the dimension.
Amount of Control	III	*Listed below are pairs of statements concerning parents' attitudes toward childrearing. For each pair, read both statements. Then determine which statement you agree with most, and circle the letter in front of that statement. Circle ONLY ONE letter per item.* 1) A. Nowadays parents place too much emphasis on obedience in their children. B. Nowadays parents are too concerned about letting children do what they want. 2) A. Children need more freedom to make up their own minds about things than they seem to get today. B. Children need more guidance from their parents than they seem to get today. 3) A. I care more than most parents I know about having my child obey me. B. I care less than most parents I know about having my child obey me. 4) A. I try to prevent my child from making mistakes by setting rules for their own good. B. I try to provide freedom for my child to make mistakes and learn from them. 5) A. If children are given too many rules, they will grow up to be unhappy. B. It is important to set and enforce rules for children to grow up to be happy adults.	Assign the parent a score of "1" for each time he or she chose the answers listed below. Count the total number of answers that match those listed. Score will range from 0 to 5 with higher score representing greater parental control. 1B, 2B, 3A, 4A, 5B

[a] Response options: not at all like me = 1, not much like me = 2, somewhat like me = 3, pretty much like me = 4, very much like me = 5, and exactly like me = 6.
Source: Power TG. Parenting dimensions inventory-short version (PDI-S): a research manual. Unpublished manuscript. Washington State University; 2002.

CHAPTER 5

FOOD PARENTING PRACTICES AND DIETARY INTAKES OF PRESCHOOLERS AND THEIR PARENTS

5.1 Introduction

While obesity prevention strategies of the past focused on education and individual behavior modification,[1] a growing body of evidence suggests that eating behaviors, which develop during infancy and early childhood and are largely influenced by the parent and home eating structure,[2,3] set the stage for future habits and may influence a child's weight status.[4] The link between the parent and the weight status of the child becomes especially important when one considers that overweight and obese children are more likely to become obese adults[5,6] and obese children are at an increased risk of chronic disease later on in life.[7-9]

Establishing healthy eating and exercise habits at an early age is crucial in preventing unnecessary weight gain. While genetics undoubtedly play a role in the development of food preferences (e.g., the inclination to like sweet and salty flavors and dislike bitter and sour flavors),[3,10-12] a child's tendency toward certain foods can be modified through familiarity (i.e., repeated exposure to and consumption of novel foods)[3,10,11,13-17] and peer modeling and through parental modeling.[3,18-25]

Not only do parents influence their child's food preferences and eating behaviors by modeling their own food choices, food preferences, and dietary behaviors, but they can also alter them through parenting practices.[2,11,26,27] Parenting practices, according to Darling and Steinberg, are "behaviors defined by specific content and socialization

goals."[28] Parenting practices may differ depending on a child's characteristics such as age, sex, eating behaviors, and weight status – and the context/situation in which the practices are being employed.[29] It is important to note that while often well intentioned, improper parenting practices can lead to unintended consequences. Parental control during a feeding situation has been shown to override a child's ability to self-regulate intake and recognize cues of hunger and satiety.[30] Parenting practices that restrict a child's access to certain foods may unintentionally promote the overconsumption of those foods.[31-34] Similarly, parents who use food as a reward may be promoting the consumption of the reward food and decreasing the likelihood that the child will consume the disliked food.[34,35]

A recent study by Couch and colleagues involving children aged 6-11 found that a number of parenting practices were linked to improved child diet quality.[2] Among these practices were encouragement/modeling of healthy eating, making healthful foods readily available in the home, and setting home food rules on snacking type, place, and size.[2] Of equal importance were the authors' findings that permissive parenting practices and restrictive feeding practices were associated with poorer child diet quality and poorer weight outcomes.[2] In a review by Larsen et al., it is suggested that the most influential parenting practices are those that impact the food environment as opposed to those that are directed toward the child's appetite.[34]

While there is numerous research about general parenting practices, child nutrition researchers have begun studying the specific parenting practices related to food and their relationships with child diet and eating behaviors.[36] These practices are referred to as food parenting practices. Research surrounding food parenting practices and child

diet quality is often limited by lack of clear definition and description of parenting practices. To eliminate discrepancies and bring clarity to the field, Vaughn and colleagues developed a parenting practices content map.[36] The map details three food parenting practice constructs—*Structure*, *Coercive Control*, and *Autonomy Support*—and highlights specific subconstructs within each of the three food parenting practice constructs. *Structure* involves the use of non-coercive parenting practices and is defined as the "parents' organization of children's environment to facilitate children's competence."[36] *Coercive Control* is defined as the "parents' pressure, intrusiveness, and dominance in relation to children's feelings and thoughts, as well as their behaviors."[36] *Autonomy Support* is the promotion of "psychological autonomy and encouragement of independence."[36] In the literature, food parenting practices related to *Structure* (e.g., rules and limit, meal and snack routine, and food availability and accessibility) and *Autonomy Support* (e.g., encouragement and nutrition education) were found associated with higher intakes of fruits and vegetables and lower intakes of unhealthy foods (e.g., sugar-sweetened beverages, snacks, and sweets).[36,37] *Coercive Control* practices (e.g., restriction, pressure to eat, and threats and bribes) were found to have inverse associations.[36,37] Researchers studying food parenting practices have been challenged by unclear concept and inconsistencies definitions used to describe parenting behaviors that influence children's dietary intakes.[38] Vaughn's content map on food parenting practices could be used as a reliable comprehensive theoretical framework to guide studies on exploring the relationship between constructs and subconstructs of food parenting practices and children's dietary intakes.

In much of the literature, nutrition interventions for youth are targeted towards school-aged children and adolescents. School-based interventions may seem to have a solid foundation as they are cost effective and can be used to target the behaviors of a large number of youth. However, recent findings indicate that poor dietary behaviors are well established by the time a child receives nutrition education in elementary school or middle school.[18,19,39] Thus, nutrition interventions might be more effective if they target 1) the parent and inappropriate parenting practices on display in the home and 2) preschoolers before negative eating behaviors and habits are formed. To better equip parents in the fight against childhood obesity, it is crucial to identify food parenting practices that have a positive impact on early eating habits. While much of the literature has focused on school-aged children and adolescents, there is a gap surrounding food parenting practices and their influence on preschooler's diets. In addition, limited research explored the interactions between parenting practices and parental dietary behaviors. Examining the interactions between parental dietary behaviors and parenting practices may reveal important insights into how parents influence the home food environment and, subsequently, shape children's dietary behaviors.[40]

Most of current studies regarding parenting practices and diet assessed only the specific foods.[41] Although investigation of specific foods would be expected related to overall dietary intakes, a more comprehensive assessment for dietary intakes including essential macronutrient and micronutrient intakes from foods as well as food group intakes is likely necessary to better understand the dietary consumption and health outcomes.

Hence, the purpose of this study was to examine the relationship between food parenting practices and dietary intakes of preschool-aged children and their parents. Figure 5.1 illustrated the model assessed in this study. Specifically, it was hypothesized that 1) positive food parenting practices (e.g., subconstructs within *Structure* and *Autonomy Support*) would be positively related to healthy dietary intakes (e.g., protein, fruits, vegetables) or inversely related to unhealthy dietary intakes (e.g., sweets and fats) and 2) negative food parenting practices (e.g., subconstructs within *Coercive Control*) would be negatively related to healthy dietary intakes (e.g., protein, fruits, vegetables) or inversely related to unhealthy dietary intakes (e.g., sweets and fats).

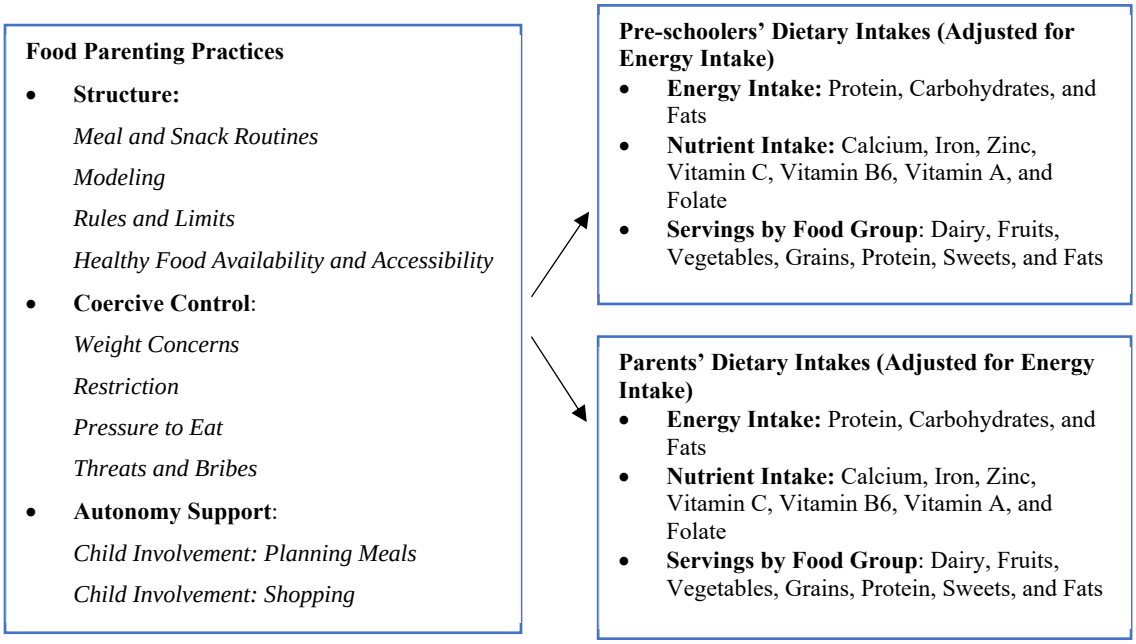

Figure 5.1 Current Study Model of Food Parenting Practices and Preschoolers'/Parents' Dietary Intakes

5.2 Methods

This study was a part of the *iGrow* Readers program conducted in 2016. IRB approval, subject assent, and parental consent were obtained in accordance with the policy statements of the Human Subjects Committee at South Dakota State University.

