Spring 2019

Parenting and Child Self-Regulation as Mechanisms for the Relationship of Household Food Insecurity with Child Dietary Behavior

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PARENTING AND CHILD SELF-REGULATION AS MECHANISMS FOR THE RELATIONSHIP OF HOUSEHOLD FOOD INSECURITY WITH CHILD DIETARY BEHAVIOR

by

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Submitted in Partial Fulfillment of the Requirements

For the Degree of Doctor of Philosophy in

Health Promotion, Education, and Behavior

The Norman J. Arnold School of Public Health

University of South Carolina

2019

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DEDICATION

For my husband Hung Manh and son Nam. It is for them I have taken this path.

ACKNOWLEDGEMENTS

It is impossible to thank all of those who have enabled me to go this far in my life and education! For me, the accomplishment of the dissertation and doctoral degree is a step of the life ladder and without any of the previous steps, I would not be there. I am deeply grateful for every single person that has ever come and gone or stayed in my life. Every single step, either with laughs or tears, success or failure, has taught me to treasure the beings, to welcome and accept people and things as they are, and to give unselfishly while seeking the ultimate truth of freedom and happiness.

My acknowledgement hereby is therefore a very simplified list to fit the limit of the dissertation pages; the list in my heart is unlimited. First, I want to thank Dr. Edward Frongillo, a dedicated professor and mentor of many American and international students. Without his guidance, support, and patience, this work would not be done. I am grateful for all the valuable advice that my committee members, Drs. Christine Blake, Cheri Shapiro, and Amy Frith, have given so that my thoughts can be challenged, my arguments can be strengthened, and my writing can be polished. I am thankful for all professors and staff in the Department of Health Promotion, Education, and Behaviors for teaching and advising me during my stay in the program.

My special gratitude is to my husband Hung Manh Pham and my son Nguyen Hoang Nam Pham for their unceasing accompanying, encouragement, and support since we have ever been with each other. All my work and achievements are attributable to them. Thank you to my parents and extended families for letting me go beyond the

traditional scope of life of a daughter, a woman, and a mother, starting with letting me become the first girl of the town to go away thousands of miles from the South to the North of Vietnam to study diplomacy and politics, and then to the United States to study women and gender studies, then health promotion—all alien topics to them. Thank you for not questioning me for pursuing higher education but unconditionally supporting despite doubts sometimes.

I am grateful for all friends and colleagues in the United States and Vietnam for giving me support whenever I need. Many of them may just meet me once or twice, or even none, but still make sure they can help as much as they can. My study and living in South Carolina have been smooth and warm with the presence and assistance of my dear friends Tatiana Martinez Jaikel, Nazratun Nayeem Monalisa, Sulochana Basnet, and Yoojin Cho. My senior friends, Shibani Kulkarni, Jessica Escobar, Andrea Warren, Seul Ki Choi, and Ligia Reyes, have always been available to give me their valuable advice and feedback. Thank you all!

My special thanks to Anna Berry Stiglbauer, John Stiglbauer, and her adorable daughter Ada Stiglbauer, for helping me and my family out many difficulties since we came to Columbia. I particularly thank Sarah Gareau for her wonderful mentorship and assurance of my progress in professional development. Many thanks to my colleagues at the Institute for Families in Society for their kindness and support so that I can complete my graduate assistantship and my dissertation at the top level. John Saavedra, please take my special thanks for generously giving your time and efforts to partially proofread this dissertation and support me throughout the writing process.

My gratitude is going on and on with all the many friends, colleagues, mentors, and supporters I have ever had in my life. Among them are those from ZERO TO THREE, iLEAP, Alive and Thrive, Fulbright program, my high school and middle school. Without being with them and having these educational and professional opportunities, I cannot have the confidence in taking leadership in transforming lives for health and well-being of everyone, particularly women and children.

ABSTRACT

Background: Food insecurity is both a nutritional problem and a stressful life experience of adults and children in households dealing with food shortage. Potential mechanisms of the associations between food insecurity and adverse outcomes in children's health and development are through parenting and child self-regulation.

Objectives: We investigated parenting and child self-regulation as potential mechanisms for the relationship of food insecurity with child dietary behaviors with two specific aims. Specific aim 1 was to understand how food insecurity and its change over time relate to parenting in early childhood. Specific aim 2 was to understand the relationship of parenting in food-related and non-food-related settings with dietary intake of young children and the role of child self-regulation in this relationship.

Methods: Data were from the Early Childhood Longitudinal Study – Birth Cohort. Parent-child dyads with non-missing outcomes were included into the analysis. Analyses were done separately for boys and girls. Regression models with full information maximum likelihood were used accounting for clusters in Stata. For specific aim 1, the parenting outcomes were parent-child interaction, difficulty sticking with rules, harsh disciplinary practices, rules about watching television, rules about food, routines of eating evening meals as a family and at a regular time in years 2, 4, and 5. Each parenting outcome was first regressed on the earlier food insecurity and covariates, then additionally regressed on the concurrent food insecurity. For Specific aim 2, the child's dietary outcomes were weekly frequency of intake of sugar-sweetened beverages, sweet

foods and desserts, salty snack foods, fruits, and vegetables in year 5. Each child dietary outcome was regressed on food parenting variables at age 4 (i.e., rules about foods, and meal routines of eating as a family and at a regular time) and covariates. General parenting variables at age 4 (i.e., parent-child interaction, difficulty sticking with rules, harsh discipline, rules about watching television, and rules about bedtime), child difficulty in self-regulation at age 4, and their interactions were then added sequentially.

Results: For specific aim 1, earlier food insecurity was associated with using harsh disciplinary practices in year 5, having rules about food in year 4, and having evening meals at a regular time in years 2 and 4 among parents of girls. Among parents of boys, earlier food insecurity was associated with having evening meals at a regular time in years 2 and 4. Concurrent food insecurity was associated with parenting in years 2 and 4 for boys and girls but not in year 5. The magnitude of the associations over time of earlier and concurrent food insecurity with harsh disciplinary practices, rules about food, and meal routines were generally greater for girls than boys. For specific aim 2, better food parenting practices at age 4 were associated with less frequent intake of unhealthy and more frequent intake of healthy foods and beverages in both boys and girls at age 5, with some differences by gender. General parenting practices at age 4 were associated with dietary behaviors differently for boys and girls. Difficulty in self-regulation at age 4 significantly modified the association between parenting practices and child's dietary behaviors for boys (evening meals at a regular time and intake of sweet foods and desserts) and girls (parent-child interaction and intake of sugar-sweetened beverages; difficulty sticking with rules and intake of sweet foods and desserts; rules about foods and intake of fruits and vegetables; and harsh discipline and intake of fruits).

Conclusions: In early childhood, earlier and concurrent food insecurity were linked with suboptimal parenting in structuring a general and food-related living environment for young children, particularly for girls and by the age of 5, through increased use of harsh discipline, lack of rules about foods, and irregular meal routines. Better food parenting and general parenting practices at age 4 were associated with children's healthy dietary behaviors at age 5, and the child's difficulty in self-regulation plays an important role in modifying this association, particularly in girls. Further investigations on the potential mechanisms for the relationship of earlier and concurrent food insecurity with parenting in early childhood and how these mechanisms change as the children reach age 5 are needed. Given that both parents and children could be active agents in the development of children's dietary behaviors, further investigations will help to identify interventions and programs targeting both parents and children to promote positive parenting in food and non-food settings and support children with difficulty in self-regulation.

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CHAPTER 1

INTRODUCTION

In 2017, 15.7% of the households with children in the United States—6 million households—were food insecure, i.e., having limited access to adequate foods to maintain a healthy life at times during a year due to lack of money and other resources.[1] Food insecurity is both a nutritional problem and a stressful life experience of adults and children in households dealing with food shortage.[2] Compared to their peers in food-secure households, children living in households with food insecurity are at a higher risk of having poor health, suboptimal nutritional status, and problems with linguistic development, school performance, and social interactions.[3–10] Food insecurity is also linked to eating behaviors of young children.[11] Potential mechanisms of the associations between food insecurity and adverse outcomes in children's health and development are through parenting[3,5,6] and child self-regulation.[12,13] Nevertheless, the role of parenting and child self-regulation as mechanisms for the relationship of food insecurity with child dietary behaviors has not been well understood, especially in the early years of the child's life.

Parenting–the way parents care and nurture their children–plays an important role in fostering children's healthy growth and fulfilled development in early childhood.[14,15] As a broad concept, parenting is inclusive of multiple aspects of child care and nurturing. Parenting could be measured in terms of styles, parent-child interaction, or specific practices in general or food-related settings.[16,17] Parenting styles reflect the global climate

of the parent-child relationship characterized by dimensions of demandingness (or control) and responsiveness (or warmth and supportiveness).[18] Parent-child interaction reveals the quality of the parent-child relationship.[19,20] Parenting practices refer to parent's specific behaviors and activities relating to the child, such as enforcing discipline with rules or punishment and setting family routines of playing, reading, eating, and sleeping.[18] Parent-child interaction and parenting practices constitute a socio-emotional structure of the child's living environment and depend on parent's personal resources, child's characteristics, and contextual stress and support.[21]

On one hand, food insecurity could be an important determinant of parent-child interaction and parenting practices, given its impacts on the household's material circumstance and the functioning and psycho-social life of the family.[22–24] Food insecurity, even if mild, has been linked with adverse health outcomes of young children and their mothers.[25] Mothers experiencing food insecurity are at heightened risk of maternal depression and anxiety,[26,27] which in turn negatively affect their parenting capacity and multiple outcomes of their children.[3,28,29] Understanding parenting in households with food insecurity in early childhood is thus important for both parent and child well-being.

On the other hand, children's eating behaviors develop in early childhood. Parents play a key role in this process through their parenting in creating an environment to nurture the children.[30,31] Children, however, vary in responding to the environment depending on their self-regulation capacity—that is the capacity to attend and adapt to situational demands occurring from the inner self or the external environment.[32,33] Child self-regulation is both nature and nurture, being a product of personality traits (often

referred as temperament) and the socialization process where the child learns and changes in response to the social context he/she is in.[34,35] This socialization process is often supported and guided by parenting, particularly in early childhood. The development of child behaviors in early childhood, including eating behavior, is therefore a function of both parenting and child self-regulation.[12,13]

Recent literature suggested an association of selected parenting aspects (e.g., quality of parent-child interaction and setting up rules for house routines) and child self-regulation with child's nutrition status (e.g., weight and body mass index) in early childhood.[12,13,30,36–39] There is, however, a gap in our understanding about the relationship of parenting and child self-regulation with child eating behaviors in early childhood. In addition, households may move in or out food insecurity and changes in household's food insecurity status over time might pose different challenges to parenting. Little is known about the relationship of food insecurity and its longitudinal change with parenting in households with young children. Previous studies on food insecurity and its impacts on parents and children were mostly cross-sectional[3,4] and targeted at older children.[5,7–10] Several studies examining food insecurity over time in households with young children focused on the child outcomes (e.g., child obesity and toddler development),[6,40] leaving a gap in understanding temporal impacts of food insecurity on parenting outcomes in these households.

To investigate parenting and child self-regulation as potential mechanisms for the relationship of food insecurity with child dietary behaviors, we addressed these two research gaps with two specific aims. In these aims, we examined parenting in building the parent-child relationship and structuring the living environment of the child through

parent-child interaction and practices of discipline, rules, and routines in general and food-related settings. We referred to parenting in food-related and non-food-related settings as *food parenting* and *general parenting*, respectively. The two specific aims were organized into two separate manuscripts.

Manuscript 1

Specific aim 1: To understand how food insecurity and its change over time relate to parenting in early childhood.

In this study, we hypothesized that both earlier and concurrent food insecurity were associated with suboptimal parenting.

Manuscript 2

Specific aim 2: To understand the relationship of parenting in food-related and non-food-related settings with dietary intake of young children and the role of child self-regulation in this relationship.

In this study, we had four hypotheses:

1) Food parenting practices in setting rules about the child's food intake and maintaining meal routines at age 4 are associated with the child's healthy dietary intake at age 5.
2) Beyond food parenting practices, general parenting in daily interactions, disciplines, and house rules at age 4 is independently associated with the child's dietary intake at age 5.
3) Child difficulty in self-regulation at age 4 is independently associated with his or her dietary intake at age 5; and

4) Child difficulty in self-regulation modifies the relationship of general and food parenting at age 4 with the child's dietary intake at age 5.

Given that differential effects of food insecurity on health, developmental, and behavioral outcomes by child gender were observed in children,[9,41,42] we investigated our hypotheses separately for boys and girls.

The results of these two studies advance knowledge of the associations of parenting with food insecurity in early childhood and of parenting and child self-regulation with child dietary behaviors at 4 and 5 years of age. We demonstrated that in early childhood, earlier and concurrent food insecurity were linked with suboptimal parenting in structuring a general and food-related living environment for young children, particularly for girls and by the age of 5, through increased use of harsh discipline, lack of rules about foods, and irregular meal routines. Better food parenting and general parenting practices at age 4 were associated with children's healthy dietary behaviors at age 5, and child difficulty in self-regulation plays an important role in modifying this association, particularly in girls. Further investigations on the potential mechanisms for the relationship of earlier and concurrent food insecurity with parenting in early childhood and how these mechanisms change as the children reach age 5 are needed. Given that both parents and children could be active agents in the development of children's dietary behaviors, further investigations will help to identify interventions and programs targeting both parents and children to promote positive parenting in food and non-food settings and support children with difficulty in self-regulation.

Chapter 1 introduces the research topic, aims, findings, and the organization of the document. Chapter 2 presents the background and significance for the research.

Chapter 3 details the research design and methods. Chapter 4 includes the two manuscripts describing the research results. Chapter 5 brings about the conclusions and implications.

CHAPTER 2

BACKGROUND AND SIGNIFICANCE

This chapter provides background information of the proposed research, followed by a description of the research significance. The background section begins with an overview of food insecurity and dietary behaviors in the United States with a focus on families with children. Following is a brief introduction of relevant theoretical frameworks of the research, i.e., child development theories, parenting concepts, and parenting in child nutrition study. Next, a review of previous studies about food insecurity and parenting is presented. In this part, we discuss the current body of knowledge about parenting in the relationship between food insecurity and child development and longitudinal effects of food insecurity on parenting. Later is a review of previous studies about parenting, child self-regulation, and child dietary intake. In this part, we explored parenting in general and food-related settings. We evaluated current knowledge about the relationship of parenting in general and food-related settings with child dietary intake and about the potential role of child self-regulation in this relationship. Summaries of research gaps are given immediately after each review section. Finally, our research is introduced with descriptions of its conceptual model and contribution to addressing the identified research gaps.