5.2.1 Participants

Children aged 3-5 years old and their parents were recruited from preschools/daycare centers in South Dakota, Minnesota, and Nebraska. To qualify for recruitment, preschools/daycare centers needed to meet the following selection criteria: 1) have at least two classrooms with 3-5 years old, and 2) each classroom needed to have separate teachers. In total, 14 preschools and daycare centers met the selection criteria and agreed to participate in the study. From the 14 participating preschools and daycare centers, 293 parent/child dyads were recruited via email and with flyers describing individual eligibility and benefits of participation.

5.2.2 Data Measurements

Demographic Information. Demographic information regarding age, race, household income, and education were self-reported by parents. Height and weight of children and parents were measured in duplicate by trained research assistants to the nearest 0.1cm and 0.1kg respectively. Parent Body Mass Index (BMI) categories and Child BMI-for-age percentiles were calculated according to Centers for Disease Control and Prevention guidelines.[42,43] Four BMI categories for adult were determined including underweight (< 18.5), normal (≥ 18.5-25), overweight (≥ 25-30), and obese (≥ 30).[42]

Child underweight (< 5th), normal (≥ 5th-85th), overweight (≥ 85th-95th), and obesity (≥ 95th) were categorized using age- and sex-specific percentile for BMI.[43]

Measures of Dietary Intakes. Dietary information was collected for parents and their children using the Harvard Service Food Frequency Questionnaire (HSFFQ). The HSFFQ was adapted from the questionnaires developed by Willett et al, and was designed to assess diet intake over the past four weeks.[44] The HSFFQ has been validated for the assessment of nutrient intakes among adults[45,46] and among children 1 to 5 years of age.[47] The questionnaire lists different food items and asks the number of times the food was consumed during the past 4 weeks. This questionnaire consists of 87 food items for adults (86 food items for children) and 9 questions about food habits, supplements and services.[44,48]

The HSFFQ was completed by caregivers on behalf of their children. Each parent completed one food frequency questionnaire about themselves, and another one about their child. *The HSFFQ User's Manual*[49] was used for guiding the HSFFQ analysis. In general, portion size in gram weight assigned to each food item on the HSFFQ are derived from national data.[49,50] Nutrient data per 100 gm portion for the food items were derived from the HSFFQ and estimated using the Harvard nutrient database.[50] Daily nutrients intakes from the HSFFQ were computed by converting the food frequency to a daily number of servings to each food item, multiplying this by the nutrient content for the assigned weight, and summing the value for all foods.[49] Food groups (dairy, fruits, vegetables, grains, protein, sweets, and fats) were determined by the HSFFQ.[49] Complete instructions were described in Chapter 4.

The HSFFQ provided dietary intakes results regarding: 1) daily nutrient intakes (vitamin A, vitamin C, calcium, zinc, folate, iron, protein, and vitamin B6); 2) daily calorie intakes and sources (carbohydrates, protein, fats); 3) daily mean servings by food groups (meat, bread/cereal, milk, vegetables, fruit, sweets and fats). The "selected nutrient intakes" (result 1 above) and "calorie intakes and sources" (result 2 above) were calculated from the frequency reported and the nutrients in the corresponding serving of food. "Mean servings by food group" (result 3) was a direct reporting of the number of servings that the participants reported.[49]

Measures of Food Parenting Practices. Food parenting practices were measured through the refined Comprehensive Home Environment Survey (CHES). Parents participants completed the CHES surveys in this study. Original CHES was developed by Courtney and colleagues (2014), which is a reliable and validated comprehensive measurement related to home environment and parenting behaviors.[51] Large numbers of items in this comprehensive tool related to food parenting practices, however, were not identified. Thus, the research team selected and recategorized food parenting practices components from this existing home environment assessment through following steps (Chapter 3 indicated the complete development process):

1) selected items for food parenting practices. Questions pertaining to food parenting practices were identified in the CHES. Using content map and the terminology developed by Vaughn et al.,[37] the research team reviewed sets of similar questions and selected those that were deemed to be one most relevant parenting practice construct. Content validity of this initial selecting items was assessed with the help of three expert

reviewers. At the end of this stage, selected items from CHES assigned to three food parenting practice constructs (*Structure*, *Coercive Control*, and *Autonomy Support*).

2) exploratory factor analysis (EFA) was used to identify potential food parenting practices scales (subconstructs).[52] The EFA was undertaken for each construct of food parenting practice. The factor extraction used principal components analysis and varimax was employed for factor rotation. Items with low rotated factor loading (< 0.40) were removed; then EFAs were repeated.[37] If an item had a rotated factor loading ≥ 0.40 on multiple factors (subconstructs), the item was included in the factor with the higher factor loading.[53] Finally, factors for each construct were identified. Internal consistency for all scales was analyzed using a correlation matrix and by calculating Cronbach's alpha (alpha > 0.70 presents an acceptable internal consistency).[54]

After the EFAs, the research team identified ten food parenting practices subconstructs under three broad constructs, including four subconstructs (i.e., *Meal and Snack Routines*, *Modeling*, *Rules and Limits*, and *Healthy Food Availability and Accessibility*) within *Structure*, four subconstructs (i.e., *Weight Concerns*, *Restriction*, *Pressure to Eat*, and *Threats and Bribes*) within *Coercive Control*, and two subconstructs (i.e., *Child Involvement: Planning Meals* and *Child Involvement: Shopping*) within *Autonomy Support*. (The final items, factor loadings, and internal consistency for each of *Structure*, *Coercive Control*, and *Autonomy Support* scales were presented in Table 3.2, Table 3.3, and Table 3.4 of Chapter 3.)

5.2.3 Statistical Analysis

All data were prepared in Microsoft Access database files and imported into Stata Statistical Software: Release 14 (StataCorp, 2015). If siblings were included in the study,

one child was randomly chosen for the data analysis. All statistics analyses were conducted by Stata Statistical Software: Release 14 (StataCorp, 2015).

Nutrition measurements estimated daily dietary intakes for children/parents from the HSFFQ regarding: 1) average daily energy, macronutrient and nutrient intake and 2) average daily number of servings by food group. Average daily energy, macronutrient and selected micronutrient intake was calculated from all food frequency questionnaires for each participant. The selected micronutrients examined were calcium, iron, zinc, vitamin C, vitamin B6, vitamin A, and folate. Average daily energy and nutrient were compared with age and gender appropriate Dietary Reference Intakes (DRI). Macronutrient percent of calorie were compared with Acceptable Macronutrient Distribution Ranges (AMDR) for children (4-18 years) and adults.[55] Micronutrient intake were compared with Recommended Dietary Allowances (RDA). Children's results were compared with 4-8 years age group of RDA, and parents' were compared with 31-50 years age group of RDA by gender.[56] Then nutrient as percentage of RDA was calculated. In addition, in order to examine the diet quality of the participants, both absolute nutrient intakes and nutrient density were reported. Nutrient density was determined using the average of daily intake of nutrients per 1000 kcal intake. Average daily number of servings from each food group were calculated from all food frequency questionnaire for each participant. Food groups determined by HSFFQ were dairy, fruits, vegetables, grains, protein, sweets, and fats. Daily servings of food group intake were compared with the recommendations by food guide pyramid for children (2-6 years)[57] and adults.[58] In addition, in order to examine the diet quality of the participants, the

number of servings from each of the seven food groups were adjusted for energy intake (servings of food groups per 1000 kcal of total energy consumed).

An average score for each of three constructs (i.e., *Structure*, *Coercive Control*, and *Autonomy Support*) and ten subconstructs of food parenting practices were calculated by averaging the contributing item scores.

Spearman's correlation analyses between dietary intakes (using nutrient density) for children/parents and ten food parenting practices subconstructs were performed for statistical significance ($p < 0.05$).

In order to examine the overall association between food parenting practices constructs and children's/parents' food group intakes, multiple linear regression analyses were performed. We used mean servings of food groups adjusted for energy intake (servings/1000 kcal) of four food groups (fruits, vegetables, sweets, and fats) separately as dependent variables, because of these food group consumptions are important factors related to diet quality. The average score for each of three food parenting practices constructs—*Structure*, *Coercive Control*, and *Autonomy Support* were used as independent variables. Models were also adjusted for potential cofounders, so that the confounding effects could be reduced. Children's regression models were adjusted for child gender, child BMI percentile category, parent education level, and parent gender role. Parents' models were adjusted for parent gender role, parent BMI category, and parent education level. Significant level was set at $p < 0.05$.

5.3 Results

5.3.1 Participant Characteristics

Of the 293 recruited, 167 parent participants completed the food frequency questionnaire and CHES survey. Table 5.1 shows the general characteristics for participants. Parents in this study were predominately mothers (82.6%), 30 to 39 years (67.7%), and white (91.2%). Parents had BMIs considered normal/underweight (45.8%), overweight (26.5%), and obese (27.7%). The majority had a household income greater than $60,000 (77.6%) and a bachelor's degree or higher (78.9%).

There were 167 child participants, 47.3% were boys and 52.7% were girls; 46.1% were 3 years, 41.9% were 4 years, and 12.0% were 5 years. The majority were white (85.6%) and were in normal/underweight BMI percentile (81.2%).

Table 5.1 Demographic Characteristics of Parents and Children (n=167)

Variable	Category	N[a]	Percent
Parent Gender Role	Father	29	17.4
	Mother	138	82.6
Parent Age	< 30 years	29	17.7
	30 to 39 years	111	67.7
	≥ 40 years	24	14.6
Parent Race	White	145	91.2
	Black	3	1.9
	American Indian	1	0.6
	Asian	8	5.0
	Other	2	1.3
Parent BMI	Normal/underweight	76	45.8
	Overweight	44	26.5
	Obese	46	27.7
Household Income	Less than $60,000	37	22.4
	$60,000 or greater	128	77.6
Parent Education	High school or less	22	13.3
	Associate's degree	13	7.8
	Bachelor's degree	75	45.2
	Graduate degree	56	33.7
Child Gender	Boy	79	47.3
	Girl	88	52.7
Child Age	3 years	77	46.1
	4 years	70	41.9
	5 years	20	12.0
Child Race	White	143	85.6
	Black	3	1.8
	American Indian	1	0.6
	Asian	8	4.8
	Other	12	7.2
Child BMI Percentile	Normal/underweight	134	81.2
	Overweight	15	9.1
	Obese	16	9.7

[a] Not all numbers may add up due to parents skipping.

5.3.2 Children's/Parents' Dietary Intakes

Table 5.2 and Table 5.3 show the HSFFQ results for children' and parents' daily dietary intakes, respectively. Table 5.4 shows the children and parents' daily dietary intakes adjusted for energy intake (per 1000 kcal).

For children, average calorie intake was 1733.77 ± 56.59 kcal; percentage of energy from protein, carbohydrates and fats were in the normal range compared with AMDR. Average absolute selected nutrient intakes were above 100% RDA for most micronutrients, except for iron (88.60% of RDA). Two children's food group intake - vegetables (2.68 servings/day) and grains (3.29 servings/day) didn't meet the recommended mean servings by food guide pyramid (3 servings/day for vegetables and 6 servings/day for grains).

For parents, average calorie intake was 1925.33 ± 71.83 kcal; percentage of energy from fats (36.95%) exceeded the normal range compared with AMDR (20%-35%). Average absolute selected nutrient intakes were above 100% RDA for most micronutrients, except for mothers' consumption of iron (60.28% of RDA). Parents' vegetables intake (4.12 servings/day) was higher than recommended mean servings (3-4 servings/day) while grains intake (2.55 servings/day) was lower than recommendation (6-11 servings/day).

Table 5.2 Summary of the HSFFQ Results on Daily Dietary Intakes for Children

Children' Daily Dietary Intakes	**Mean**	**SD**	**Nutrient Recommendations**	
Energy Intake			**AMDR (Percent of Calorie)[a]**	
Calorie (kcal)	1733.77	56.59	-	
Protein (g)	68.58	2.52	-	
Protein, % kcal	15.84	0.16	10 - 30	
Carbohydrates (g)	66.56	2.04	-	
Carbohydrates, % kcal	50.33	0.44	45 - 65	
Fats (g)	219.81	7.83	-	
Fats, % kcal	34.88	0.31	25 - 35	
Selected Nutrient Intake			**RDA for Children[b]**	**Percentage of RDA**
Calcium (mg)	1100.83	36.91	1000	110.08
Iron (mg)	8.86	0.35	10	88.60
Zinc (mg)	9.82	0.35	5	275.01
Vitamin C (mg)	68.75	4.20	25	275.01
Vitamin B6 (mg)	1.30	0.05	0.6	216.55
Vitamin A (mcg, RAE[c])	601.47	21.88	400	150.37
Folate (mcg, DFE[d])	364.40	14.26	200	182.20
Food Group Intake			**Recommended Mean Servings[e]**	
Dairy (servings)	4.02	0.15	2	
Fruits (servings)	3.35	0.17	2	
Vegetables (servings)	2.68	0.15	3	
Grains (servings)	3.29	0.15	6	
Protein (servings)	2.17	0.11	2	
Sweets (servings)	1.65	0.08	-	
Fats (servings)	3.24	0.13	-	

[a] Acceptable Macronutrient Distribution Ranges (AMDR) for children 4 to 18 years.[55]
[b] Recommended Dietary Allowances (RDA) of vitamins and elements for children 4 to 8 years.[56]
[c] RAE = Retinol Activity Equivalents.
[d] DFE = Dietary Folate Equivalents.
[e] Food guide pyramid for young children 2 to 6 years.[57]

Table 5.3 Summary of the HSFFQ Results on Daily Dietary Intakes for Parents

Parents' Daily Dietary Intakes	**Mean (F/M)[a]**	**SD (F/M)**	**Nutrient Recommendations**	
Energy Intake			**AMDR (Percent of Calorie)[b]**	
Calorie (kcal)	1925.33	71.83	-	
Protein (g)	81.39	3.10	-	
Protein, % kcal	17.03	0.21	10 - 35	
Carbohydrates (g)	78.37	2.83	-	
Carbohydrates, % kcal	46.62	0.51	45 - 65	
Fats (g)	226.93	9.52	-	
Fats, % kcal	36.95	0.40	20 - 35	
Selected Nutrient Intake			**RDA for Adults (F/M)[c]**	**Percentage of RDA (F/M)**
Calcium (mg)	1040.92	50.81	1000	104.09
Iron (mg)	10.85/11.64	0.46/1.16	18/8	60.28/145.55
Zinc (mg)	11.45/12.12	0.47/1.27	8/11	143.08/110.19
Vitamin C (mg)	92.48/106.06	7.88/14.43	75/95	123.30/117.85
Vitamin B6 (mg)	1.73	0.08	1.3	133.45
Vitamin A (mcg, RAE[d])	966.46/1058.58	73.22/141.09	700/900	138.07/117.62
Folate (mcg, DFE[e])	439.17	17.84	400	109.79
Food Group Intake			**Recommended Mean Servings[f]**	
Dairy (servings)	2.21	0.14	2 - 3	
Fruits (servings)	2.39	0.16	2 - 4	
Vegetables (servings)	4.12	0.32	3 - 4	
Grains (servings)	2.55	0.11	6 - 11	
Protein (servings)	2.46	0.11	2 - 3	
Sweets (servings)	1.87	0.11	-	
Fats (servings)	3.60	0.15	-	

[a] F = females, M = males.
[b] Acceptable Macronutrient Distribution Ranges (AMDR) for adults.[55]
[c] Recommended Dietary Allowances (RDA) of vitamins and elements for males and females 31 to 50 years.[56]
[d] RAE = Retinol Activity Equivalents.
[e] DFE = Dietary Folate Equivalents.
[f] Food guide pyramid for adults.[58]

Table 5.4 Summary of the HSFFQ Results for Children and Parents' Daily Dietary Intakes Adjusted for Energy Intake

Daily Dietary Intakes Adjusted for Energy Intake	Children		Parents	
	Mean	**SD**	**Mean**	**SD**
Energy Density				
Protein (g/1000 kcal)	39.60	0.39	42.58	0.53
Fats (g/1000 kcal)	38.76	0.35	41.06	0.45
Carbohydrates (g/1000 kcal)	125.83	1.10	116.55	1.27
Selected Nutrient Density				
Calcium (mg/1000 kcal)	649.79	12.73	540.41	13.11
Iron (mg/1000 kcal)	5.07	0.06	5.74	0.08
Zinc (mg/1000 kcal)	5.68	0.07	6.03	0.08
Vitamin C (mg/1000 kcal)	38.73	1.73	47.32	2.01
Vitamin B6 (mg/1000 kcal)	0.75	0.01	0.90	0.01
Vitamin A (mcg/1000 kcal)	350.49	7.10	494.81	19.65
Folate (mcg/1000 kcal)	208.18	3.04	229.18	3.97
Food Group Intake /1000 kcal				
Dairy (servings/1000 kcal)	2.39	0.07	1.14	0.04
Fruits (servings/1000 kcal)	1.89	0.07	1.20	0.05
Vegetables (servings/1000 kcal)	1.53	0.06	2.07	0.09
Grains (servings/1000 kcal)	1.89	0.04	1.35	0.04
Protein (servings/1000 kcal)	1.24	0.03	1.30	0.04
Sweets (servings/1000 kcal)	0.97	0.04	1.01	0.05
Fats (servings/1000 kcal)	1.87	0.05	1.91	0.06

5.4.3 Correlation Between Children's/Parents' Daily Dietary Intakes and Food Parenting Practices Subconstructs

Table 5.5 and Table 5.6 show the results of Spearman's correlation analyses between children's/parents' daily dietary intakes per 1000 kcal (Table 5.4) and ten food parenting practices subconstructs, respectively.