1. Food insecurity and dietary behaviors in the United States

Food insecurity is an experience of having limited access to adequate foods to maintain a healthy life at times during a year due to lack of money and other resources.[1]

Food insecurity as a non-voluntary experience ties to three issues: "1) uncertainty about future food availability and access; 2) insufficiency in the amount and kind of food required for a healthy lifestyle; and (3) the need to use socially unacceptable ways to acquire food."[43(p44)] The uncertainty, insufficiency, and social unacceptability make food insecurity become not only a nutritional problem but also a stressful life experience.[43] Food insecurity may induce undereating when food is short and overeating when food is available, resulting in poor nutritional status. Experiencing food insecurity may lead to distress, worry, and tension in family and social interactions.[43] Efforts to manage the challenging food situation may create chaotic routines in the household and disturb the psycho-social life of all members.[23,44] Food insecurity is closely related to economic hardship, yet not identical,[45] and can exert independent effects on the living, health, and well-being of the individuals and their households.[46]

Food insecurity is both an individual and collective experience, yet it is commonly measured at the household level.[47] In the United States, 11.8% of the households (i.e., 15 million households) were food insecure, and among the households with children, 15.7% (i.e., 6 million households) were food insecure as reported in 2017.[1] Both children and adults are subject to the household's food insecurity, yet their food-insecure experience may vary and child food insecurity is often under reported.[2,8,48–50]

In addition to food insecurity, suboptimal dietary behaviors are also a nutrition issue of concerns for the public health in the United States. Suboptimal dietary behaviors are associated with excess weight gain and development of obesity and obesity-related chronic diseases across the life span, including at young ages and later in adulthood.[51–56] In the United States, one in every five children aged 2-5 years is either overweight or

obese,[57,58] and the prevalence of overweight and obesity in adulthood is even more striking: 68.5%, i.e. two in every three adults aged 20 and above.[57] Improving dietary behaviors and diet quality of the population at all ages is at the center of national strategies to curb the excess-weight epidemic.[59–61] Despite multiple efforts at different levels and settings, the diet quality of Americans remains far from the optimal recommendations as seen in the American average score of Healthy Eating Index—which was only 59 out of 100, according to the National Health and Nutrition Examination Survey, 2013-2014— and the diet quality of children is even lower than the average, i.e., 53 out of 100 for children aged 6-17.[62] Low-quality diets—diets with limited consumption of fruit and vegetables and excessive intake of empty calories from solid fats and added sugars—put the children at great risk of childhood obesity, as well as multiple health and social problems going along with this non-communicable chronic disease.

2. Theoretical framework

2.1. Child development theories

Understanding child development theories is important to understanding the development of child dietary behaviors. One of the most important theories in child development is the Ecological System Theory of Urie Bronfenbrenner. First introduced in 1977, the highlight of this theory is that human development takes place in a complex environment of many systems that are nested in each other. These systems involve multiple elements within and beyond the individual's scope. These elements unceasingly evolve, interact, and compound to determine how the individual is developing physically and psychosocially.

The systems in which the individuals develop were identified as "microsystem," "mesosystem," "exosystem," and "macrosystem."[63] The individual's age, sex, health, etc. are individual factors. These individual factors are nested within the microsystem of multiple relations between the individual and his or her immediate environment such as family, school, neighborhood, and religious group. This microsystem is nested within the mesosystem of complex interrelations among the components of the individual's immediate environment. The mesosytem is nested within the exosystem of distal social structures, such as government agencies, communication and transportation facilities, neighborhood, and mass media. This mesosystem is nested within the macrosystem of fundamental constitution underlining the operation of the socio-economic and cultural systems in which the mesosystem takes place.[64]

In the 1990s-2000s, the Ecological System Theory gradually developed together with the Life Course Theory in human development and health.[65–67] One of the most important concepts in the Life Course Theory is timing, i.e., the time of exposure to events, circumstances, and experiences. Different timing of the same events or experiences may affect the individual differently, as the meaning of such events and experiences varies by developmental stages.[66] Also, early life experiences determine later life trajectories.[65,67,68] The ideas about time were incorporated into the Ecological System Theory as Bronfenbrenner expanded it in 1994; he included the chronosystem that takes into account individual and environmental dynamics over time along the micro-, meso-, exo-, and macrosystems. In this expanded model, he also acknowledged that genetic inheritance is a crucial part of human development.[69] These two components emphasized "the continuity and change in the biopsychological characteristics of human beings both

as individuals and as groups [….] over the life course across successive generations and through historical time, both past and present," thus expanding the Ecological System Theory of Human Development into the Bioecological Theory of Human Development.[70] Various theories of human development, including that of Bronfenbrenner, were later synthesized in Sameroff's Unified Theory of Development in 2010. This theory emphasized inter-active, inter-dependent, and inter-inclusive relationship between individual and context, raising the need to integrate personal change, contextual, regulation, and representation models in studying human development.[71]

Another central theory of child development is Attachment Theory. Developed by Bowlby from the 1950s to early 1980s, Attachment Theory highlights the emotional bond between the infant and the caregiver(s) that ensures a secure environment for the child's exploration and learning.[72] Secure environments and relationships in early life foster the process of structuring the child's brain and developing important skills (such as self-regulation) and capacities (such as cognitive or socio-emotional competences).[20] Attachment Theory was further developed by Ainsworth in the late 1970s. She proposed the sensitivity-responsivity theory of attachment that "children develop secure attachments with caregivers who are sensitive and responsive to them."[19(p10)] Sensitivity indicates the capacity of the caregiver to be aware of the infant's non-verbal and verbal communications for his or her needs and wants, and responsivity or responsiveness refers to the caregiver's capacity to respond contingently and appropriately to those signals.[19] The sensitivity and responsivity of the caregiver can be observed in the caregiver-child interaction in feeding and beyond feeding contexts. They constitute the quality of caregiver-child relationship that lays the foundation for early childhood development.

2.2. Parenting concepts

While Ecological System Theory emphasizes the need to understand individuals within the environments in which they are situated and acknowledges dynamic interactions within and across systems, Attachment Theory underscores the crucial role of the caregivers in infancy and early childhood. According to Richter (2004), while the term caregiver is inclusive in addressing all people who possibly provide care, the term divorces from an embedded characteristic of caregiving that the term parent or parenting embraces, i.e., "the *perspectives* and *deep emotional involvement* in the rearing and socialization of a young child."[19(p6)] In infancy and early childhood, parents—particularly mothers—play a fundamental role in giving care, rearing, and providing social experiences for children to grow and develop.[14,15] In most cases, parents hold the central place in the microsystem of the child's development. Examining parenting in the microsystem (i.e., its relationships with the child) and in the exosystem (i.e., its relationship with other factors in the child's immediate environment, such as living conditions) will be crucial to the study of child behavior development in early childhood.

Parenting is effortful, extensive, and complex. According to Bornstein, parenting is "a job whose primary object of attention and action is the child."[14(p894)] This job spans from child bearing to child caring, socializing, and enculturating. The purpose of the job is extensive, from nurturing and protecting to guiding, educating, and preparing the child to participate in society.[14] Parenting takes place in daily interaction between the parent and the child, both proactively and reactively.[14] How parents behave in parent-child interactions reflects the characteristics of their parenting, which could be either positive (being sensitive, responsive, supportive, stimulating, and warm) or negative (being harsh,

ignorant, hostile, intrusive, and abusive). Parenting also involves attitudes and practices that the mother uses to structure the child's daily life. Parenting attitudes reflect the parent's cognition that underlies the practices and "conditions the quality and structure of the home environment."[14(p917)] Parenting practices, on the other hand, are parent's specific behaviors and activities relating to the child, such as enforcing discipline with rules or punishment and creating family routines of playing, reading, eating, and sleeping. These practices constitute an overall socio-emotional environment from which a parenting style is formed. This overall socio-emotional environment may embody different levels of demandingness (or control) and responsiveness (or warmth and supportiveness), and create four basic types of parenting styles: authoritative (high control/demand and high warmth/support), authoritarian (high control/demand and low warmth/support), permissive (low control/demand and high warmth/support), and uninvolved (low control/demand and low warmth/support).[73,74]

2.3. Parenting and child nutrition

Parenting can be domain-specific. In the field of child nutrition, parenting concepts have been introduced to understand the role and impacts of the parents on the child's nutritional outcomes. Corresponding with the general concepts of parenting styles and parenting practices, the concepts of feeding styles and feeding practices have been developed.[17,75] Feeding styles reflect mother-child interactions *in feeding contexts*. Like general parenting styles, they are built upon two dimensions of demandingness/control and responsiveness/supportiveness in food-related situations. The combination of different levels of these two dimensions makes up four feeding styles: authoritative, authoritarian, permissive/indulgent, and neglecting/uninvolved feeding styles. Feeding

practices, on the other hand, refer to "specific techniques or behaviors usually used to facilitate or limit ingestion of foods" such as "pressure to eat, restriction, monitoring of the child's food intake, or the use of rewards for food consumption."[16(p827)]

In addition, the child nutrition literature also uses the term "food parenting practices" to capture a broader scope of parenting, i.e., not only about feeding the child but also about constructing the child's food environment. This concept, however, is not clearly and consistently defined.[76] A recent effort mapped out the constructs and subconstructs in food parenting practices. Three "overarching, higher-order food parenting constructs" were specified: coercive control, structure, and autonomy support. Under these are specific subconstructs, e.g., coercive control includes restriction, pressure to eat, threats and bribes, using food to control negative emotions; structure includes rules and limits, limited/guided choices, monitoring, meal and snack routines, modeling, food availability, food accessibility, food preparation, and unstructured practices; autonomy support includes nutrition education, child involvement, encouragement, praise, reasoning, and negotiation.[77(p100)]

In brief, the Ecological System Theory and the Unified Theory of Development assert the need to understand the child's development within the context of multiple interrelated systems; meanwhile, within the immediate environment containing the child, Attachment Theory underscores the parent-child relationship and parenting in infancy and early childhood as foundational factors for the child's development from early to later in life. Along with these theories is the notion of time that demands understanding the child's development, not only in a multi-layer system, but also in a longitudinal process of time and the importance of timing. Personal change is inextricable from

change in the social context and the regulatory processes by self and others. Parenting is multidimensional and complex in both general and food-related settings. Examining parenting in the child's early life (i.e., from birth to five) with change in its context (e.g., food insecurity) and contribution of child self-regulation will be beneficial to bring in-depth understanding about the role of the parents and child self-regulation in the child development of dietary behaviors in early childhood.

3. Food insecurity and parenting

3.1. Parenting in the relationship between food insecurity and child development

The current literature has well established that food insecurity is associated with negative impacts on children's development and health. Food insecurity was found to be associated with absenteeism at school,[8] poor school performance,[9] behavioral problems,[78] poor dietary intake,[79] weight status, low levels of physical activity,[79] anemia,[80] and other health problems.[81] The significant effect of food insecurity in the household on the child's development and health, however, may vary by the type of outcome and by age.[82] For example, among children under five years old in the United States, evidence for the significant association of food insecurity with iron deficiency anemia could be found in Skalicky et al. (2005) (children 6-36 months)[80] and Park et al. (2009) (children ≤ 36 months)[83], and with dietary intake in Cunningham et al. (2012) (2-year old children).[84] Bhattacharya et al. (2004), however, found insignificant associations of food insecurity with iron deficiency anemia and with dietary intake in children 2-5 years, though significant association of food insecurity with dietary intake was found in children 12-17 years.[85] Similarly, Eicher-Miller et al. (2009) did not find significant association of food insecurity with child iron deficiency anemia in children 3-5 years after controlling for

body mass index (BMI) status and meals eaten at school, but that association was found significant in children 12-15 years after controlling for all potential confounders (i.e., BMI status, meals eaten at school, menstruation status, and C-reactive protein status).[86]

Using data from the Early Childhood Longitudinal Study – Birth Cohort (ECLS-B), Bronte-Tinkew et al. (2007)[3] and Zaslow et al. (2008)[4] found that the household food insecurity at 9 months of age did not *directly* affect the child's health and development, including health status, weight for length,[3] attachment sort, and mental proficiency[4] at 2 years of age. Household food insecurity, however, was found to influence the child's health and development outcomes through maternal depression and parenting.[3,4] These studies demonstrated that, besides better mental health, the mother's positive parenting is important to compensate for the negative effect of household food insecurity on the child's nutritional and developmental outcomes.

3.2. Longitudinal effect of food insecurity on parenting

"Parenting is part of a complex developmental system […]. Within complex developmental systems like the parent-child, it is unlikely that any single factor will account for even substantial amount[s] of variation. Parenting effects are conditional and not absolute."[14(p916)] Belsky's process model of the determinants of parenting suggested that parenting depends on the parent's personal resources, child's characteristics, and contextual stress and support.[21] The studies of Bronte-Tinkew et al. (2007) and Zaslow et al. (2008) gave evidence that while parenting is among the most proximal factors to determine child outcomes, parenting itself is influenced by the situation of food insecurity in the household. Understanding parenting in specific contexts of living

conditions, particularly food insecurity, is essential to improving multiple outcomes of early childhood development and health.

To date, understanding about the relationship between food insecurity and parenting is not adequate. Though we know that food insecurity is related to parenting as a mediator in the relationship between food insecurity and the child's health and developmental outcomes,[3,4] relatively few studies have been devoted to gaining in-depth understanding about parenting itself in relation with food insecurity. In addition, food insecurity and parenting were often measured at one single time point,[3,4] and that limits our understanding about the longitudinal effect of food insecurity on parenting.

Food insecurity may change over time. Persistent food insecurity and transitional food insecurity might pose different challenges to parenting; understanding how different food insecurity situations in households with young children is related to parenting remains unclear. Previous studies about food insecurity over time focused mainly on the child outcomes. Using longitudinal data from the Massachusetts Special Supplemental Nutrition Program for Women, Infants, and Children, Metallinos-Katsaras et al. (2012) found that persistent household food insecurity without hunger from the first visit in infancy to the last visit when the child was about 2 to 5 years was related to child obesity; this association was only significant when the mother was either underweight or overweight as measured by her body mass index.[40] This suggests the mother plays a critical role in translating the negative effect of the household food insecurity into the child's problem with weight. Using data from the first two waves of the Early Childhood Longitudinal Study – Birth Cohort, Hernandez and Jacknowitz found that, only transient, but not persistent, adult food insecurity from infancy to toddlerhood influenced toddler

development.[6] This finding in toddlers is not consistent with that of Jyoti et al. (2005) in a study of school-age children. They found that both persistent food insecurity and transitioning into and out of food insecurity were associated with some outcomes in school-age children, including weight gain, BMI gain, reading score, math score, and social skills, and the significant associations could depend on the child's gender.[9] Hernandez and Jacknowitz suggested the reason for insignificant association between food insecurity and toddlers' development is that toddlers are buffered from the effects of persistent food insecurity; no further verification of this reason has been conducted.