For children, most food parenting practices subconstructs within *Structure* had positive relationships with healthy nutrient density and food group intakes (servings/1000 kcal) and negative relationships with unhealthy intakes. For example, *Meal and Snack Routines* was positively related to the intake of iron (r = 0.19), folate (r = 0.22), and grains (r = 0.16); and negatively related to the intake of sweets (r = -0.19) and food group fats (r = -0.17). *Modeling* was positively related to the intake of carbohydrates (r = 0.26), folate (r = 0.21), and fruits (r = 0.21); and negatively related to the intake of fats (r = -0.32), sweets (r = -0.16), and food group fats (r = -0.28). *Rules and Limits* was positively related to the intake of carbohydrates (r = 0.16), iron (r = 0.19), vitamin C (r = 0.26), fruits (r = 0.17) and vegetables (r = 0.25); and negatively related to the intake of fats (r = -0.17). *Healthy Food Availability and Accessibility* was positively related to the intake of iron (r = 0.28), vitamin B6 (r = 0.33), folate (r = 0.15), fruits (r = 0.20), vegetables (r = 0.29), and protein (r = 0.19); and negatively related to the intake of fats (r = -0.19) and sweets (r = -0.24). However, *Rules and Limits* and *Healthy Food Availability and Accessibility* were also found had negative relationship with the intakes of calcium and dairy.

Food parenting practices subconstructs within *Coercive Control* mostly had positive relationships with unhealthy children's nutrient and food group intakes. For

example, *Weight Concerns* was positively related to the intake of fats (r = 0.15). *Threats and Bribes* was positively related to the intake of sweets (r = 0.19) and food group fats (r = 0.16). In addition, *Coercive Control* mostly had negative relationships with healthy children's nutrient and food group intakes. For example, *Weight Concerns* was negatively related to the intake of calcium (r = -0.16) and vitamin A (r = -0.16); *Restriction* was negatively related to the intake of dairy (r = -0.16); *Pressure to Eat* was negatively related to the intake of calcium (r = -0.17) and dairy (r = -0.16); and *Threats and Bribes* was negatively related to the intake of iron (r = -0.17).

Food parenting practices subconstructs within *Autonomy Support* mostly had positive relationships with healthy children's nutrient and food group intakes. *Child Involvement: Shopping* was found positively related to the intake of carbohydrates (r = 0.17), vitamin C (r = 0.21), vitamin B6 (r = 0.22), vitamin A (r = 0.23), fruits (r = 0.19), and vegetables (r = 0.27); and negatively related to the intake of fats (r = -0.23).

Similar correlations were also found for parents' dietary intakes (Table 5.6). For parents, most food parenting practices subconstructs within *Structure* had positive relationships with healthy nutrient and food group intakes and negative relationships with unhealthy intakes. All four parenting practices subconstructs within *Structure* were found positively related to the intake of vitamin C (r = 0.15 to 0.40), vitamin A (r = 0.19 to 0.37), and fruits (r = 0.18 to 0.36); and negatively related to the intake of food group sweets (r = -0.16 to -0.35). All *Structure* practices except *Meal and Snack Routines* were positively related to the intake of vitamin B6 (r = 0.16 to 0.30) and vegetables (r = 0.17 to 0.26). All *Structure* practices except *Healthy Food Availability and Accessibility* were positively related to the intake of folate (r = 0.15 to 0.24) and negatively related to the

intake of food group fats (r = -0.16 to -0.30). *Modeling* was also found positively related to the intake of carbohydrates (r = 0.21) and iron (r = 0.16). *Meal and Snack Routines* and *Modeling* was negatively related to the intake of fats (r = -0.16 and -0.28, respectively).

Food parenting practices subconstructs within *Coercive Control* showed several relationships with parents' dietary intakes. *Weight Concerns* had positive relationship with the intake of protein (r = 0.18) and food group protein (r = 0.16); *Restriction* had positive relationship with the intake of iron (r = 0.17) and food group protein (r = 0.16); *Threats and Bribes* had positive relationship with the intake of sweets (r = 0.23).

Food parenting practices subconstructs within *Autonomy Support* had positive relationships with healthy parents' nutrient and food group intakes and negative relationships with unhealthy intakes. *Child Involvement: Planning Meals* was negatively related to the intake of fats (r = -0.15) and food group fats (r = -0.16); *Child Involvement: Shopping* was found positively related to the intake of iron (r = 0.16), zinc (r = 0.22), vitamin B6 (r = 0.18), vitamin A (r = 0.26), fruits (r = 0.16), and vegetables (r = 0.17).

In general, for both children and parents, food parenting practices subconstructs within *Structure* and *Autonomy Support* were mostly positively related to the healthy daily dietary intakes (per 1000 kcal) and negatively related to the unhealthy intakes. For children, food parenting practices subconstructs within *Coercive Control* mostly had positive relationships with unhealthy dietary intakes (per 1000 kcal) and negative relationships with healthy dietary intakes.

Table 5.5 Spearman's Correlation Between Daily Dietary Intakes and Food Parenting Practices Subconstructs for Children

Children's Daily Dietary Intakes/1000 kcal	Food Parenting Practices									
	Structure				Coercive Control				Autonomy Support	
	Meal and Snack Routines	Modeling	Rules and Limits	Healthy Food Availability and Accessibility	Weight Concerns	Restriction	Pressure to Eat	Threats and Bribes	Child Involvement: Planning Meals	Child Involvement: Shopping
Energy Density (g/1000 kcal)										
Protein	0.08	-0.04	-0.07	0.07	0.03	-0.06	-0.08	-0.08	0.01	0.05
Fats	-0.11	**-0.32***	**-0.17***	**-0.19***	**0.15***	-0.09	-0.14	0.12	-0.01	**-0.23***
Carbohydrates	0.05	**0.26***	**0.16***	0.12	-0.14	0.09	0.14	-0.06	0.03	**0.17***
Selected Nutrient Density[a]										
Calcium	-0.02	-0.11	**-0.20***	**-0.20***	**-0.16***	-0.13	**-0.17***	0.07	-0.05	-0.01
Iron	**0.19***	0.15	**0.19***	**0.28***	-0.09	0.12	**0.16***	**-0.17***	-0.01	0.10
Zinc	0.10	-0.09	0.00	0.12	-0.04	-0.05	-0.02	-0.07	0.03	0.06
Vitamin C	0.05	0.09	**0.26***	0.14	0.00	0.10	0.15	-0.07	0.09	**0.21***
Vitamin B6	0.15	0.14	0.14	**0.33***	0.04	0.08	0.08	-0.11	0.11	**0.22***
Vitamin A	0.04	0.04	0.06	0.10	**-0.16***	-0.07	0.03	-0.01	0.06	**0.23***
Folate	**0.22***	**0.21***	0.15	**0.15***	-0.07	0.04	0.14	-0.15	0.01	0.11
Food Group Intake (servings/1000 kcal)										
Dairy	-0.05	-0.13	**-0.21***	**-0.24***	-0.14	**-0.16***	**-0.16***	0.09	-0.04	-0.05
Fruits	0.06	**0.21***	**0.17***	**0.20***	0.00	0.10	-0.03	-0.10	0.11	**0.19***
Vegetables	0.14	0.10	**0.25***	**0.29***	-0.04	0.03	**0.18***	-0.02	0.11	**0.27***
Grains	**0.16***	0.04	0.02	0.03	-0.09	0.09	0.09	-0.08	**-0.17***	-0.09
Protein	0.14	0.03	0.09	**0.19***	0.09	0.04	-0.02	-0.09	0.03	0.07
Sweets	**-0.19***	**-0.16***	-0.04	**-0.24***	0.14	0.08	0.01	**0.19***	0.06	-0.11
Fats	**-0.17***	**-0.28***	-0.03	-0.06	0.11	0.01	0.05	**0.16***	0.00	-0.11

* $p < 0.05$.

[a] Units for nutrients: calcium (mg/1000 kcal), iron (mg/1000 kcal), zinc (mg/1000 kcal), vitamin C (mg/1000 kcal), vitamin B6 (mg/1000 kcal), vitamin A (mcg/1000 kcal), and folate (mcg/1000 kcal).

Table 5.6 Spearman's Correlation Between Daily Dietary Intakes and Food Parenting Practices Subconstructs for Parents

	Food Parenting Practices									
	Structure				**Coercive Control**				**Autonomy Support**	
Parents' Daily Dietary Intakes/1000 kcal	**Meal and Snack Routines**	**Modeling**	**Rules and Limits**	**Healthy Food Availability and Accessibility**	**Weight Concerns**	**Restriction**	**Pressure to Eat**	**Threats and Bribes**	**Child Involvement: Planning Meals**	**Child Involvement: Shopping**
Energy Density (g/1000 kcal)										
Protein	0.07	0.09	0.06	0.08	**0.18***	0.13	-0.04	-0.05	0.02	0.13
Fats	**-0.16***	**-0.28***	-0.15	-0.12	0.01	-0.02	-0.10	0.06	**-0.15***	-0.14
Carbohydrates	0.11	**0.21***	0.12	0.08	-0.09	-0.02	0.11	-0.04	0.09	0.07
Selected Nutrient Density[a]										
Calcium	0.13	0.12	-0.04	0.04	0.00	-0.02	-0.12	-0.07	-0.06	0.03
Iron	0.10	**0.16***	0.09	0.14	0.07	**0.17***	0.03	-0.14	0.07	**0.16***
Zinc	0.10	0.12	0.07	0.12	0.10	0.10	-0.06	-0.07	0.06	**0.22***
Vitamin C	**0.15***	**0.17***	**0.27***	**0.40***	0.13	0.13	0.10	-0.13	0.06	0.10
Vitamin B6	0.13	**0.16***	**0.18***	**0.30***	0.12	0.08	0.04	-0.06	0.04	**0.18***
Vitamin A	**0.22***	**0.29***	**0.19***	**0.37***	0.07	0.06	0.00	-0.12	0.09	**0.26***
Folate	**0.16***	**0.24***	**0.15***	0.10	0.02	0.04	0.08	-0.15	0.07	0.07
Food Group Intake (servings/1000 kcal)										
Dairy	0.09	0.03	-0.07	-0.03	-0.01	-0.05	-0.09	-0.03	-0.06	-0.02
Fruits	**0.25***	**0.24***	**0.18***	**0.36***	0.03	0.11	0.06	-0.08	0.12	**0.16***
Vegetables	0.11	**0.17***	**0.20***	**0.26***	0.09	0.02	0.03	-0.10	-0.01	**0.17***
Grains	0.02	0.02	-0.07	-0.07	-0.11	0.02	0.03	-0.09	-0.02	-0.10
Protein	0.07	0.11	0.09	0.10	**0.16***	**0.16***	-0.08	-0.14	0.08	0.01
Sweets	**-0.19***	**-0.35***	**-0.25***	**-0.16***	0.07	-0.07	-0.08	**0.23***	-0.11	-0.15
Fats	**-0.18***	**-0.30***	**-0.16***	-0.05	0.06	0.04	-0.03	0.11	**-0.16***	-0.10

* $p < 0.05$.

[a] Units for nutrients: calcium (mg/1000 kcal), iron (mg/1000 kcal), zinc (mg/1000 kcal), vitamin C (mg/1000 kcal), vitamin B6 (mg/1000 kcal), vitamin A (mcg/1000 kcal), and folate (mcg/1000 kcal).

5.4.4 Multiple Regression Models for Children's/Parents' Food Group Intake

To examine overall associations between three food parenting practices constructs and children's/parents' daily food group intakes (servings/1000 kcal), multiple linear regression analyses were performed. Table 5.7 shows the associations of *Structure*, *Coercive Control*, and *Autonomy Support* with children's daily food group intakes (fruits, vegetables, sweets, and fats). For each food group regression models, Model 1 was without adjusting for potential confounders, and Model 2 was adjusted for child gender, child BMI percentile category, parent education level, and parent gender role. For children, both unadjusted and adjusted models showed that higher score of *Autonomy Support* was associated with a higher intake on the daily servings of fruits per 1000 kcal (coef. = 1.55 for unadjusted model, coef. = 1.66 for adjusted model); higher score of *Structure* was associated with a higher intake on the daily servings of vegetables per 1000 kcal (coef. = 1.25 for unadjusted model, coef. = 1.17 for adjusted model), and a lower intake on the daily servings of sweets per 1000 kcal (coef. = -0.65 for unadjusted model, coef. = -0.72 for adjusted model). Only in the unadjusted model shows that higher score of *Coercive Control* had a higher intake on the daily servings of sweets per 1000 kcal (coef. = 0.53).

Table 5.8 shows the associations of *Structure*, *Coercive Control*, and *Autonomy Support* with parents' daily food group intakes (fruits, vegetables, sweets, and fats). For each food group regression models, Model 1 was without adjusting for potential confounders, and Model 2 was adjusted for parent gender role, parent BMI category, and parent education level. For parents, both unadjusted and adjusted models presented that higher score of *Structure* was associated with a higher intake on the daily servings of

fruits per 1000 kcal (coef. = 1.54 for unadjusted model, coef. = 1.49 for adjusted model), and a lower intake on the daily servings of sweets per 1000 kcal (coef. = -1.62 for unadjusted model, coef. = -1.59 for adjusted model). In unadjusted models, it was found that higher score of *Structure* also had a higher intake on the daily servings of vegetables per 1000 kcal (coef. = 1.59), and a lower intake on the daily servings of fats per 1000 kcal (coef. = -1.24).

Table 5.7 Multiple Regression Models on Daily Food Group Intake for Children

Variables		Children' Daily Food Group Intake (servings/ 1000 kcal)							
		Fruits		Vegetables		Sweets		Fats	
		Unadjusted[a]	Adjusted[b]	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
Food Parenting Practices									
Structure	coef.[c]	1.00	0.83	1.25	1.17	-0.65	-0.72	-0.81	-0.63
	p Value	0.062	0.133	**0.015***	**0.025***	**0.031***	**0.017***	0.054	0.144
Coercive Control	coef.	0.33	0.29	0.47	0.71	0.53	0.28	0.41	0.30
	p Value	0.473	0.550	0.292	0.127	**0.043***	0.285	0.257	0.434
Autonomy Support	coef.	1.55	1.66	1.14	0.94	0.08	0.31	-0.41	-0.11
	p Value	**0.012***	**0.011***	0.052	0.123	0.827	0.371	0.388	0.829
N		167	164	167	164	167	164	167	164
R-squared		0.0913	0.1252	0.0951	0.1627	0.0474	0.1679	0.0421	0.1148
p Value		**0.001***	**0.021***	**0.001***	**0.002***	**0.047***	**0.001***	0.071	**0.039***

* $p < 0.05$.

[a] Results from separate regression models for each independent variable, without adjusting for potential confounders.

[b] Results from separate regression models for each independent variable, adjusted for child gender, child BMI percentile category, parent education level, and parent gender role.

[c] coef. = unstandardized coefficients.

Table 5.8 Multiple Regression Models on Daily Food Group Intake for Parents

Variables		**Parents' Daily Food Group Intake (servings/ 1000 kcal)**							
		Fruits		**Vegetables**		**Sweets**		**Fats**	
		Unadjusted[a]	**Adjusted[b]**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Food Parenting Practices									
Structure	coef.[c]	1.54	1.49	1.59	1.45	-1.62	-1.59	-1.24	-1.25
	p Value	**< 0.001***	**0.001***	**0.039***	0.069	**< 0.001***	**< 0.001***	**0.007***	0.009
Coercive Control	coef.	0.42	0.32	1.05	1.00	-0.29	-0.32	0.39	0.37
	p Value	0.252	0.374	0.117	0.147	0.417	0.364	0.322	0.369
Autonomy Support	coef.	0.79	0.70	0.27	0.01	-0.50	-0.51	-0.58	-0.49
	p Value	0.103	0.146	0.755	0.990	0.284	0.280	0.261	0.368
N		167	165	167	165	167	165	167	165
R-squared		0.1386	0.2073	0.0533	0.0744	0.1321	0.1976	0.0726	0.0787
p Value		**< 0.001***	**< 0.001***	**0.030***	0.200	**< 0.001***	**< 0.001***	**0.006***	0.163

* $p < 0.05$.

[a] Results from separate regression models for each independent variable, without adjusting for potential confounders.

[b] Results from separate regression models for each independent variable, adjusted for parent gender role, parent BMI category, and parent education level.

[c] coef. = unstandardized coefficients.

5.4 Discussion

The purpose of this study was to examine the relationship between food parenting practices and dietary intakes of preschool-aged children/parents. The results supported our hypothesis. In general, the main findings indicated that for both preschoolers and their parents, food parenting practices construct—*Structure* and its subconstructs were positively related to healthy dietary intakes (e.g., fruits) and inversely related to unhealthy dietary intakes (e.g., sweets). The results suggest that food parenting practices for preschoolers are important to consider when trying to improve healthy children's dietary intakes as well as modify parents' dietary intakes.