In brief, parenting is influenced by the household's living conditions, particularly food insecurity. Understanding how food insecurity influences parenting over time from infancy to early childhood will give additional insights about the impact of adverse living conditions on the shaping of parenting characteristics and practices. Without in-depth understanding about parenting in households with food insecurity over time, we will not understand diverse needs of the parents in varied situations of food insecurity. Lack of such understanding will make the effort to support parenting for the health and well-being of the children difficult.

4. Parenting, child self-regulation, and child dietary intake

4.1. General parenting and food parenting

While examining child nutritional outcomes, general parenting are inclusive of parenting behaviors in a wide range of situations beyond feeding context, and food parenting focuses specifically on food-related practices.[17,75] General parenting establishes an overall socio-emotional environment for the child's development; meanwhile food

parenting practices relate to shaping the child's food environment by allowing what, when, where, how, and how much to eat.[77]

General parenting can take place in daily interactions with the child. In parent-child interactions, the parent can best support the child by being responsive, stimulating, and engaging in the mother-child interactions. By doing this, the parent can help the child to express his/her needs, learn new skills, and develop self-regulation.[35] The parent's supportiveness in daily interactions with the child reflects the parent's capacity of recognizing the child's signals of needs and satisfaction so that the parent can respond and support the child appropriately and efficiently. While the context of the interactions varies, this parenting capacity is relatively consistent across contexts. Evidence shows that the quality of mother-child interactions in feeding and non-feeding contexts is highly correlated, especially in studies with infants and young children.[87,88]

General parenting can also take place with practices to structure the child's overall environment. How the mother structures the child's environment may depend on her parenting attitude, disciplinary approach, and enforcement practices. Firm parenting by being assertive with rules reflects the parent's high demand and expectation on the child in his/her daily life. Harsh discipline can create a discouraging and toxic environment.[89–95] Having house rules, e.g., time to sleep, time to watch television, and chores to do, create routines for daily functioning. A structural environment with these features is beneficial for the child's development, including self-regulation and the establishment of healthy eating habits.[96–99]

Food parenting practices are part of the structural processes with a specific focus on food. Having rules and limits on kinds of food to eat and maintaining meal or snack

routines, for example, contribute to structuring the child's food environment on what to eat, when to eat, and with whom to eat. As such, the child's eating habits develop while his/her dietary intake is guided and controlled. Given its contribution to directly shaping the child's food environment, food parenting is conceptualized as a proximal influential factor on the child's diet, while general parenting is a distal factor.[17,75]

4.2. Food parenting and child dietary intake

One of the most studied constructs of food parenting is restriction, i.e., "enforcing parent-centered, authoritarian-type limits on a child's access to foods or opportunity to consume those foods."[77(p100),100] Vaughn et al. (2016) distinguished two types of restriction in food parenting: overt and covert. Overt restriction is an explicit, coercive control of "what, when, where, and how much the child eats."[77(p100)] This is often referred in the literature as restrictive feeding practice. Covert restriction, on the other hand, involves structuring the food environment by "limiting opportunities for consumption."[77(p100)] Covert restriction, such as having rules about foods, is classified in the content map of food parenting practices by Vaughn et al. (2016) under "Structure," while overt restriction is classified under "Coercive control."[77(p100)]

The distinction between the two kinds of food restriction is important because the impact of restriction on child eating behavior might depend on how the restriction is implemented. Studies with young children aged 3-5 years in the United States and children aged 2-6 years in the United Kingdom found that coercive control by restricting food intake may lead to increased desire and intake of palatable food,[100,101] and decreased consumption of fruits and vegetables.[102] A study with 2-year-old children in Scotland, however, found that absence of restriction on unhealthy food consumption may put the

child at leveraged risk of poor diets.[103] Another study with 2-year-old children in the Netherlands provided that parental prohibition of unhealthy snacks and soft drinks and prohibition of cookies and cake may promote the child's healthier diets.[104] Given these mixed findings, Blissett (2011) suggested that, while coercive restriction may be counterproductive, "moderate restriction" and "non-directive practices" may be beneficial to facilitate healthy dietary intake in young children.[16] This idea is repeated in Larsen et al. (2015) when they criticized highly controlling feeding practices and asserted the need of some control over young children's dietary intake.[105] Similarly, Vaughn et al. (2016) emphasized the need to distinguish coercive control with restriction and structure with rules and limits.[77]

Vaughn et al. (2016) also made an important point about the need to consider long-term effect of the food parenting practice with rules and limits. They stated that, compared to coercive control methods, it might take longer for food rules to demonstrate the impact on the child's eating outcomes. It is because "newly adopted food rules may be less effective, especially if children are not accustomed to rules and limits in general."[77(p113)] While studies about rules and limits of food are mostly cross-sectional and focus mainly on older children and adolescents, this suggests longitudinal studies, including those examining younger children, are needed.

Another subconstruct of food parenting in structuring the food environment of the child is meal and snack routines. According to Vaughn et al. (2016), "meal and snack routines refer to the parent-created structure involving the location, timing, presence of family members, atmosphere or mood, and presence or absence of distractions during meals and snacks."[77(p106)] While such conceptualization is comprehensive, the measures

of meal and snack routines within food parenting practices are not. Vaughn et al. (2016) denoted that "existing measures typically capture just one or two aspects of these routines, such as the frequency with which meals and snacks are eaten together as a family […]."[77(p106)]

The relationship between frequent family meals and healthy eating patterns is evident in children and adolescents, for both boys and girls, yet studies on younger children are few.[106,107] Two studies on younger children were found. One is a cross-sectional study examining children aged 1-5 years in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) in New York state. This study pointed out that the frequency of eating family dinner together was positively associated with *serving* fruits or vegetables, not the child's actual *intake*.[108] Another is a study by Anderson and Whitaker (2010). Using the Early Childhood Longitudinal Study – Birth Cohort, this study examined household routines, including frequency of family meals, yet the outcome of interest was child obesity rather than child dietary intake.[36] The effect of food parenting with meal and snack routines on the dietary intake of young children is still not well understood.

4.3. General parenting and child dietary intake

Previous studies found significant associations between general parenting and child dietary intake, though significance and magnitude of the associations vary with different measured levels of general parenting, and with different child age groups. Lytle et al. (2003), Kremers et al. (2003), and Pearson et al. (2010) studied teens and adolescence. They found that general parenting with authoritative style, i.e., high demand/control and high responsiveness/supportiveness, was positively associated with

fruit and vegetable intake in children.[109–111] Pearson et al. (2010) additionally found that the children of authoritative parents consumed less unhealthy snacks than those of neglectful parents.[111] A study of Philips et al. (2014) examined children aged 6-12 years. They provided evidence for positive association between sweet food consumption frequency and coercive control, negative association between fruit and vegetables consumption frequency and overprotection, negative association between soft drinks consumption and structure, yet the *magnitudes* of these associations were small.[112] Studying children from kindergarten to second grade, Arredondo et al. (2006) found that parents who used positive reinforcement and monitoring, as well as those who used appropriate discipline were more likely to have active and healthy-eating children. In this study, use of control was associated with unhealthy eating, and girls exhibited more effect of parental control on their unhealthy intake than boys.[113] Some other studies, however, found no association between general parenting and child dietary intake, e.g., De Bourdeaudhuij et al. (2009) and Vereecken et al. (2009) with children at 11 years of age.[114,115]

Studies about the relationship between general parenting and child dietary intake with children under 5 years old are few. In their study with children from 9 months to 2 years old in the United States, Bronte-Tinkew et al. (2007) specified the path model where food insecurity affected child weight through general parenting and infant feeding practices. In this path model, the association between high maternal responsiveness in mother-child interaction and better infant feeding practices at 9 months of age was significant.[3] Given that the measures of maternal responsiveness and infant feeding practices in this study were at the same time point, i.e., when the child was about 9

months old, understanding about the effect of general parenting on shaping child eating habits between infancy and school-age years remains unclear.

Other studies with children under 5 years old focused on child weight rather than child dietary intake. For example, using data from the Early Childhood Longitudinal Study- Birth Cohort (ECLS-B), Anderson et al. (2010) found household routines, including limited screen-viewing time, adequate nighttime sleep, and having regular dinners with family members, were independently associated with lower risk of obesity of preschool-aged children. They also confirmed that having a greater number of routines was associated with greater magnitude of reduced obesity risk for these children.[98] In another study, Anderson et al. (2014) detected an association between the quality of mother-child interaction at 9 months of age and child obesity at 5.5 years, however, the association was no longer significant after adjusting for race/ethnicity, maternal education, and household income.[116] With these two studies, Anderson et al. (2010 & 2014) examined different aspects of maternal parenting: the routines of having limited screen-viewing time and adequate nighttime sleep relate to general parenting with non-food house rules, and the quality of mother-child interaction relates to general parenting with maternal supportiveness to the child in mother-child interaction. Having regular dinners with family members, on the other hand, is part of food parenting practices. The finding that having a greater number of routines reduced obesity risk for children suggested an additive effect of general parenting and food parenting on child nutrition outcomes.

Studies about parenting inclusive of multiple aspects of general parenting and food parenting in relation with child dietary intake are scant, particularly with children

under 5 years old. Only one study of this type was found in Australia. A study by Peters et al. (2013) with children aged 2-5 years in Australia examined multiple aspects of general parenting, including parenting discipline (i.e., laxness, over-reactivity/ aggressiveness, or verbosity), general parenting styles (i.e., authoritative, authoritarian, and permissive parenting), and food parenting (i.e., restriction, pressure to eat, monitoring, and frequency of family dinners). This study found that higher fruit and vegetable consumption in Australian children aged 2–5 years was associated with positive general parenting – i.e., lower over-active parenting and higher authoritative parenting. Food parenting with restrictive feeding and having dinners as a family were also associated with higher intake of fruits and vegetables in these children. Lax parenting and over-active parenting were two types of general parenting that were positively associated with consumption of less healthy foods, i.e., foods outside of the five core healthy food groups suggested by the Australian Dietary Guidelines. Having more takeaway foods and more television viewing were two food parenting and general parenting practices that were related to higher consumption of non-core food groups.[117] With this study, Peters et al. (2013) asserted the need to expand the research on parenting beyond the classic parenting styles and the need to make more effort to examine the complexity and multiple dimensions of parenting in influencing child diet.

4.4. Relationship between general parenting and food parenting, and their impacts on child dietary intake

Though food parenting and general parenting are often examined separately in relation with child nutrition outcomes, food parenting and general parenting do not exist independently from each other in real life. Hughes et al. (2005) found that general

parental control was linked with more authoritarian feeding styles, and parental responsiveness to children was associated with authoritative feeding styles.[88] Blissett & Haycraft (2008) did not find association between authoritarian parenting and controlling feeding practices, yet they found association between permissive parenting and less monitoring of child unhealthy intake in both mothers and fathers. The association between permissive parenting and increased food restriction was significant in mothers only. The association between permissive parenting and pressure to eat was significant in fathers, but not mothers. Authoritative parenting was associated with less pressure to eat by fathers only.[118] In Vereecken et al. (2010), over-reactive parenting style (i.e., parental tendency to react quickly to children's misbehavior in an exaggerated or irritable manner) was found positively associated with parent-centered feeding practices (i.e., warning and physically struggling), and negatively associated with child-centered feeding practices (reasoning and praising).[115] All of these findings suggest an association between general parenting and food parenting, though some mismatch among subconstructs may exist within and across parents. Part of the mismatch may relate to wide variation in measurement of general and food parenting due to their complex conceptualization. In addition, cross-sectional studies like the above could not establish the direction of the relationship, leaving unknown whether general parenting predicts food parenting or vice versus. Further work, particularly with longitudinal data, is needed to gain comprehensive understanding about the relationship between general parenting and food parenting.

Recent scholarship established the need to understand general parenting as a context for food parenting. For example, when discussing about rules and limits, Vaughn et al. (2016) suggested being accustomed to rules and limits in general can set stage for

newly adopted food rules to come into play.[77] Kremer et al (2013) called for further studies on joint contribution of general parenting and food parenting to shaping child dietary behaviors. They suggested future research to focus on "applying a contextual higher-order moderation approach" that views "context as a dynamic system."[17(pS-27)] In this system, "the role and functioning of each element depends on its context of other, simultaneously working components, horizontally (i.e., within levels) and vertically (i.e., across levels)."[17(pS-28)] To date, how general parenting and food parenting independently and interactively affect child eating behaviors remains unclear.[75] Further examination of the relationship between general parenting and food parenting, and their contribution to influencing child dietary intake will help advance this research direction.

4.5. The role of child self-regulation

Child self-regulation is generally defined as "the primarily volitional cognitive and behavioral process through which an individual maintains levels of emotional, motivational, and cognitive arousal that are conducive to positive adjustment and adaptation."[119(p900)] Self-regulation is a fundamental component that underpins all domains of child development. It is because "living and learning require people to react to changing events and then to regulate their reaction."[35(p93)] Meanings of the child' regulatory behaviors change with age because what is new or challenging to the child changes over time as the child grows up.[35]

Given broad, multidimensional, and fluid conceptualization of child self-regulation, different terms have been used in different fields to describe self-regulation and its subcomponents.[33(p8)] For example, neuropsychologists use *executive function* with a focus on attentional flexibility, working memory, and inhibitory control as its

subcomponents; developmental psychologists use *delay of gratification* and *behavioral self-regulation* with focus on thought suppression, attentional flexibility, working memory, inhibitory control, distraction, and impulse control; personality psychologists use *temperament* with focus on consciousness.[33] In nutrition study, child temperament is often used. Temperament is defined as "constitutionally based individual differences in reactivity and self-regulation, influenced by heredity, maturation, and experience."[120(p56)] With this definition, child temperament and child self-regulation are actually inextricable from each other. Together with temperamental aspect, child self-regulation is also inclusive of inhibitory control that is a part of cognitive processes underlying behaviors.[120] In child nutrition study, the term "child self-regulation" is increasingly being used, particularly in studying child eating behaviors and child obesity. Child self-regulation in nutrition study is often concerned with child's sensory capacity, emotional and behavioral response to stressful situations, reaction to inner cues of need (e.g., hunger or satiety), and efforts to send signals to regulate the external environment in responding to his/her need.[12,13]

Child self-regulation may play an important role in translating and modifying the effect of parenting into child nutritional outcomes.[12] Parenting, both general and food-specific, can help the child improve self-regulation by providing positive support and structural experience in daily life and food-related circumstances. In contrast, unsupportive parenting is detrimental to the child in strengthening the internal regulatory systems.[35] Excessive control might override the child's internal cues by dictating his/her focus on the external guidance and instructions. A child with better self-regulation might have better sensory capacity to recognize and respond to their nutritional needs and

satiety to communicate with caregivers for appropriate intake.[13,121] A child with difficulty in self-regulation, on the other hand, is more likely to have problem with his/her sensory sensitivity, making him/her less ready to accept some food items, particularly fruits and vegetables, than others without this problem.[16(p830)] The self-regulatory capacity also implies inhibitory control that might help the child to respond efficiently to their inner cues of fullness and restrain him-/herself from overeating.[12] Better self-regulation may also help the child better respond to stress and reduce the risk of emotional eating.[122,123]

Recent evidence shows an increased risk of obesity among children with poor self-regulation.[38,124–126] The association of self-regulation and obesity in young children also appears to differ by child gender[37]. Anderson et al. (2017) found household routines—an aspect of parenting in structuring the living environment for children—was associated with better emotional self-regulation of children at age 3. Their hypothesis that emotional self-regulation was a mediator of the relationship between household routines and child obesity was, however, not confirmed. In this study, the absence of a parenting practice, i.e., having a regular bedtime, and poor emotional self-regulation at age 3 independently predicted the child obesity at age 11.[38] Evidence for the independent and interactive role of child self-regulation in the relationship between parenting and child dietary intake has not yet known.