The participants in this study were recruited from three midwestern states. Compared to the population data at the state level,[59] the sample slightly over-represented White population, slightly under-represented Black and American Indian population; and had higher household income and education level. Regarding to the BMI, both parents and children participants had lower overweight and obese percent compared to the state population.[60] (Description of study setting at the state level was provided in the supplemental materials Appendix 5.1). As for the dietary intakes, the consumption of iron for participating children and mothers were lower than RDA, and the consumption of grains for children and their parents were also lower. In the United States, approximately half of dietary iron comes from bread, cereal, and other whole and/or enriched grain products. Iron intake may be better increased through increased intake of grains and some vegetables.[61] As children's dietary intake patterns are likely to track into adulthood, early efforts to meets recommendations for both nutrients and food groups may have positive health benefits longer term into adult life.[62]

Consistent with related literature about food parenting practices and children's dietary intakes, we confirmed the results of previous studies that more nondirective child-centered food practices (such as *Structure* and *Autonomy Support* constructs) were related to consuming healthier diets (e.g., fruit and vegetable consumption)[63-65], and *Coercive Control* practices was associated with unhealthy behaviors (e.g., sweets and fats consumption).[66] Our study also provided more associations between specific food parenting practices and children's energy and nutrient intakes, for example *Meal and Snack Routines* was associated with higher consuming of iron and folate; *Rules and Limits*, *Healthy Food availability and accessibility*, *Child Involvement: Shopping* were associated with higher consuming of vitamin C, B6, A, and folate. These findings were consistent with the similar associations reported in our study, which these food parenting practices also related to higher consuming of food groups which contains these nutrients (e.g., grain, fruits, and vegetables). No known literature explored the relationship between food parenting practices and children dietary nutrient intakes, future studies are needed to confirm theses associations using more rigorous diet assessment protocols in larger samples with longitudinal data.

The associations between food parenting practices and children's dietary intakes did produce some unexpected results. For example, *Rules and Limits* and *Healthy Food Availability and Accessibility* were found negatively related to dairy intakes; *Pressure to Eat* had weak positive relationship with vegetable intakes. Previous studies of how *Rules and limits* influence child eating behaviors have inconsistent findings.[36] With some studies suggesting that *Rules and Limits* are associated with higher intakes healthier diets,[67,68] others show different associations between unhealthy foods.[69,70] This could be

because even though *Rules and Limits* is focusing on noncoercive practice, it still has the property in enforcing parent-centered limits on a child's access of foods. The distinction between coercive and noncoercive types of restriction may help with a better understanding of *Rules and Limits*. Regarding to *Pressure to Eat*, it is important to distinguish between practices that pressure a child to eat more food and those that pressure a child to eat more healthy foods.[36] Intakes of vegetables may be more strongly related to the use of pressure to eat healthy foods.[36] Another explanation is immediate and long-term impacts of these practices are different. For example, previous studies found that *Pressure to Eat* had desired effect in the short term, but over time the repeated pressure to eat disliked foods may cause children to develop aversions.[71,72] To establish a causal relationship for food parenting practices and dietary intakes, longitudinal study can benefit and indicate the long-term impacts of food parenting practices.

There was limited literature examine the relationship between food parenting practices and parent dietary intakes. One explanation is it is easier for parents/caregivers to use food parenting practices to stimulate children's intake of healthy foods than changing their own dietary behaviors. Our studies indicated that food parenting practices within *Structure* construct were positively associated fruits intakes and negatively associated with sweets and fats intakes. Thus, the use of food parenting practices not only improves the children's intake of healthy foods and prevents intake of unhealthy foods, but also helps with parents' healthy diet behaviors. The relationships between parenting practices, and children's/parents' dietary intakes were more complicated.[73] Parents not only influence children but also react to the behaviors and personalities of their

children.[36] More future work are needed to examine the bidirectional relationship of parent-child interactions around food.

5.4.1 Limitation and Strength

Limitations to this study are important to acknowledge. Reporting bias is possible as parents reported data for both of children and themselves. Food frequency survey was used to assess the intakes of nutrients. Overreporting or underreporting may exist and can affect the usefulness of the collected dietary data.[73] This study used the refined CHES survey - an existing home environments assessment to capture food parenting practices constructs and subconstructs. In addition, the results from this study only present the relationships between food parenting practices and dietary intakes, causality is difficult to establish. At last, the sample population in this study were limited to preschool children (one child from one parent) and the majority of parents were mothers, had higher household income and education level compared to the state population.[40] This may limit the generalizability to different age groups of children or a larger level population.

One of the study strengths is the age group assessed since preschool age is an important developmental period for adopting healthy eating habits. Another study strength is using Vaughn's comprehensive theoretical framework which has clear structure and definitions to measure food parenting practices.[36] In addition, this study provides a comprehensive dietary intakes result including energy intakes, nutrient intakes, and food groups intakes through a validated dietary measurement tool. Furthermore, this study linked both parents' and children's data, which is added to the study's strength.

5.4.2 Implications for Research and Practice

With the present study, we used data from a sample of preschoolers and their parents to investigate the associations between food parenting practices and dietary intakes of selected nutrients and food groups. The results addressed the importance of food parenting practices for healthy dietary intakes for both preschoolers and their parents, which suggested that future interventions and educational programs could target parents to explore effective ways to change food parenting practices and their impact on child diet and eating behaviors. Additionally, the results of this study create the opportunity for future investigation of interactive effects between parents' dietary behavior, their food parenting practices, and children's dietary behavior. To establish a causal relationship between food parenting practices and dietary intakes, longitudinal studies are needed to examine the long-term impacts of food parenting practices. Furthermore, future research can apply for a larger sample or population.

REFERENCES

1. Swinburn B, Egger G, Raza F. Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. *Prev Med.* 1999;29(6 Pt 1):563-570.
2. Couch SC, Glanz K, Zhou C, Sallis JF, Saelens BE. Home food environment in relation to children's diet quality and weight status. *J Acad Nutr Diet.* 2014;114(10):1569-1579.e1561.
3. Scaglioni S, Arrizza C, Vecchi F, Tedeschi S. Determinants of children's eating behavior. *Am J Clin Nutr.* 2011;94(6 Suppl):2006s-2011s.
4. Agras WS, Kraemer HC, Berkowitz RI, Hammer LD. Influence of early feeding style on adiposity at 6 years of age. *J Pediatr.* 1990;116(5):805-809.
5. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med.* 1997;337(13):869-873.
6. Grilo CM, Pogue-Geile MF. The nature of environmental influences on weight and obesity: a behavior genetic analysis. *Psychol Bull.* 1991;110(3):520-537.
7. Guo SS, Chumlea WC. Tracking of body mass index in children in relation to overweight in adulthood. *Am J Clin Nutr.* 1999;70(1 Part 2):145s-148s.
8. Freedman DS, Khan LK, Serdula MK, Dietz WH, Srinivasan SR, Berenson GS. The relation of childhood BMI to adult adiposity: the Bogalusa Heart Study. *Pediatrics.* 2005;115(1):22-27.
9. Wijga AH, Scholtens S, Bemelmans WJ, et al. Comorbidities of obesity in school children: a cross-sectional study in the PIAMA birth cohort. *BMC Public Health.* 2010;10:184. doi:10.1186/1471-2458-10-184.

10. Benton D. Role of parents in the determination of the food preferences of children and the development of obesity. *Int J Obes Relat Metab Disord.* 2004;28(7):858-869.

11. Birch LL. Development of food preferences. *Annu Rev Nutr.* 1999;19:41-62.

12. Desor JA, Maller O, Andrews K. Ingestive responses of human newborns to salty, sour, and bitter stimuli. *J Comp Physiol Psychol.* 1975;89(8):966-970.

13. Birch LL, Marlin DW. I don't like it; I never tried it: effects of exposure on two-year-old children's food preferences. *Appetite.* 1982;3(4):353-360.

14. Pliner P. The effects of mere exposure on liking for edible substances. *Appetite.* 1982;3(3):283-290.

15. Anzman-Frasca S, Savage JS, Marini ME, Fisher JO, Birch LL. Repeated exposure and associative conditioning promote preschool children's liking of vegetables. *Appetite.* 2012;58(2):543-553.

16. Hausner H, Olsen A, Moller P. Mere exposure and flavour-flavour learning increase 2-3 year-old children's acceptance of a novel vegetable. *Appetite.* 2012;58(3):1152-1159.

17. Wardle J, Cooke LJ, Gibson EL, Sapochnik M, Sheiham A, Lawson M. Increasing children's acceptance of vegetables; a randomized trial of parent-led exposure. *Appetite.* 2003;40(2):155-162.