In brief, parenting, i.e., including both general and food parenting, is complex and multi-dimensional. Previous studies about the influence of parenting on child dietary intake were not inclusive of multiple aspects of general and food parenting, resulting in obscure understanding about the relationship between parenting and child dietary intake. Knowledge gaps also remain in understanding independent and joint contribution of

general and food parenting on child dietary intake in early childhood. Child self-regulation may play an important role in modifying the relationship between maternal parenting and the child's dietary intake, yet more evidence is needed to clarify this postulate.

5. Conceptual framework and significance

5.1. Summary of research gaps and specific aims

The role of parenting and child self-regulation as mechanisms for the relationship of food insecurity with child dietary behaviors has not been well understood, especially in the early years of the child's life. Parenting is influenced by the household's living conditions, particularly food insecurity. Understanding how food insecurity influences parenting over time from infancy to early childhood will give additional insights about the impact of adverse living conditions on the shaping of parenting characteristics and practices. Previous studies on food insecurity and its effects on parents and children were mostly cross-sectional[3,4] and targeted at older children.[5,7–10] Several studies examining food insecurity over time in households with young children focused on child outcomes (e.g., child obesity and toddler development),[6,40] leaving a gap in understanding temporal effects of food insecurity on parenting outcomes in these households. To bridge this knowledge gap, our specific aim 1 was to understand how food insecurity and its change over time relate to parenting in early childhood. We examined the parent-child relationship and structuring of the living environment of the child through parent-child interaction and practices of discipline, rules, and routines in general and food-related settings. We hypothesized that both earlier and concurrent food insecurity were associated with suboptimal parenting.

Recent literature suggested an association of selected parenting aspects (e.g., quality of parent-child interaction and setting up rules for house routines) and child self-regulation with child's nutrition status (e.g., weight and body mass index) in early childhood.[12,13,30,36–39] There is, however, a gap in our understanding about the relationship of parenting and child self-regulation with child eating behaviors in early childhood. To bridge this knowledge gap, our specific aim 2 was to understand the relationship of parenting practices in both food-related and non-food-related settings with dietary intake of young children and the role of child self-regulation in this relationship. We referred to parenting in food-related and non-food-related settings as *food parenting* and *general parenting*, respectively. For food parenting, we examined rules about foods and meal routines, i.e., having evening meals as a family and having evening meals at a regular time. For general parenting, we examined parents' behaviors in parent-child interactions, firmness and harshness in discipline, and having rules about watching television and bedtime. We tested four hypotheses:

1. Food parenting practices in setting rules about the child's food intake and maintaining meal routines at age 4 are associated with the child's healthy dietary intake at age 5.

2. Beyond food parenting practices, general parenting in daily interactions, disciplines, and house rules at age 4 is independently associated with the child's dietary intake at age 5.

3. Child difficulty in self-regulation at age 4 is independently associated with his or her dietary intake at age 5; and

4. Child difficulty in self-regulation modifies the relationship of general and food parenting at age 4 with the child's dietary intake at age 5.

Given that differential effects of food insecurity on health, developmental, and behavioral outcomes by child's gender were observed in children,[9,41,42] and the relationship of parenting, child self-regulation, and child dietary intake might differ by child gender,[37,39,113,124,127,128] we conducted all analyses separately for boys and girls.

5.2. Conceptual framework

In early childhood, food insecurity may trigger suboptimal parenting in building the parent-child relationship (e.g., less supportiveness in parent-child interaction). Food insecurity may also negatively affect parenting in structuring the child's living environment in general setting (e.g., difficulty sticking with rules, use of harsh disciplinary practices, lack of house rules) and food-related settings (e.g., lack of rules about food, and lack of meal routines). Parenting in general and food-related settings is referred as *general parenting* and *food parenting*, respectively. Food parenting can work together with general parenting to create a structured healthy environment for children. Such an environment is important to support healthy eating behaviors in children, resulting in less frequent intake of sugar-sweetened beverages, sweet foods and desserts, and salty snacks, and more frequent intake of fruits and vegetables. The child's difficulty in self-regulation can independently relate to his or her frequent intake of foods and beverages (**Figure 2.1**). The associations of food insecurity with parenting and of parenting and child self-regulation with child dietary intake might differ by child gender.

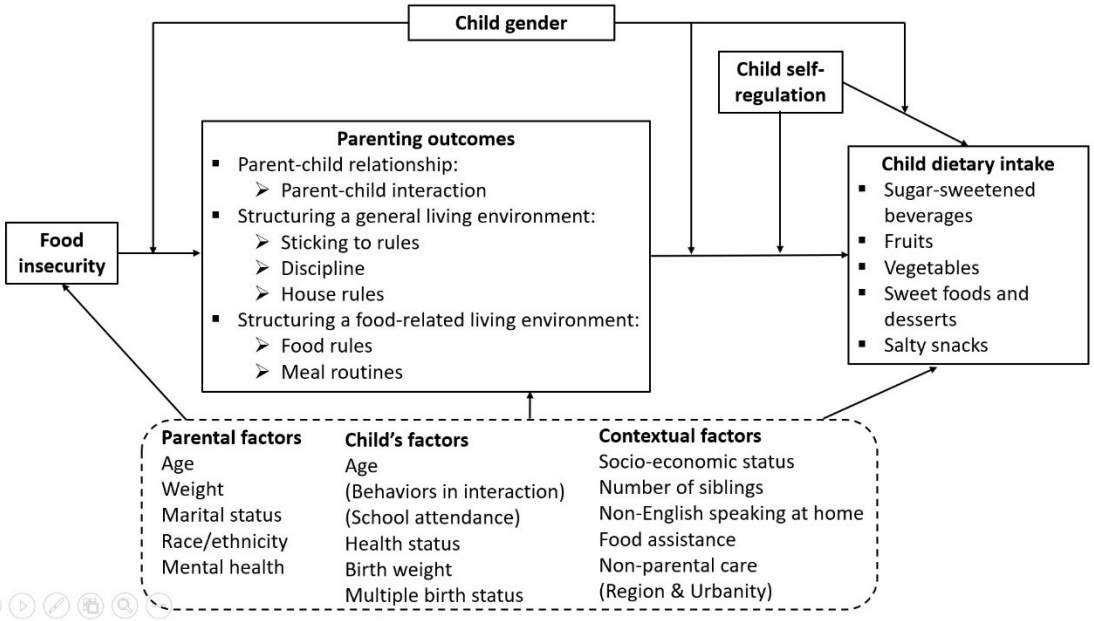

Figure 2.1 Conceptual framework of the relationships among food insecurity, parenting, child self-regulation, and child dietary intake

The association of parenting and child dietary intake can also differ by the difficulty in self-regulation of the child. These associations may be influenced by maternal factors (e.g., parent's age, weight, marital status, race or ethnicity, and mental health), child factors (e.g., child's age, child behaviors in parent-child interaction, health status, birth weight, and multiple birth status), and contextual factors (e.g., socio-economic status, number of siblings, language speaking at home, food assistance, and non-parental care).[9] The child behaviors in parent-child interaction could be a confounder for the association between food insecurity and parenting, given that these behaviors may reflect the child's situational arousal in a parent-child interaction and also his or her underlying personal trait and behavioral tendency to influence parenting behaviors in parent-child interaction and in broader settings.[119,120] School attendance, region of residence, and urbanity may also influence the association between parenting and child dietary intake.

5.3. Significance

Our specific aim 1 was to understand how food insecurity and its change over time relate to parenting in early childhood. To achieve this aim, we examined both earlier and concurrent food insecurity and different aspects of parenting in parent-child interaction and structuring a general and food-related living environment. By doing so, we advance knowledge of temporal impacts of food insecurity on parenting in early childhood. We specify parenting practices with which food insecurity is significantly associated and different patterns of these associations by time and child gender, shedding light on the relationship between food insecurity and parenting in early childhood and also opening up plausible explanations for different associations of food insecurity on child outcomes by gender that have been found in the literature[3,4,6,9]. The association between food insecurity in early childhood and harsh disciplinary practices, for example, could be a mechanism through which boys and girls with food-insecure parents are more susceptible to problems in behaviors, school performance, and health compared to their peers with food-secure parents.

Our specific aim 2 was to understand the relationship of parenting practices in both food-related and non-food-related settings with dietary intake of young children and the role of child self-regulation in this relationship. By examining specific parenting practices in both food-related and general settings, we bring insights about what helps by understanding the unique and combined contributions of specific parenting practices in creating a healthy structured environment for the development of the child's eating behaviors. Furthermore, through examining the child's difficulty in self-regulation and its interaction with parenting practices, we provide understanding about how the child might

play a role in modifying the effect of parenting practices on shaping his or her eating habits. Accounting for both parents and children, our study brings a more comprehensive understanding about the development of child dietary behavior, compared to other studies where either parents' or children's role are examined.

CHAPTER 3

RESEARCH DESIGN AND METHODS

Chapter 3 describes the methodology of this research, starting with introducing the data source. Following are descriptions of the data collection, sampling procedures, and sample sizes. Next, the measures used in the analyses of each manuscript were defined and the data analysis plan of each specific aim was explained. Last is a description of data security management and ethical considerations.

1. Data source

Data were from the Early Childhood Longitudinal Study – Birth Cohort (ECLS-B). The ECLS-B provides rich information about the living, learning, developmental, and health-related experiences of children born in 2001 in the United States from birth to kindergarten age. The ECLS-B was led by the U.S. Department of Education, National Center for Education Statistics (NCES), in collaboration with other federal education and health policy agencies. The ECLS-B was part of the Early Childhood Longitudinal Study (ECLS) that had two cohorts – a birth cohort (ECLS-B) and a kindergarten cohort (ECLS-K). The ECLS-B aimed to collect comprehensive and reliable data of child development and the environments where this development took place. The ultimate goal was to enable better understanding about varied aspects of child development and health in the first six years, including the early development, health care, nutrition and physical well-being, school readiness, and experiences in early care and education programs.[129]

2. Data collection

The ECLS-B had five waves of data collection. The first wave surveyed parents or guardians of the sampled children (i.e., those born between January and December of 2001), and assessed these children between October 2001 and December 2002 when they were approximately 9 months old. The second wave surveyed the parents and assessed the children between January 2003 and December 2003 when the children were approximately 2 years old. The third wave surveyed the parents and the children between Fall 2005 and Spring 2006 when they were at the age to join preschool education, i.e., about 4 years old. The fourth wave surveyed the parents and the children from September 2006 to March 2007 when most of the children were joining kindergarten at the age of 5. The fifth wave surveyed a subset sample of the parents and the children who were not eligible to participate in kindergarten in the previous year from October 2007 to March 2008[130]. In manuscript 1 and 2, we used the data from the first four waves.

The ECLS-B collected data from varied sources using different methods. They included computer-assisted personal interviewing (CAPI) and a self-administered questionnaire or audio computer-assisted self-interviewing (ACASI) with parents or guardians during home visits (all waves); child direct assessments during home visits (all waves, assessments varied by wave); child observations during home visits (the first and second waves); self-administered questionnaires with fathers (both resident and non-resident fathers in the first and second waves, and only resident father in the third wave); birth certificates; telephone interviews with early care and education providers (ECEPs) for children not enrolled in kindergarten or a higher grade (the second, third, and fourth waves); telephone interviews with wrap-around early care and education providers

(WECEPs) for children in kindergarten and other care arrangement (the fourth and fifth waves); self-administered surveys with teachers of children enrolled in kindergarten or a higher grade (the fourth and fifth waves). All field supervisors and interviewers received training for data collection and were certified. Besides that, the ECLS-B also made data available if needed about schools from NCES's Common Core of Data (CCD) and Private School Universe Survey (PSS), and zip codes of the children's residence, care providers, and schools.[130] In manuscript 1 and 2, we used data from parent interviews and child assessments only.

3. Sampling procedures and sample sizes

The ECLS-B used a complex sampling design to select a nationally representative probability sample of children born in 2001 in the United States from the registered births in the National Center for Health Statistics (NCHS) vital statistics system.[129] All children born from January to December in 2001 in the United States were eligible to be selected in the first wave of data collection, except those born to mothers under 15 years old, or those who died before the 9-month assessment, or those who were adopted before the 9-month assessment.[129] In the later waves, children whose parents or guardians completed interviews in the previous wave were followed, and those who died or moved permanently out of the United States by the time of data collection were excluded.[130] The third wave additionally included American Indian/Alaska Native children who had a completed parent interview in the first wave but not in the second wave. The fourth wave subsampled the target population to reduce cost. In this wave, American Indian/Alaska Native children who had a completed parent interview in the first wave, and either second or the third wave or both were included. The fifth wave repeated the surveys with the

subsample in the fourth wave, but only included those entering kindergarten the first time due to age eligibility or delayed entry, i.e., excluded children who were in kindergarten or higher in the 2006–07 school year and did not repeat kindergarten in the 2007–08 school year[130]. As required by the IES Data Security Data Office, all sample sizes reported in this research will be rounded to the nearest 50.

In the first wave, the ECLS-B sample design aimed at high precision standards for estimates of both overall and specific analytic domains. The core ECLS-B sample consists of births sampled within 96 primary sampling unit (PSUs). This core sample represented all eligible infants born in the United States in 2001. The PSUs were the individual counties or groups of adjacent counties. Besides the 96 PSUs for the core sample selection, the ECLS-B also used a supplementary sample of 18 PSUs that were selected from a frame of areas with higher proportion of American Indian/Alaska Native births. Subgroups of special interest, i.e., infants of American Indian/Alaska Native, Chinese, and Other Asian/Pacific Islander racial groups, infants of low and very low birth weights, and twins, were oversampled to obtain required sample sizes. In this wave, the original selected sample size was 14,200 cases; 10,700 cases of parents completed the parent interviews; and 10,200 children of these cases completed the assessments. In the second wave, 9,850 parents completed the 2-year parent interviews, and 9,200 children completed the assessments. In the third wave, 8,950 parents completed the interviews, and 8,750 children completed the assessment. In the fourth wave, 7,000 parents completed the interviews, and 6,900 children completed the assessment.