18. Sutherland LA, Beavers DP, Kupper LL, Bernhardt AM, Heatherton T, Dalton MA. Like parent, like child: child food and beverage choices during role playing. *Arch Pediatr Adolesc Med.* 2008;162(11):1063-1069.

19. Harper LV, Sanders KM. The effect of adults' eating on young children's acceptance of unfamiliar foods. *J Exp Child Psychol.* 1975;20(2):206-214.

20. Johannsen DL, Johannsen NM, Specker BL. Influence of parents' eating behaviors and child feeding practices on children's weight status. *Obesity (Silver Spring).* 2006;14(3):431-439.

21. Fisher JO, Mitchell DC, Smiciklas-Wright H, Birch LL. Parental influences on young girls' fruit and vegetable, micronutrient, and fat intakes. *J Am Diet Assoc.* 2002;102(1):58-64.

22. Birch LL. Effects of peer models' food choices and eating behaviors on preschoolers' food preferences. *Child Dev.* 1980;51(2):489-496.

23. Addessi E, Galloway AT, Visalberghi E, Birch LL. Specific social influences on the acceptance of novel foods in 2-5-year-old children. *Appetite.* 2005;45(3):264-271.

24. Shutts K, Kinzler KD, DeJesus JM. Understanding infants' and children's social learning about foods: previous research and new prospects. *Dev Psychol.* 2013;49(3):419-425.

25. Hendy HM, Raudenbush B. Effectiveness of teacher modeling to encourage food acceptance in preschool children. *Appetite.* 2000;34(1):61-76.

26. Patrick H, Nicklas TA. A review of family and social determinants of children's eating patterns and diet quality. *J Am Coll Nutr.* 2005;24(2):83-92.

27. Campbell KJ, Crawford DA, Salmon J, Carver A, Garnett SP, Baur LA. Associations between the home food environment and obesity-promoting eating behaviors in adolescence. *Obesity (Silver Spring).* 2007;15(3):719-730.

28. Darling N, Steinberg L. Parenting style as context: an integrative model *Psychol Bull.* 1993;1(13):487-496.

29. Ventura AK, Birch LL. Does parenting affect children's eating and weight status? *Int J Behav Nutr Phys Act.* 2008;5:15. doi:10.1186/1479-5868-5-15.

30. Johnson SL, Birch LL. Parents' and children's adiposity and eating style. *Pediatrics.* 1994;94:653-661.

31. Frankel LA, O'Connor TM, Chen T-A, Nicklas T, Power TG, Hughes SO. Parents' perceptions of preschool children's ability to regulate eating. Feeding style differences. *Appetite.* 2014;76:166-174.

32. Birch LL, Fisher JO, Davison KK. Learning to overeat: maternal use of restrictive feeding practices promotes girls' eating in the absence of hunger. *Am J Clin Nutr.* 2003;78(2):215-220.

33. Fisher JO, Birch LL. Restricting access to foods and children's eating. *Appetite.* 1999;32(3):405-419.

34. Larsen JK, Hermans RCJ, Sleddens EFC, Engels RCME, Fisher JO, Kremers SPJ. How parental dietary behavior and food parenting practices affect children's dietary behavior. Interacting sources of influence? *Appetite.* 2015;89:246-257.

35. Birch LL, Zimmerman SI, Hind H. The influence of social-affective context on the formation of children's food preferences. *Child Dev.* 1980;51(3):856-861.

36. Vaughn AE, Ward DS, Fisher JO, et al. Fundamental constructs in food parenting practices: a content map to guide future research. *Nutr Rev.* 2016;74(2):98-117.

37. Vaughn AE, Dearth-Wesley T, Tabak RG, Bryant M, Ward DS. Development of a comprehensive assessment of food parenting practices: the home self-

administered tool for environmental assessment of activity and diet family food practices survey. *J Acad Nutr Diet.* 2017;117(2):214-227.

38. Gevers DW, Kremers SP, De Vries NK, Van Assema P. Clarifying concepts of food parenting practices. A Delphi study with an application to snacking behavior. *Appetite.* 2014;79:51-57.

39. Birch LL, Fisher JO. Development of eating behaviors among children and adolescents. *Pediatrics.* 1998;101(3 Pt 2):539-549.

40. Larsen JK, Hermans RC, Sleddens EF, Engels RC, Fisher JO, Kremers SP. How parental dietary behavior and food parenting practices affect children's dietary behavior. Interacting sources of influence? *Appetite.* 2015;89:246-257.

41. Arlinghaus KR, Vollrath K, Hernandez DC, et al. Authoritative parent feeding style is associated with better child dietary quality at dinner among low-income minority families. *Am J Clin Nutr.* 2018;108(4):730-736.

42. National Institutes of Health. The practical guide: the identification, evaluation and treatment of overweight and obesity in adults. Available at: https://www.nhlbi.nih.gov/files/docs/guidelines/prctgd_c.pdf. Accessed January 10, 2018.

43. Barlow SE. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics.* 2007;120(Supplement 4):S164-S192.

44. Watts V, Rockett H, Baer H, Leppert J, Colditz G. Assessing diet quality in a population of low-income pregnant women: a comparison between Native Americans and whites. *Matern Child Health J.* 2007;11(2):127-136.

45. Baer HJ, Blum RE, Rockett HR, et al. Use of a food frequency questionnaire in American Indian and Caucasian pregnant women: a validation study. *BMC Public Health.* 2005;5. doi:10.1186/1471-2458-5-135.

46. Wei EK, Gardner J, Field AE, Rosner BA, Colditz GA, Suitor CW. Validity of a food frequency questionnaire in assessing nutrient intakes of low-income pregnant women. *Matern Child Health J.* 1999;3(4):241-246.

47. Blum RE, Wei EK, Rockett HR, et al. Validation of a food frequency questionnaire in Native American and Caucasian children 1 to 5 years of age. *Matern Child Health J.* 1999;3(3):167-172.

48. Harvard T.H. Chan School of Public Health Nutrition Department's file download site. Available at: https://regepi.bwh.harvard.edu/health/nutrition.html. Accessed December 11, 2016.

49. Colditz G. Dietary intake and health outcomes: final report. U.S. Department of Agriculture, Economic Research Service website. Available at: https://naldc.nal.usda.gov/download/32818/PDF. Accessed December 11, 2016.

50. Suitor CJ, Gardner J, Willett WC. A comparison of food frequency and diet recall methods in studies of nutrient intake of low-income pregnant women. *J Am Diet Assoc.* 1989;89(12):1786-1794.

51. Pinard CA, Yaroch AL, Hart MH, Serrano EL, McFerren MM, Estabrooks PA. The validity and reliability of the comprehensive home environment survey (CHES). *Health Promot Pract.* 2014;15(1):109-117.

52. Yong AG, Pearce S. A beginner's guide to factor analysis: focusing on exploratory factor analysis. *Tutor Quant Methods Psychol.* 2013;9(2):79-94.

53. Haszard JJ, Williams SM, Dawson AM, Skidmore PM, Taylor RW. Factor analysis of the comprehensive feeding practices questionnaire in a large sample of children. *Appetite.* 2013;62:110-118.

54. Taber KS. The use of cronbach's alpha when developing and reporting research instruments in science education. *Res Sci Educ.* 2018;48(6):1273-1296.

55. Trumbo P, Schlicker S, Yates AA, Poos M. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein and amino acids. *J Am Diet Assoc.* 2002;102(11):1621-1630.

56. Dietary Reference Intakes for Calcium and Vitamin D. In: Ross AC, Taylor CL, Yaktine AL, Del Valle HB, eds. Washington (DC): National Academies Press (U.S.); 2011: https://www.nap.edu/catalog/13050/dietary-reference-intakes-for-calcium-and-vitamin-d.

57. Tips for using the food guide pyramid for young children booklet. U.S. Department of Agriculture, Food and Nutrition Service website. Available at: https://www.fns.usda.gov/food-guide-pyramid-young-children-graphic-resources. Accessed December 11, 2018.

58. Food guide pyramid booklet, 1992 (revised 1996). U.S. Department of Agriculture, Food and Nutrition Service website. Available at: https://www.fns.usda.gov/food-guide-pyramid-print-materials. Accessed December 11, 2018.

59. U.S. Census Bureau data. QuickFacts: South Dakota; Minnesota; Nebraska. U.S. Census Bureau website. Available at:

https://www.census.gov/quickfacts/fact/table/SD,MN,NE/AGE135218. Accessed June 4, 2020.

60. Nutriton, physical activity, and obesity: data, trends, and maps. Centers for Disease Control and Prevention, Division of Nutrition, Physical Activity, and Obesity website. Available at: https://www.cdc.gov/nccdphp/dnpao/data-trends-maps/index.html. Accessed June 4, 2020.

61. Iron-fact sheet for health professionals. National Institutes of Health, Office of Dietary Supplements website. Available at: https://ods.od.nih.gov/factsheets/Iron-HealthProfessional/. Accessed July 15, 2020.

62. Mackenzie ML, Triador L, Gill JK, et al. Dietary intake in youth with prader-willi syndrome. *Am J Med Genet A.* 2018;176(11):2309-2317.

63. Sleddens EF, Kremers SP, Stafleu A, Dagnelie PC, De Vries NK, Thijs C. Food parenting practices and child dietary behavior. Prospective relations and the moderating role of general parenting. *Appetite.* 2014;79:42-50.

64. Murashima M, Hoerr SL, Hughes SO, Kaplowitz SA. Feeding behaviors of low-income mothers: directive control relates to a lower BMI in children, and a nondirective control relates to a healthier diet in preschoolers. *Am J Clin Nutr.* 2012;95(5):1031-1037.

65. Vereecken C, Rovner A, Maes L. Associations of parenting styles, parental feeding practices and child characteristics with young children's fruit and vegetable consumption. *Appetite.* 2010;55(3):589-596.

66. Vaughn AE, Tabak RG, Bryant MJ, Ward DS. Measuring parent food practices: a systematic review of existing measures and examination of instruments. *Int J Behav Nutr Phys Act.* 2013;10. doi:10.1186/1479-5868-10-61.

67. De Bourdeaudhuij I. Family food rules and healthy eating in adolescents. *J Health Psychol.* 1997;2(1):45-56.

68. Lopez NV, Ayala GX, Corder K, et al. Parent support and parent-mediated behaviors are associated with children's sugary beverage consumption. *J Acad Nutr Diet.* 2012;112(4):541-547.

69. Bourdeaudhuij ID, Oost PV. Personal and family determinants of dietary behaviour in adolescents and their parents. *Psychol Health.* 2000;15(6):751-770.

70. Corsini N, Wilson C, Kettler L, Danthiir V. Development and preliminary validation of the toddler snack food feeding questionnaire. *Appetite.* 2010;54(3):570-578.

71. Gregory JE, Paxton SJ, Brozovic AM. Maternal feeding practices predict fruit and vegetable consumption in young children. Results of a 12-month longitudinal study. *Appetite.* 2011;57(1):167-172.

72. Galloway AT, Fiorito LM, Francis LA, Birch LL. "Finish your soup": counterproductive effects of pressuring children to eat on intake and affect. *Appetite.* 2006;46(3):318-323.

73. Fleary SA, Ettienne R. The relationship between food parenting practices, parental diet and their adolescents' diet. *Appetite.* 2019;135:79-85.

Appendix 5.1 Descriptions of Study Setting at the State Level

Variable	South Dakota	Minnesota	Nebraska
Population (2019)	884,659	5,639,632	1,934,408
Race			
White	84.4%	84.1%	88.3%
Black or African American	2.4%	6.8%	5.1%
American Indian and Alaska Native	9.0%	1.4%	1.5%
Asian	1.7%	5.1%	2.7%
Household Income			
Median household income (in 2018 dollars, 2014-2018)	$56,499	$68,411	$59,116
Education			
Bachelor's degree or higher, percent of persons age 25+, 2014-2018	28.5%	35.4%	31.3%
High School graduate or higher, percent of persons age 25+, 2014-2018	91.7%	93.0%	91.1%
Health			
Overweight, adults aged 18 years and older, 2016	37.3%	37.0%	36.6%
Obese, adults aged 18 years and older, 2016	29.6%	27.8%	32.0%
Overweight, children aged 2 to 4 years, 2016	19.7%	16.0%	16.5%
Obese, children aged 2 to 4 years, 2016	17.1%	12.2%	15.2%

Source: Population, race, household income, and education data are derived from: U.S. Census Bureau data. QuickFacts: South Dakota; Minnesota; Nebraska. U.S. Census Bureau website. Available at: https://www.census.gov/quickfacts/fact/table/SD,MN,NE/AGE135218. Accessed June 4, 2020; overweight and obesity rates are from: Nutrition, physical activity, and obesity: data, trends, and maps. Centers for Disease Control and Prevention, Division of Nutrition, Physical Activity, and Obesity website. Available at: https://www.cdc.gov/nccdphp/dnpao/data-trends-maps/index.html. Accessed June 4, 2020.

CHAPTER 6

CONCLUSION

Childhood obesity has reached increasing levels to the point where one in three children is considered obese or overweight.[1] These children are at higher risk for health conditions. Further, children's diet plays a key role that related to childhood obesity.[2] Therefore, it is important to examine and understand the factors that influence young children's diet.

Parental influences play a particularly important role in determining the children's weight and shaping children's dietary behaviors.[3] For preschoolers, parents are usually the primary determinants of the types and amount of food children eat.[4] Children's dietary intakes could be influenced by their parents in general parenting approach (i.e., parenting styles) and specific parenting practices (e.g., food parenting practices).[5] Therefore, it is important to examine the associations between parenting styles, food parenting practices, and dietary intakes of preschoolers and their parents.

In recent years, researchers have used validated tools to assess the food parenting practices. But there is still a need for a comprehensive measurement of food parenting practices. To identify items and factors of food parenting practices as well as decrease the responding burden, the modification of the original CHES[6] was conducted. Following the guidance of the content map[7] of food parenting practices, the exploratory factor analysis results of this study highlighted the specific subconstructs within each of three food parenting practice constructs—*Structure*, *Coercive Control*, and *Autonomy Support*. The majority of identified subconstructs had moderate to high internal consistency (alpha ≥ 0.60). Additional correlation results indicated healthful practices like *Meal and Snack*

Routines, *Modeling*, *Rules and Limits*, *Healthy Food Availability and Accessibility*, and *Child Involvement* were positively correlated with one another, and unhealthful practices like *Restriction* and *Weight Concerns* were also inter-related. By identifying alternative factor structures, the refined CHES was expected to provide a comprehensive measurement of food parenting practices. Future research can build on this preliminary work to improve the measurement properties of the food parenting practices, examine its application to other populations and predict child eating behaviors.

In addition, this research examined the relationship between general parenting styles (i.e., authoritative, authoritarian, indulgent, and uninvolved) and dietary intakes of preschool-aged children and their parents. The main findings indicated no significant differences were seen for most assessed children's and parental dietary nutrients and food group intakes between authoritative parenting style and other three parenting styles. Children's food group intakes were positively associated with corresponding parental food group intakes, moreover, authoritative parents predicted more child fruits consumption. These results provided evidence for the benefits of authoritative parenting style and suggested that future interventions to increase preschool children's fruit consumption could target toward increasing caregivers' authoritative behaviors. These findings also suggested that integrating both general parenting and other parental dietary behaviors (e.g., food parenting practices and parental diet) is important for future research to improve the understanding the complex process of parent-child interactions and dietary behaviors.

The research continued to examine the relationship between food parenting practices and dietary intakes of preschool children/parents. The results were consistent

with previous studies that more nondirective child-centered food practices (such as *Structure* and *Autonomy Support* constructs) were related to consuming healthier diets (e.g., fruit and vegetable consumption), and *Coercive Control* practices was associated with unhealthy behaviors (e.g., sweets and fats consumption).These relationships were found for both preschoolers and their parents. Our study also provided more associations between specific food parenting practices and children's energy and nutrient intakes. The results suggested that food parenting practices for preschoolers are important to consider when trying to improve healthy children's dietary intakes as well as modify parents' dietary intakes.

In general, this dissertation addressed the importance of parenting styles and food parenting practices for healthy dietary intakes for preschoolers and their parents. Future interventions and educational programs could target parents to explore effective ways to change both general and specific parental influences on child diet and eating behaviors.

REFERENCES

1. Hales CM, Carroll MD, Fryar CD, Ogden CL. Prevalence of obesity among adults and youth: United States, 2015-2016. *NCHS Data Brief.* 2017(288):1-8.
2. Burnett AJ, Lamb KE, McCann J, Worsley A, Lacy KE. Parenting styles and the dietary intake of pre-school children: a systematic review. *Psychol Health.* 2020:1-20. doi:10.1080/08870446.2020.1743842.
3. Papaioannou MA, Cross MB, Power TG, et al. Feeding style differences in food parenting practices associated with fruit and vegetable intake in children from low-income families. *J Nutr Educ Behav.* 2013;45(6):643-651.
4. Wang L, Van De Gaar VM, Jansen W, Mieloo CL, Van Grieken A, Raat H. Feeding styles, parenting styles and snacking behaviour in children attending primary schools in multiethnic neighbourhoods: a cross-sectional study. *BMJ Open.* 2017;7(7):e015495. doi:10.1136/bmjopen-2016-015495.
5. Gerards SM, Kremers SP. The role of food parenting skills and the home food environment in children's weight gain and obesity. *Curr Obes Rep.* 2015;4(1):30-36.
6. Pinard CA, Yaroch AL, Hart MH, Serrano EL, McFerren MM, Estabrooks PA. The validity and reliability of the comprehensive home environment survey (CHES). *Health Promot Pract.* 2014;15(1):109-117.
7. Vaughn AE, Ward DS, Fisher JO, et al. Fundamental constructs in food parenting practices: a content map to guide future research. *Nutr Rev.* 2016;74(2):98-117.