After randomly selecting one child in the twins, the data available for analysis in our research were 9,850 for the first wave, 9,050 for the second wave, 8,200 for the third

wave, and 6,400 for the fourth waves. For both aims, all parent-child dyads with no missing data for the outcome variables were included into the analysis. In manuscript 1, the sample sizes of the analysis for most of the parenting outcomes, except parent-child interaction and rules about television, reached 99.9%. For parent-child interaction, the missing data were 21.1% and 14.7% in year 2 in year 3, respectively. For rules about television, 2.66% and 2.46% of the observations were excluded in years 3 and 4, respectively, due to missing data and televisions unavailable in the households. In manuscript 2, 99.9% of the data collected for the fourth wave were used.

4. Measures

4.1. Parenting variables

In manuscript 1, we used the parenting variables in year 2, 4, and 5 (if available) as outcome variables. In manuscript 2, they were independent variables.

Parent's behaviors in a *parent-child interaction* were measured by the parent's scales in a playing task in years 2 and 4 by the Two Bags Task.[131,132] In year 2, the Two Bags Task was composed of six parent scales (range 1-7): parental sensitivity, parental intrusiveness, parental stimulation of cognitive development, parental positive regard, parental negative regard, and parental detachment. In year 4, the Two Bags Task had five parent scales (range 1-7): parental emotional supportiveness, parental stimulation of cognitive development, parental intrusiveness, parental negative regard, and parental detachment. For each year, we combined the separate parent scales into a total parent scale using factor scores from a factor analysis with one factor (Cronbach's alpha = 0.737 and 0.637 in year 2 and year 4, respectively). Higher total parent scale scores reflect more parental emotional supportiveness and less adverse interactions. In Manuscript 1, using

the total parent scale scores, we created standardized variables to measure parent's behaviors in parent-child interaction in years 2 and 4. In Manuscript 2, the non-standardized variable measuring parent's behaviors in parent-child interaction in year 4 was used.

Parent's difficulty sticking with rules was measured by an item asking if the parent had "little or no difficulty sticking with his/her rules for the child even when close relatives, including grandparents, are there."[133] This item was rated on a 5-point Likert-scale, higher scores indicate more difficulty sticking with rules: 1= exactly like me, 2= very much like me, 3= somewhat like me, 4= not much like me, or 5= not at all like me. We recoded the item to reflect if the parent had difficulty sticking with rules: 1= yes if the response was 4 – 5 and 0= no if the response was 1 – 3. We made this variable binary because the variation in the response was only clear between these two groups and the binary variable reflected the essence of the response results. *Harsh disciplinary practices* were measured by a binary variable indicating whether the parent used any discipline practices amongst spanking, hitting the child, making fun of him or her, and yelling or threatening when the child got angry and misbehaved (yes/no). Parents were asked if they had *rules about television watching* (yes/no).

Parents were asked whether they had *rules about kinds of food the child ate* (yes/no). Practices relating to family meal routines were captured through parent's reports of the number of days in a typical week when *at least some of the family ate the evening meal together* (range 0-7) and the number of days in a typical week when *the evening meal was served at a regular time* (range 0-7). Examining the distribution of the reported days revealed a clear variation starting at 5 days. We used the cut-off at 5 days to recode

these two items as whether the family ate the evening meal together regularly and whether having the evening meal served at a regular time was a routine: 0= no if less than 5 days per week and 1= yes if 5 and above.

4.2. Food insecurity

In manuscript 1, we used the food security variables in month 9 and years 2 to 4 as independent variables. In manuscript 2, the food security variables were not used.

The parent's *food insecurity* was measured using the US Department of Agriculture's validated scale of 10 items asking the severity of the food insecurity experienced by the adults in the households during the preceding 12 months.[131,132] Given that even marginal food-security (i.e., having 1 or 2 affirmative items) is associated with poor child outcomes,[9,25,134] we classified parents as food insecure if they affirmed any item (yes/no).

4.3. Child dietary intake

In manuscript 1, we did not use the child's dietary intake variables. In manuscript 2, we used child dietary intake in year 5 as outcome variables.

Parents were asked how often the child had eaten or drunk *sugar-sweetened beverages, sweet foods and desserts, salty snack foods, fruits, and vegetables* during the previous 7 days "from the time the child got up until he or she went to bed," inclusive of "food eaten at home, preschool or school, restaurants, play dates, anywhere else, and over the weekend."[135(p81)] Sugar-sweetened beverages were inclusive of soda pop and fruit drinks that are not 100% fruit juice; sweet foods and desserts were inclusive of candy, ice cream, cookies, brownies, and other sweets; salty snack foods were inclusive of potato chips, corn chips, pretzels, popcorn, or crackers; fruits were inclusive of fresh fruit,

applesauce, canned peaches, canned fruit cocktail, frozen berries, or dried fruit; and vegetables were not inclusive of French-fries and other fried potatoes.

The frequency of intake of these foods and beverages over 7 days were originally reported as: 1= once a day, 2= two times a day, 3= three times a day, 4= four or more times a day, 5= one to three times during the past 7 days, 6= four to six times during the past 7 days, 7= never during the past 7 days. We recoded them to reflect the average frequency of the dietary intake within a week: 0= 0 time per week if no consumption, 2= 2 times per week if consumed one to three times during the past 7 days, 5= 5 times per week if consumed four to six times during the past 7 days, 7= 7 times per week if consumed once a day, 14= 14 times per week if consumed two times a day, 21= 21 times per week if consumed three times a day, 28= 28 times per week if consumed four or more time a day. The squared roots of the frequencies were used in analyses to adjust for the skew distributions.

4.4. Child difficulty in self-regulation

Child *difficulty in self-regulation* in year 4 was used as an independent variable in manuscript 2. Seven items from the Preschool and Kindergarten Behavior Scales–Second Edition (PKBS-2) and Social Skills Rating System (SSRS) were selected. The selection was based on the items' face validity that could conceptually operationalize the two sub-constructs of self-regulation, i.e., attention and self-regulatory capacity. Regarding attention, there were 3 items: 1) child has difficulty in concentrating, 2) child pays attention well, and 3) child keeps working until finished. Regarding self-regulatory capacity, there were 4 items: 1) child has temper tantrums, 2) child was overly active, 3) child works or plays independently, and 4) child acted impulsively. These items were

coded on a 5-Likert scale: 1= never, 2= rarely, 3= sometimes, 4= often, 5= very often. These items were combined using factor analysis to reflect the child's difficulty in self-regulation (Cronbach's alpha = 0.718).

4.5. Covariates

In manuscript 1, we used all variables below in month 9, year 2, and year 4 as covariates. In manuscript 2, these variables in year 4 were used as covariates.

Parent's age, weight, marital status, race, and depression status were used as parent covariates. The *parent's age* was reported in years, *weight* in kilograms. *Marital status* was coded as 1= married, 2= separated/divorced/widowed, 3= never married, and 4= non-bio or adoptive parent. *Race-ethnicity* was coded as 1= White, non-Hispanic, 2= Black or African American, non-Hispanic, 3= Hispanic, race or no race specified, 4= Asian, non-Hispanic, and 5= Native American, Pacific Islander, or more than 1 race, non-Hispanic. The parent's *depression status* was measured by the 12-item version of the Center for Epidemiologic Study Depression Scale (CES-D) in month 9 and year 4. The CES-D score was created as guided by the ECLS-B User Manual[129] and classified as 1= non-depressed, 2= mildly depressed, 3= moderately depressed, and 4= severely depressed. In year 2, the parent's depression status was measured by the Depression Scale of the Composite International Diagnostic Interview Short Form (CIDI–SF). It was coded as 1= having major depression and 0= not having major depression.[132]

Regarding child covariates, the *child's age* was the decimal months at the time the direct child assessment occurred. C*hild behaviors in parent-child interactions* were measured by the child scales of the Nursing Child Assessment Teaching Scale (NCATS) in month 9 and the Two Bags Task in years 2 and 4.[131,132]. The NCATS child scale had

23 items; the child's behavior score was the sum of the affirmative child items (Cronbach's alpha = 0.625). The Two Bag Task in year 2 had three child scales: child engagement of parent, child sustained attention, and child negativity toward parent. In year 4 were three child scales: child engagement of parent, child quality of play, and child negativity toward parent. These child scales from the Two Bag Task in years 2 and 4 did not load well together on one factor using factor analysis; therefore, scores of these child scales were not combined. *Child health status* was recoded as 1= poor or fair and 0= excellent, very good, or good health. *Child birth weight* was coded as 1= normal birth weight, 2= moderate low birth weight, and 3= very low birth weight. For *multiple birth status*, 1= singleton, 2= twin, and 3= higher order.

For contextual covariates, the *household's socio-economic status* was measured by a composite score computed by the ECLS-B from: mother/female guardian's education, father/male guardian's education, mother/female guardian's occupation, father/male guardian's occupation, and household income. The score ranged from -2.31 to 2.18; a higher score indicates a higher socio-economic status.[129] The *number of siblings* was an integer number. *Primary language speaking at home* was coded as 0= English and 1= other than English. Food assistance was measured by whether the parent or child *received the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)* in the preceding 12 months (yes/no), and whether the parent or any other member of the household had *received food stamps* since the child was born or since the last interview (yes/no). *Non-parental care* was measured by the hours per week the child was in all non-parental care arrangement. Manuscript 2 additionally used *household*

region (1= Northeast, 2= Midwest, 3= South, 4= West), and *urbanity* (yes/no) as covariates.

5. Data analysis

5.1. Manuscript 1 – Specific aim 1

All analyses were conducted in Stata 14.2. Using univariate analysis, we examined the socio-demographic characteristics and parenting outcomes of the full sample in month 9, years 2, 4, and 5. Bivariate analysis was used to investigate the crude associations between earlier food insecurity and later parenting outcomes. Multivariable analysis was used to further examine the associations of earlier and concurrent food insecurity with parenting outcomes accounting for covariates. First, each of the parenting outcomes (P_k) was modeled as a function of the earlier food insecurity (F_{k-1}), time-invariant covariates, and time-variant covariates:

$$P_k = \beta_0 + \beta_1 F_{k-1} + \beta_3 \text{ time-invariant covariates} + \beta_4 \text{ time-variant covariates}_{k-1} + E_k$$

Then, *concurrent* food insecurity (FI_k) was added:

$$P_k = \beta_0 + \beta_1 F_{k-1} + \beta_2 F_k + \beta_3 \text{ time-invariant covariates} + \beta_4 \text{ time-variant covariates}_{k-1} + E_k$$

The subscript k-1 and k refer to the time of assessment in month 9, year 2, year 4, and year 5. B_o specifies the constant. β_1 is a coefficient indicating the difference in a parenting outcome at k between a parent with and without food insecurity at k-1, holding other covariates constant. β_2 indicates the effect of change in food insecurity from k-1 to k on the parenting outcome at k between a parent with and without food insecurity at k-1, holding other covariates constant. β_3 and β_4 represent coefficients of time-invariant

covariates (i.e., child birth weight and multiple birth status) and time-variant covariates at k (i.e., all other covariates).

All analyses were stratified by the child gender. The *sem* procedure with the *mlmv* option and *cluster* control in Stata was used to implement regression models with full information maximum likelihood to retrieve as much information as possible from observations with missing values in independent variables and covariates.[136] This procedure did not account for sampling weights; instead, we accounted for weighting by controlling for the variables related with oversampling, i.e., race and ethnicity, child birth weight, and multiple birth status.[137] Potential biases due to missing data in parenting outcomes across waves were controlled by accounting for parental, child, and contextual covariates. We used linear regression for both continuous and dichotomous parenting outcomes to facilitate interpretation; linear and logistic models fit equally well if the probabilities are moderate.[138,139]

5.2. Manuscript 2 – Specific aim 2

Data analyses were conducted in Stata 14.2. The sample's characteristics by child gender was obtained with univariate analyses. Using the *sem* procedure with the *mlmv* option and cluster control in Stata, four main regression models with full information maximum likelihood were built to test the research hypotheses for boys and girls separately. Model 1 regressed the child's dietary outcomes on food parenting variables and covariates. Model 2 added general parenting variables. Model 3 additionally included the child's difficulty in self-regulation. Model 4 added interactions of the child's difficulty in self-regulation and parenting variables. Each interaction in Model 4 was entered separately; only significant interactions remained in the model. Instead of using

sampling weights, the variables relating to oversampling (i.e., race and ethnicity, child birth weight, and multiple birth status) were included into the models.[137] In these models, the square roots of the frequency of the child's dietary intake were used and standardized coefficients were reported. When the interactions were significant, the model was re-run for unstandardized coefficients. These were used to calculate the estimated frequency of intake at different values of the variables in the interactions: at 0 and 1 for binary variables; at mean and at mean ± 1.282 SD for continuous variables to enable comparisons across the middle 80% of the sample distribution.

6. Data security management and ethical considerations

The ECLS-B case-level data require a restricted-use data license. With support from the Department of Health Promotion, Education, and Behavior, Arnold School of Public Health, and the USC Sponsored Award Management office, the application for the ECLS-B restricted-use data license started in October 2016. The application was approved at the end of January 2017. The data were received in February 2017. The license is granted for a three-year period, from February 2017 to February 2020.

The access to and disclosure of the ECLS-B restricted-use data abides by the terms of the license and conforms strictly with the requirement of security procedures. The data and all relevant documents will be stored under lock and key at the assigned Project Office in Room 542, Discovery I Building. Only the authorized users may have key access to this secure project office. The data may only be used on a standalone, desktop computer which is password-protected. The IES Data Security Office states "all printouts, tabulations, and reports are required to be edited for any possible disclosures of subject data before such output is seen by non-licensed individuals;" and "a draft copy of

all information products that are based on or use restricted-use data to the IES Data Security Office for a disclosure review."[140(p32)]

This research received an exemption from Human Research Subject Regulations issued by the University of South Carolina Institutional Review Board on 10/16/2017.

CHAPTER 4

RESULTS

This chapter presents the results of the proposed research in two manuscripts. The manuscript 1 addresses specific aim 1, i.e., to understand how food insecurity and its change over time relate to parenting in early childhood. The manuscript 2 addresses specific aim 2, i.e., to understand the relationship of parenting practices in both food-related and non-food-related settings with dietary intake of young children and the role of child self-regulation in this relationship. These two manuscripts are prepared for submission to peer-reviewed journals to be decided jointly by the authors.

1. Manuscript 1

EARLIER AND CONCURRENT FOOD INSECURITY ARE ASSOCIATED WITH SUBOPTIMAL PARENTING IN EARLY CHILDHOOD[1]

[1] Nguyen HT, Frongillo EA, Blake CE, Shapiro CJ, Frith AL. To be submitted to a journal to be decided.

ABSTRACT

Background: Children living in households with food insecurity are at a heightened risk of having poor health, suboptimal nutritional status, and problems with linguistic development, school performance, and social interactions. A potential mechanism of the association between food insecurity and adverse children's health and development is through parenting.

Objectives: This study aimed to understand how food insecurity and its change over time relate to parenting in early childhood.

Methods: Data were from the Early Childhood Longitudinal Study – Birth Cohort. Parental interviews and child assessments were conducted when children were about 9 months and 2, 4, and 5 years old. Dependent variables were parenting in general settings (i.e., parent's behaviors in parent-child interaction, difficulty sticking with rules, use of harsh disciplinary practices, rules about watching television) and food-related settings (i.e., rules about food, meal routines of having evening meal as family and having evening meal at regular time). These parenting outcomes were examined in years 2, 4, and 5. Using full information maximum likelihood regression stratified by child gender, each parenting outcome was first regressed on the earlier food insecurity and covariates, then additionally regressed on the concurrent food insecurity, controlling for child, parent, and contextual covariates. Cases were included in the analysis if having no missing data for the outcome variables.

Results: Earlier food insecurity was associated with using harsh disciplinary practices in year 5, having rules about food in year 4, and having evening meals at a regular time in years 2 and 4 among parents of girls. Among parents of boys, earlier food

insecurity was associated with having evening meals at a regular time in years 2 and 4. Concurrent food insecurity was associated with parenting in years 2 and 4 for boys and girls but not in year 5. The magnitude of the associations over time of earlier and concurrent food insecurity with harsh disciplinary practices, rules about food, and meal routines were generally greater for girls than boys.

Conclusions: In early childhood, earlier and concurrent food insecurity were linked with suboptimal parenting in structuring a general and food-related living environment for young children, particularly for girls and by the age of 5, through increased use of harsh discipline, lack of rules about foods, and irregular meal routines. Further investigations on the potential mechanisms for the relationship of earlier and concurrent food insecurity with parenting in early childhood and how these mechanisms change as the children reach age 5 are needed.

Introduction

In 2017, 15.7% of the households with children in the United States–6 million households–were food insecure, i.e., having limited access to adequate foods to maintain a healthy life at times during a year due to lack of money and other resources.[1] Food insecurity is both a nutritional problem and a stressful life experience of adults and children in households dealing with food shortage.[2] Compared to their peers in food-secure households, children living in households with food insecurity are at a higher risk of having poor health, suboptimal nutritional status, and problems with linguistic development, school performance, and social interactions.[3–10] A potential mechanism of the association between food insecurity and adverse children's health and development is through parenting,[3,5,6] yet the relationship between food insecurity and parenting has not been well-understood, especially in the early years of the child's life.

Parenting–the way parents care and nurture their children–plays an important role in fostering children's healthy growth and fulfilled development in early chidhood.[11,12] As a broad concept, parenting is inclusive of multiple aspects of child care and nurturing. Parenting could be measured in terms of styles, parent-child interaction, or specific practices in general or food-related settings.[13,14] Parenting styles reflect a global climate of the parent-child relationship characterized by dimensions of demandingness (or control) and responsiveness (or warmth and supportiveness).[15] Parent-child interaction reveals the quality of the parent-child relationship.[16,17] Parenting practices refer to parent's specific behaviors and activities relating to the child, such as enforcing discipline with rules or punishment and setting family routines of playing, reading, eating, and sleeping.[15] Parent-child interaction and parenting practices constitute a socio-

emotional structure of the child's living environment and depend on parent's personal resources, child's characteristics, and contextual stress and support.[18]

Food insecurity could be an important determinant of parent-child interaction and parenting practices, given its negative effects on the household's material circumstance and the functioning and psycho-social life of the family.[19–21] Food insecurity, even if mild, has been linked with adverse health of young children and their mothers.[22] Mothers experiencing food insecurity are at heightened risk of maternal depression and anxiety,[23,24] which in turn negatively affects their parenting capacity and their children.[3,25,26] Understanding parenting in households with food insecurity in early childhood is, thus, important for both parent's and child's well-being.

The household's food insecurity status may change over time. Earlier and concurrent food insecurity might pose different challenges to parenting, yet little has been known about the relationship of food insecurity and its longitudinal change with parenting in households with young children. Previous studies on food insecurity and its effects on parents and children were mostly cross-sectional[3,4] and targeted at older children.[5,7–10] Several studies examining food insecurity over time in households with young children focused on child outcomes (e.g., child obesity and toddler development),[6,27] leaving a gap in understanding temporal effects of food insecurity on parenting outcomes in these households. To bridge this knowledge gap, our study aimed to understand how food insecurity and its change over time relate to parenting in early childhood. We examined the parent-child relationship and structuring of the living environment of the child through parent-child interaction and practices of discipline, rules, and routines in general and food-related settings. We hypothesized that both earlier

and concurrent food insecurity were associated with suboptimal parenting. Given that differential effects of food insecurity on health, developmental, and behavioral outcomes by child's gender were observed in children,[9,28,29] we investigated our hypotheses separately for boys and girls.

Methods

Conceptual framework

In early childhood, food insecurity may trigger suboptimal parenting in building the parent-child relationship (e.g., less supportiveness in parent-child interaction). Food insecurity may also negatively affect parenting in structuring the child's living environment in general settings (e.g., difficulty sticking with rules, use of harsh disciplinary practices, lack of house rules about television watching) and food-related settings (e.g., lack of rules about food, and lack of meal routines to eat as family or at a regular time) (**Figure 4.1**). The association between food insecurity and parenting in early childhood might differ by child gender. Food insecurity and parenting may be influenced by parent's age, weight, marital status, race or ethnicity, and mental health (i.e., maternal factors); child's age, child behaviors in parent-child interaction, health status, birth weight, and multiple birth status (i.e., child factors); socio-economic status, number of siblings, language speaking at home, food assistance, and non-parental care (i.e., contextual factors).[9] The child behaviors in parent-child interaction should be accounted, given that it may reflect the child's situational arousal in a parent-child interaction, and also his or her underlying personal trait and behavioral tendency to influence parenting behaviors in parent-child interaction and in broader settings.[30,31]

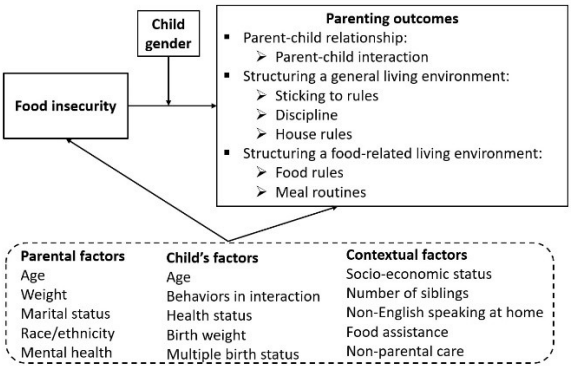

Figure 4.1 Conceptual framework for the relationship of food insecurity with parenting and influences of parental, child, and contextual factors.

Data and sample sizes

Data were from the Early Childhood Longitudinal Study–Birth Cohort (ECLS-B), nationally representative data about the living, learning, developmental, and health-related experiences of children born in 2001 in the United States from birth to kindergarten age. Using a cluster list-frame design, the ECLS-B collected data in five waves: when the children were around 9 months (month 9), 2 years (year 2), 4 years (year 4), and 5-6 years in 2006 and 2007 (the kindergarten 2006 and the kindergarten 2007 waves).[32,33] All children born from January to December in 2001 in the United States were eligible to be selected in the first wave of data collection, except those born to mothers under 15 years old, died before the 9-month assessment, or adopted before the 9-month assessment.[32] In the later waves, children whose parents or guardians completed interviews in the previous wave were followed; those who died or moved permanently out of the United States by the time of data collection were excluded. The year-4 wave additionally included American Indian/Alaska Native children who had a completed parent interview in month 9 but not in year 2. The year-5 wave subsampled the target population to reduce cost. In this wave, American Indian/Alaska Native children who had

a completed parent interview in month 9 and either year 2 or year 4 or both were included.[33]

The data we used were from the parent's interviews and child development assessments in the four main waves of the ECLS-B, i.e., month 9, year 2, year 4, and year 5. For twins, one of the children was selected randomly. Parents were inclusive of mothers, fathers, non-parent relatives, and non-relative caregivers; most parents were mothers (98.7%, 97.3%, 95.3%, and 94.0% in month 9, year 2, year 4, and year 5, respectively). Our analysis included all observations with no missing data for the parenting outcomes of interest at the examined waves (**Table 4.1**). For most of the outcomes, except parent-child interaction and rules about television, the excluded observations were minimal (i.e., less than 1%). For rules about television, 2.66% and 2.46% of the observations were excluded in years 3 and 4, respectively, due to missing data and televisions unavailable in the households. Missing data for parent behaviors in parent-child interaction were 21.1% and 14.7% in year 2 and year 3, respectively. Investigation of the characteristics of parents with and without data for parent behaviors in parent-child interaction revealed a missing-at-random pattern[34] where the drop-out process depended only on the observed covariates and the observed parent behaviors in parent-child interaction in the previous waves. These two groups did not differ by food insecurity status.

Measures

Parenting outcomes

Parent's behaviors in a *parent-child interaction* were measured by the parent's scales in a playing task in years 2 and 4 by the Two Bags Task.[35,36] In year 2, the Two

Bags Task was composed of six parent scales (range 1-7): parental sensitivity, parental intrusiveness, parental stimulation of cognitive development, parental positive regard, parental negative regard, and parental detachment. In year 4, the Two Bags Task had five

Table 4.1 Samples by parenting outcomes and data collection waves by child's gender, rounded to the nearest 50. Early Childhood Longitudinal Study – Birth Cohort, 2001-2006.

Parenting outcomes	Year 2		Year 4		Year 5	
	Boys	Girls	Boys	Girls	Boys	Girls
Parent-child relationship:						
Parent in parent-child interaction[a]	3,650	3,500	3,550	3,500		
Structuring a general living environment:						
Difficulty sticking with rules[b]	4,650	4,400	4,200	4,000	3,250	3,100
Harsh disciplinary practices[c]	4,650	4,400	4,150	4,000	3,250	3,100
Rules about watching TV[c]			4,050	3,900	3,200	3,050
Structuring a food-related living environment:						
Rules about food[c]			4,200	4,000	3,250	3,100
Evening meals as a family[d]	4,650	4,400	4,200	4,000	3,250	3,100
Evening meals at a regular time[d]	4,650	4,400	4,150	4,000	3,250	3,100

[a] scale, standardized; [b] scale, range 1-5; [c] binary, 0 or 1; [d] frequency, days/week

parent scales (range 1-7): parental emotional supportiveness, parental stimulation of cognitive development, parental intrusiveness, parental negative regard, and parental detachment. For each year, we combined the separate parent scales into a total parent scale using factor scores from a factor analysis with one factor (Cronbach's alpha = 0.737 and 0.637 in year 2 and year 4, respectively). Higher total parent scale scores reflect more parental emotional supportiveness and less adverse interactions. Using the total parent scale scores, we created standardized variables to measure parent's behaviors in parent-child interaction in years 2 and 4.

Parent's difficulty sticking with rules was measured by an item asking if the parent had "little or no difficulty sticking with his/her rules for the child even when close relatives, including grandparents, are there."[37] This item was rated on a 5-point Likert-

scale, higher scores indicate more difficulty sticking with rules: 1= exactly like me, 2= very much like me, 3= somewhat like me, 4= not much like me, or 5= not at all like me. Given that the meaning of the responses referred to either having difficulty sticking with rules or not, we recoded the item to create a binary variable reflecting if the parent had difficulty sticking with rules: 1= yes if the response was 4 – 5 and 0= no if the response was 1 – 3. *Harsh disciplinary practices* were measured by a binary variable indicating whether the parent used any discipline practices amongst spanking, hitting the child, making fun of him or her, and yelling or threatening when the child got angry and misbehaved (yes/no). Parents were asked if they had *rules about television watching* (yes/no).

Parents were asked whether they had *rules about kinds of food the child ate* (yes/no). Practices relating to family meal routines were captured through parent's reports of the number of days in a typical week when *at least some of the family ate the evening meal together* (range 0-7) and the number of days in a typical week when *the evening meal was served at a regular time* (range 0-7). As suggested by previous studies[38] and the data distribution, we distinguished the group having meal routines of eating evening meals as a family and at a regular time versus the group that did not, using the cut-off at 5 days: 1= yes (having the routine) if 5 days or more per week, 0= no (not having the routine) if less than 5 days per week.

Food insecurity

The parent's *food insecurity* was measured using the US Department of Agriculture's validated scale of 10 items asking the severity of the food insecurity experienced by the adults in the households during the preceding 12 months.[32,33] Given

that even marginal food-security (i.e., having 1 or 2 affirmative items) is associated with poor child outcomes,[9,22,39] we classified parents as food insecure if they affirmed any item (yes/no).

Covariates

Parent's age, weight, marital status, race, and depression status were used as parent covariates. The *parent's age* was reported in years, *weight* in kilograms. *Marital status* was coded as 1= married, 2= separated/divorced/widowed, 3= never married, and 4= non-bio or adoptive parent. *Race-ethnicity* was coded as 1= White, non-Hispanic, 2= Black or African American, non-Hispanic, 3= Hispanic, race or no race specified, 4= Asian, non-Hispanic, 5= Native American, Pacific Islander, or more than 1 race, non-Hispanic. The parent's *depression status* was measured by the 12-item version of the Center for Epidemiologic Study Depression Scale (CES-D) in month 9 and year 4. The CES-D score was created as guided by the ECLS-B User Manual[32] and classified as 1= non-depressed, 2= mildly depressed, 3= moderately depressed, and 4= severely depressed. In year 2, the parent's depression status was measured by the Depression Scale of the Composite International Diagnostic Interview Short Form (CIDI–SF). It was coded as 1= having major depression and 0= not having major depression.[36]

Regarding child covariates, the *child's age* was the decimal months at the time the direct child assessment occurred. C*hild behaviors in parent-child interaction* were measured by the child scales of the Nursing Child Assessment Teaching Scale (NCATS) in month 9 and the Two Bags Task in years 2 and 4.[35,36] The NCATS child scale had 23 items; the child total scale score was the sum of the affirmative child items (Cronbach's alpha = 0.625). The Two Bag Task in year 2 had three child scales: child engagement of

parent, child sustained attention, and child negativity toward parent. In year 4 were three child scales: child engagement of parent, child quality of play, and child negativity toward parent. These child scales from the Two Bag Task in years 2 and 4 did not load well together on one factor using factor analysis; therefore, scores of these child scales were not combined. *Child health status* was recoded as 1= poor or fair and 0= excellent, very good, or good health. *Child birth weight* was coded as 1= normal birth weight, 2= moderate low birth weight, and 3= very low birth weight. For *multiple birth status*, 1= singleton, 2= twin, and 3= higher order.

For contextual covariates, the *household's socio-economic status* was measured by a composite score computed by the ECLS-B from: mother/female guardian's education, father/male guardian's education, mother/female guardian's occupation, father/male guardian's occupation, and household income. The score ranged from -2.31 to 2.18; a higher score indicates a higher socio-economic status.[32] The *number of siblings* was an integer number. *Primary language speaking at home* was coded as 0= English and 1= other than English. Food assistance was measured by whether the parent or child *received The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)* in the preceding 12 months (yes/no), and whether the parent or any other member of the household had *received food stamps* since the child was born or since the last interview (yes/no). *Non-parental care* was measured by the hours per week the child was in all non-parental care arrangement.

Analytic methods

All analyses were conducted in Stata 14.2. Using univariate analysis, we examined the socio-demographic characteristics and parenting outcomes of the full

sample in month 9, years 2, 4, and 5. Bivariate analysis was used to investigate the crude associations between earlier food insecurity and later parenting outcomes. Multivariable analysis was used to further examine the associations of earlier and concurrent food insecurity with parenting outcomes accounting for covariates. In Model 1, each of the parenting outcomes (P_k) was modeled as a function of the *earlier* food insecurity (F_{k-1}), time-invariant covariates, and time-variant covariates:

$$P_k = \beta_0 + \beta_1 F_{k-1} + \beta_3 \text{ time-invariant covariates} + \beta_4 \text{ time-variant covariates}_{k-1} + E_k$$

In Model 2, *concurrent* food insecurity (FI_k) was added:

$$P_k = \beta_0 + \beta_1 F_{k-1} + \beta_2 F_k + \beta_3 \text{ time-invariant covariates} + \beta_4 \text{ time-variant covariates}_{k-1} + E_k$$

The subscript k-1 and k refer to the time of assessment in month 9, year 2, year 4, and year 5. β_o specifies the constant. β_1 is a coefficient indicating the difference in a parenting outcome at k between a parent with and without food insecurity at k-1, holding other covariates constant. β_2 indicates the effect of change in food insecurity from k-1 to k on the parenting outcome at k between a parent with and without food insecurity at k-1, holding other covariates constant. β_3 and β_4 represent coefficients of time-invariant covariates (i.e., child birth weight and multiple birth status) and time-variant covariates at k (i.e., all other covariates).

We also tested Model 3 where earlier parenting (P_{k-1}) were added into the second model. This model would allow us to additionally account for the effect of the earlier parenting practices on the outcomes—the concurrent parenting practices. Compared to Model 2, Model 3 yielded similar results for the associations of earlier and concurrent food insecurity with concurrent parenting. Model 3, however, gave less

information about these associations over time because less associations were tested as accounting for the earlier parenting practices. Only the results of Model 2 were, therefore, reported in this manuscript.

All analyses were stratified by the child gender. The *sem* procedure with the *mlmv* option and *cluster* control in Stata was used to implement regression models with full information maximum likelihood to retrieve as much information as possible from observations with missing values in independent variables and covariates.[40] This procedure did not account for sampling weights; instead, we accounted for weighting by controlling for the variables related with oversampling, i.e., race and ethnicity, child birth weight, and multiple birth status.[41] Potential biases due to missing data in parenting outcomes across waves were controlled by accounting for parental, child, and contextual covariates. We used linear regression for both continuous and dichotomous parenting outcomes to facilitate interpretation; linear and logistic models fit equally well if the probabilities are moderate.[42,43]

Results

Descriptive statistics

As the children aged from month 9 to year 5, parents were more likely to have difficulty sticking with rules, use harsh disciplinary practices, have rules about watching TV, and have rules about food; parents were less likely to have evening meal routines as a family and at a regular time (**Table 4.2**). During this period, parental report of their food insecurity status fluctuated from 22.7% to 17.0%, 20.7%, and 18.0% in month 9 and years 2, 4, and 5, respectively. Girls were about 49% of the children in all study waves. Most children had fair to good health, normal weight at birth, and were a singleton. A

Table 4.2 Descriptive statistics by data-collected waves. Early Childhood Longitudinal Study – Birth Cohort, 2001-2006.

Variables	Month 9 (N= 9,850) Mean (SD) [Range] or %	Year 2 (N= 9,050) Mean (SD) [Range] or %	Year 4 (N= 8,200) Mean (SD) [Range] or %	Year 5 (N= 6,400) Mean (SD) [Range] or %
Parenting outcomes:				
Parent behaviors in parent-child interaction—Total parent scale scores	34.4 (4.46) [15 – 49]	-0.0977 (0.530)* [-5 – 17]	-0.0439 (0.547) [-5 – 2]	
Difficulty sticking with rules		16.4%	14.7%	18.9%
Harsh disciplinary practices		40.4%	58.7%*	58.3%
Rules about watching TV			90.6%	92.4%
Rules around food			74.9%	75.3%
Evening meals as a family		82.5%	74.9%	75.8%
Evening meals at a regular time		76.1%	66.7%	68.2%
Explanatory variable:				
Food insecurity	22.7%	17.0%	20.7%	18.0%
Child covariates:				
Girls	48.7%	48.7%	48.9%	48.9%
Child age (months)	10.5 (1.90) [6.2 – 22.3]	24.5 (1.33) [16.8 – 38.2]	53.0 (4.20) [44.0 – 65.3]	65.1 (3.78) [56.7 – 74.5]
Child behaviors in parent-child interaction — Total child scale scores, NCAST scale	15.4 (2.74)* [4 – 23]			
Child behaviors in parent-child interaction—Child engagement scores, Two Bags Task scale		4.49 (1.12)* [1 – 7]	4.44 (0.894)* [1 – 7]	
Child behaviors in parent-child interaction—Sustained attention scores Two Bags Task scale		4.40 (1.13)* [1 – 7]		
Child behaviors in parent-child interaction—Child negativity scores, Two Bags Task scale		1.37 (0.759)* [1 – 7]	1.33 (0.715)* [1 – 7]	
Child performance in parent-child interaction—Child quality of play score, Two Bags Task scale			4.02 (0.883)* [1 – 7]	
Child poor health	3.08%*	2.96%*	3.06%*	2.84%
Child normal birthweight	76.7%*			
Child moderately low birthweight	13.0%*			
Child very low birthweight	10.3%			
Singleton	90.8%			
Twin	8.44%			
Higher order	0.79%			

Variables	Month 9 (N= 9,850) Mean (SD) [Range] or %	Year 2 (N= 9,050) Mean (SD) [Range] or %	Year 4 (N= 8,200) Mean (SD) [Range] or %	Year 5 (N= 6,400) Mean (SD) [Range] or %
Parent covariates:				
Parent age (years)	28.3 (6.53) [15 – 68]	29.8 (6.72) [17 – 70]	32.5 (6.91) [17 – 82]	33.6 (7.02) [18 – 83]
Parent weight (kilograms)	70.7 (19.0) [25.1 – 175]	71.2 (18.7) [35.2 – 170.6]	73.8 (19.2) [37.3 – 137]	73.9 (18.7) [36.9 – 137]
Married	64.6%	66.5%	68.0%	67.6%
Separated/Divorced/Widowed	6.45%	6.96%	8.81%	10.1%
Never married	28.3%	25.3%	20.8%	20.0%
Non-bio or adoptive parent	0.67%	1.40%	2.40%	2.65%
White, non-Hispanic	44.3%	45.4%	46.6%	43.3%
Black or African American, non-Hispanic	16.2%	15.8%	15.3%	15.8%
Hispanic, race or no race specified	18.2%	17.9%	17.4%	17.8%
Asian, non-Hispanic	13.9%	13.3%	13.0%	14.3%*
Native American, Pacific Islander, or more than 1 race, non-Hispanic	7.55%	7.61%	7.76%	8.82%
Non-depressed	56.3%		56.5%	60.2%
Mildly depressed	25.3%		25.5%	24.2%
Moderately depressed	11.4%		11.6%	9.69%
Severely depressed	7.09%*		6.43%	5.98%
Having major depression		9.27%		
Contextual covariates:				
Household's socio-economic status	-0.0663 (0.859) [-2.13 – 2.18]	-0.0667 (0.854) [-2.19 – 2.16]	-0.0163 (0.837) [-2.25 – 2.09]	-0.00863(0.853) [-2.31 – 2.09]
Number of siblings	1.02 (1.13) [0 – 9]	1.15 (1.14) [0 – 10]	1.41 (1.14) [0 – 8]	1.48 (1.14) [0 – 9]
Language speaking at home other than English	22.1%	21.8%	20.7%	21.8%
Received WIC[a] in the past 12 months	54.3%	42.4%	34.1%	22.1%
Received food stamps	21.8%	22.4%*	26.2%	23.8%
Non-parental care (hours/week)	16.1 (20.7) [0 – 140]	16.5 (20.2) [0 – 150]	23.9 (20.1) [0 – 170]	10.8 (15.4) [0 – 141]

[*] $p<0.05$ in t-test or chi-square test by child's gender
Note: Sample sizes were rounded to the nearest 50.
[a]WIC: the Special Supplemental Nutrition Program for Women, Infants, and Children

majority of parents were married (65-68%), about one in every four or five parents were never married, and the rest were either separated, divorced, or non-bio, adoptive parents.

More than two in every five parents were non-Hispanic White, about 15-16% were non-Hispanic African American, about 18% were Hispanic with race or no race specified, 13-14% were non-Hispanic Asian, and the rest were non-Hispanic Native American, Pacific Islander, and others. Nearly two in every five parents were not depressed, about one in every four parents were mildly depressed, about one in every ten parents were moderately depressed, and 6-7% were severely depressed. About one in every four households did not speak English at home. The percentage of households receiving WIC was highest in month 9 and continuously decreased to about 22% in year 5. The percentage of households receiving food stamps slightly increased over time from 21.8% to 22.4%, 26.2%, and 23.8% in month 9, years 2, 4, and 5, respectively. Non-parental care increased from month 9 (16.1 hours per week) to year 4 (23.9 hours per week) and decreased in year 5 (10.8 hours per week).

Bivariate regressions

Without controlling for covariates, earlier food insecurity was associated with almost all measures of parenting outcomes in the subsequent years (**Table 4.3**). For both boys and girls, earlier food insecurity was associated with lower parent's scores in parent-child interaction in years 2 and 4, and decreased probabilities of having favorable parenting practices, i.e., having rules about watching television and rules about food in years 4 and 5, having the routine of eating evening meals as a family in years 4 and 5, and having the routine of eating evening meals at a regular time in years 2, 4, and 5. Earlier food insecurity was associated with higher probabilities of having unfavorable parenting practices, i.e., having difficulty sticking with rules in years 2 and 4 for girls, and using harsh discipline in years 2, 4, and 5 for both boys and girls.

Table 4.3 Coefficients of earlier food insecurity[a] from bivariate regressions with parenting outcomes. Stratified by child's gender. Cluster control. Full information maximum likelihood method. Early Childhood Longitudinal Study – Birth Cohort, 2001-2006.

Parenting outcomes	Year 2		Year 4		Year 5	
	Boys	Girls	Boys	Girls	Boys	Girls
Parent-child relationship:						
Parent in parent-child interaction[b]	**-0.281**	**-0.341**	**-0.247**	**-0.249**		
Structuring a general living environment:						
Difficulty sticking with rules[c]	0.0113	**0.0386**	0.0301	**0.0521**	0.0321	0.0166
Harsh disciplinary practices[c]	**0.0775**	**0.0866**	**0.0432**	**0.0578**	**0.0429**	**0.111**
Rules about watching TV[c]			**-0.0538**	**-0.0479**	**-0.0500**	**-0.0421**
Structuring a food-related living environment:						
Rules about food[c]			**-0.122**	**-0.140**	**-0.0963**	**-0.147**
Evening meal as a family[c]	-0.0125	-0.0216	**-0.0473**	**-0.0584**	**-0.0519**	**-0.0461**
Evening meal at a regular time[c]	**-0.0873**	**-0.0973**	**-0.0897**	**-0.1109**	**-0.0817**	**-0.0497**

[a] Earlier food insecurity (FI) refers to FI in month 9, year 2, and year 4 for parenting outcomes in year 2, year 4, and year 5, respectively.
[b] scale, standardized;
[c] binary, 0 or 1
Bold coefficient: *earlier* FI coefficient with p-value <0.05

Multivariable regressions

Some associations between earlier food insecurity and parenting in bivariate regressions remained at a smaller magnitude after adding covariates (**Table 4.4**). *For girls*, earlier food insecurity was associated with using harsh disciplinary practices in year 5 (β_1= 0.0816, p<0.05), having rules about food in year 4 (β_1= -0.0474, p<0.05), and having evening meals at a regular time in years 2 and 4 (β_1s= -0.0569 and -0.0672, respectively, both p<0.05). *For boys*, earlier food insecurity was associated with having evening meals at a regular time in years 2 and 4 (β_1s= -0.0471 and -0.0532, respectively, both p<0.05).

In addition to earlier food insecurity and covariates, concurrent food insecurity was associated with parenting in years 2 and 4 for boys and girls but not in year 5 (**Table 4.5**).

Table 4.4 Coefficients of *earlier food insecurity*[a] (β_1) from multivariable regressions with parenting outcomes. Stratified by child's gender. Controlled for parent and child's covariates and covariates of socio-economic status, food assistance, and non-parental care. Cluster control. Full information maximum likelihood method. Early Childhood Longitudinal Study – Birth Cohort, 2001-2006.

Parenting outcomes	Year 2		Year 4		Year 5	
	Boys	Girls	Boys	Girls	Boys	Girls
Parent-child relationship:						
Parent in parent-child interaction[b]	0.0271	-0.0405	0.0230	-0. 0496		
Structuring a general living environment:						
Difficulty sticking with rules[c]	-0.00122	0.0160	0.0224	0.0379	0.00643	-0.0136
Harsh disciplinary practices[c]	0.0259	0.0289	0.0211	0.0224	0.0108	**0.0816**
Rules about watching TV[c]			-0.0255	-0.0155	-0.0150	0.0029 0
Structuring a food-related living environment:						
Rules about food[c]			-0.0298	**-0.0474**	0.0311	-0.0288
Evening meal as a family[c]	-0.0140	-0.0241	-0.0188	-0.0328	0.00324	-0.0245
Evening meal at a regular time[c]	**-0.0471**	**-0.0569**	**-0.0532**	**-0.0672**	-0.0105	-0.0145

[a] Earlier food insecurity (FI) refers to FI in month 9, year 2, and year 4 for parenting outcomes in year 2, year 4, and year 5, respectively;
[b] scale, standardized;
[c] binary, 0 or 1;
Bold coefficient: *earlier* FI coefficient with p-value <0.05
Parent's covariates: Parent's age, weight, marital status, race, and depression status (time-variant).
Child's covariates: Child performance in parent-child interaction, child age, perceived child health (time-variant); child birthweight, and multiple birth status (time-invariant).
Covariates of household conditions, food assistance, and non-parental care: Household's socio-economic status, number of siblings, primary language at home was not English, parent or child received WIC in the past 12 months, parent or any other member of the household had received food stamps since the child was born or since the last interview, and hours per week the child was in all non-parental care arrangement (time-variant).

For girls, concurrent food insecurity was associated with harsh disciplinary practices in years 2 and 4 (β_2s= 0.0492 and 0.710, respectively, both $p< 0.05$); earlier but not concurrent food insecurity was significantly associated with harsh disciplinary practices in year 5 (β_1= 0.0804, $p<0.05$). Concurrent food insecurity of girls' parents was associated with rules about food in year 4 (β_2= -0.0356, $p< 0.05$), the routine of eating evening meals as a family in years 2 and 4 (β_2s = -0.0477 and -0.0503, respectively, both $p< 0.05$), and the routine of eating evening meals at a regular time in years 2 and 4 (β_2s = -0.0546 and -0.0943, respectively, both $p< 0.05$). In year 2, in addition to concurrent food

Table 4.5 Coefficients of *earlier food insecurity*[a] (β_1) and *concurrent* food insecurity[b] (β_2) from multiple regressions with parenting outcomes. Stratified by child's gender. Controlled for parent and child's covariates and covariates of socio-economic status, food assistance, and non-parental care. Cluster control. Full information maximum likelihood method. Early Childhood Longitudinal Study – Birth Cohort, 2001-2006.

Parenting outcomes	FI	Year 2		Year 4		Year 5	
		Boys	Girls	Boys	Girls	Boys	Girls
Parent-child relationship:							
Parent in parent-child interaction[c]	β_1	0.0280	-0.0594	0.0356	-0.0337		
	β_2	-0.00467	0.0771	-0.0473	-0.0717		
Structuring a general living environment:							
Difficulty sticking with rules[d]	β_1	-0.00205	0.0168	0.0205	0.0336	0.0111	-0.0275
	β_2	0.00378	-0.00348	0.00849	0.0188	-0.0117	0.0390
Harsh disciplinary practices[d]	β_1	0.0115	0.0177	0.0169	0.00627	0.00302	**0.0804**
	β_2	**0.0582**	**0.0492**	0.0197	**0.0710**	0.0260	0.00436
Rules about watching TV[d]	β_1			-0.0201	-0.0132	-0.0167	-0.00297
	β_2			-0.0248	-0.0105	0.00308	0.0161
Structuring a food-related living environment:							
Rules about food[d]	β_1			-0.0327	-0.0393	0.0363	-0.0290
	β_2			0.0128	**-0.0356**	-0.0150	0.000625
Evening meal as a family[d]	β_1	-0.00302	-0.0132	-0.0158	-0.0213	0.00528	-0.0280
	β_2	**-0.0444**	**-0.0477**	-0.0135	**-0.0503**	-0.00853	0.00995
Evening meal at a regular time[d]	β_1	-0.0301	**-0.0444**	**-0.0489***	-0.0457	-0.0124	-0.00712
	β_2	**-0.0688**	**-0.0546**	-0.0191	**-0.0943**	0.00209	-0.0198

FI = Food Insecurity;
[a] *Earlier food insecurity* (FI) refers to FI in month 9, year 2, and year 4 for parenting outcomes in year 2, year 4, and year 5, respectively.
[b] *Concurrent* food insecurity (FI) refers to FI in year 2, year 4, and year 5 for parenting outcomes in year 2, year 4, and year 5, respectively.
[c] scale, standardized;
[d] binary, 0 or 1
Bold coefficient: *earlier* FI coefficient with p-value <0.05
Bold & underlined coefficient: *concurrent* FI coefficient with p-value <0.05
Parent's covariates: Parent's age, weight, marital status, race, and depression status (time-variant).
Child's covariates: Child performance in mother-child interaction, child age, perceived child health (time-variant); and child birthweight, multiple birth status (time-invariant).
Covariates of household conditions, food assistance, and non-parental care: Household's socio-economic status, number of siblings, primary language at home was not English, parent or child received WIC in the past 12 months, parent or any other member of the household had received food stamps since the child was born or since the last interview, and hours per week the child was in all non-parental care arrangement (time-variant).

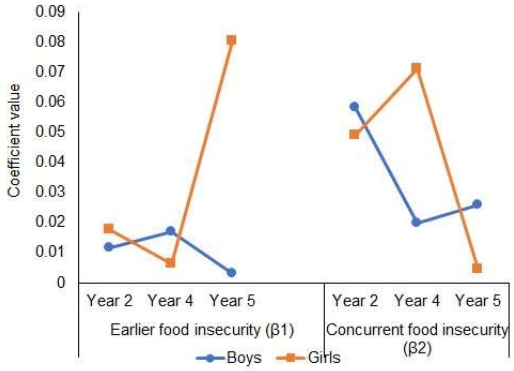

Figure 4.2 Magnitude of the associations of earlier and concurrent food insecurity with harsh discipline practices by years and child gender

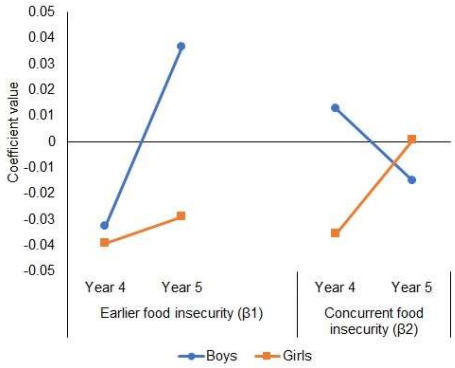

Figure 4.3 Magnitude of the associations of earlier and concurrent food insecurity with rules about food by years and child gender

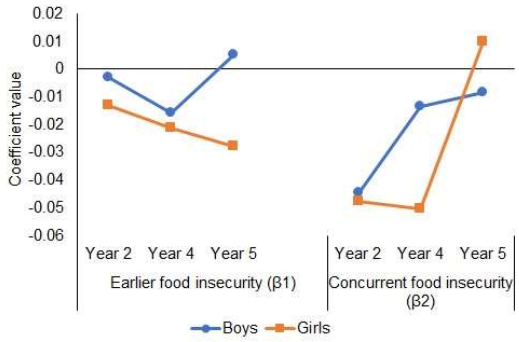

Figure 4.4 Magnitude of the associations of earlier and concurrent food insecurity with the routine of having evening meals as a family by years and child gender

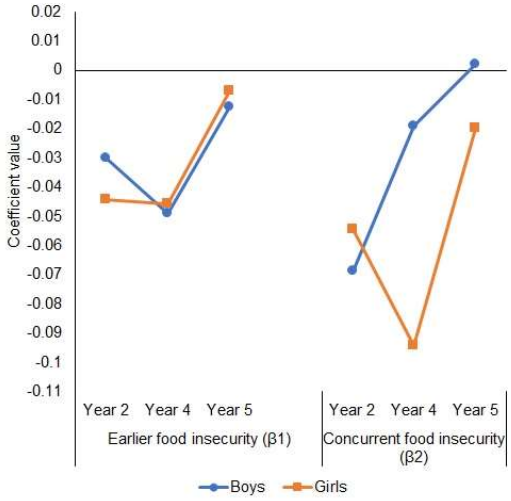

Figure 4.5 Magnitude of the associations of earlier and concurrent food insecurity with the routine of having evening meals at a regular time by years and child gender

insecurity, earlier food insecurity was significantly associated with the routine of eating evening meals at a regular time (β_1= -0.0444, p<0.05). *For boys,* concurrent food insecurity was associated with three parenting practices in year 2, i.e., harsh disciplinary practices (β_2= 0.582, p< 0.05), the routine of eating evening meal as a family (β_2= -0.0444, p< 0.05), and the routine of eating evening meals at a regular time (β_2= -0.0688, p< 0.05). In year 4, earlier food insecurity was associated with the routine to eat evening

meals at a regular time (β_1= -0.0489, $p<0.05$), but concurrent food insecurity was not (β_2= -0.0191, $p>0.05$).

The magnitude of the associations over time of earlier and concurrent food insecurity with harsh disciplinary practices, rules about food, and meal routines were generally greater for girls than boys (**Figures 4.2 – 4.5**). Compared to boys, the associations of earlier food insecurity were greater for girls with the harsh discipline outcome (**Figure 4.2**), rules about food (**Figure 4.3**), and the routine of having evening meals as a family (**Figure 4.4**) in year 5; the associations of concurrent food insecurity were greater for girls with harsh discipline (**Figure 4.2**), rules about food (**Figure 4.3**), the routine of having evening meals as a family (**Figure 4.4**), and the routine of having evening meals at a regular time in year 4 (**Figure 4.5**) in year 4. In other time points, the associations of earlier and concurrent food insecurity with the examined outcomes were relatively similar between boys and girls.

Discussion

Earlier and concurrent food insecurity were associated with a heightened risk of using harsh discipline and a decreased probability of having rules about foods and meal routines, which is suboptimal parenting in structuring a general and food-related living environment for young children. The associations of earlier and concurrent food insecurity with suboptimal parenting differed by child gender and temporal period.

While both boys and girls had heightened risk of having parents using suboptimal parenting practices in households with earlier and concurrent food insecurity, the associations of food insecurity with parenting in early childhood were generally greater for girls than boys. Previous studies showed different effects of food insecurity on

nutritional and non-nutritional outcomes among older children by gender. Jyoti et al. (2005) found that food insecurity was associated with developmental outcomes among school-age children; girls but not boys in households with earlier food insecurity particularly had an increased risk of weight gain, gain in body mass index, and poor mathematic performance; becoming food insecure was significantly associated with poor reading performance among girls only. In a randomized obesity prevention trial with Head Start preschooler in Michigan, Jansen et al. (2017) found short-term change in household food insecurity was related to body mass index and diet quality changes in girls but not boys. Jackson and Vaughn (2017) found that household food insecurity in childhood was associated with misconduct in male but not female adolescents. In our study, young children, particularly girls, in households with earlier and concurrent food insecurity had an increased risk of having parents using harsh discipline, setting no rules about food, and creating no regular meal routines, providing the first evidence for gendered effects of food insecurity on parenting and with young children.

Harsh discipline exerts adverse impacts on child's cognitive ability, psycho-social development, and behaviors in early and later childhood.[44–48] Using harsh disciplinary practices, inclusive of corporal punishment and verbal aggression, is prevalent when children are about 2-5 years old.[49,50] As the child gets older, corporal punishment reduces, whereas verbal aggression does not.[49,50] Mothers are likely to use harsh discipline more than fathers[49,51] and boys are more likely to have parents use harsh discipline than girls.[49,51] In our study, earlier and concurrent food insecurity of parents was positively associated with parents' use of harsh discipline, and the magnitude of association was greater for girls compared to boys. A possible explanation for the

association of food insecurity and harsh parenting practices is that food insecurity is a stressor and a marker of stressful conditions[52] experienced by parents in the household. Stressful conditions could lead to parental stress, which in turn, is expressed as harsh disciplinary practices to the children. The different expression of stress and use of harsh disciplinary practices by child gender could relate to different expectations of parents to girls and boys, i.e., girls are often expected to be monitored and controlled and boys are often encouraged to be independent.[53] Mothers are also likely to have higher expectations for girls than boys in their efforts and achievements.[54] Under stressful conditions with food insecurity, the stress and expectations of the mothers, who were most of the parents in this study, may have turned into harsh disciplinary practices to girls more than boys.

Food insecurity is likely to force parents to take actions to adapt to food shortage, resulting in compromised dietary quality, particularly among women.[55–57] Actions to adapt to food shortage could include ignoring meal planning and routines,[20] leading to lack of rules about food and meal routines such as eating as a family and at a regular time. In our study, earlier and concurrent food insecurity were associated with lower probabilities of having rules about foods and meal routines in year 2 and 4; why parents of young girls were more likely than parents of young boys to not have rules about food and meal routines and why the associations of food insecurity and these parenting practices do not carry over into year 5 are not clear.

Concurrent food insecurity was associated with harsh disciplinary practices, rules about food, and evening meal routines in years 2 and 4, regardless of earlier food insecurity. These associations of concurrent food insecurity with parenting outcomes in

years 2 and 4 imply two issues. First, food shortage might exert an immediate effect on parenting in structuring the general and food-related living environment for their children before starting kindergarten. Second, consistent food insecurity and moving into food insecurity could negatively affect parenting outcomes in these early years. Earlier food insecurity, i.e., food insecurity in month 9, year 2, and year 4, was associated with the parenting practices of having evening meals at a regular time in year 2 for girls and year 4 for boys and using harsh disciplinary practices in year 5 for girls, regardless of food insecurity in the concurrent years. That earlier food insecurity was associated with parenting in years 2, 4, and 5 and concurrent food insecurity was associated with parenting in year 2 and 4 suggests a need of further investigations on the potential mechanisms for the relationship of earlier and concurrent food insecurity with parenting in early childhood and how these mechanisms change as the children reach age 5. The mechanisms and their changes at the child age of 5 could relate to parents (e.g. parent's better coping strategies over time), children (e.g. child development periods), and schools (e.g. school food programs). Understanding such mechanisms may shed light on the difference in the associations of food insecurity and parenting by child gender and age periods. Randomized control studies would be beneficial to investigate whether interventions continually addressing the food-shortage risk of families with young children throughout infancy and early childhood by the age of 5 could improve parenting practices in structuring a healthy living environment for the children in these early years of life.

Although previous cross-sectional studies established an association between food insecurity and parenting,[3–5] this study provides understanding about the relationship

between food insecurity and parenting over time in early childhood. Examining both earlier and concurrent food insecurity and different aspects of parenting in parent-child interaction and structuring a general and food-related living environment, the study advances knowledge of temporal impacts of food insecurity on parenting in early childhood. The study specifies parenting practices with which food insecurity is significantly associated and different patterns of these associations by time and child gender, shedding light on the relationship between food insecurity and parenting in early childhood and also opening up plausible explanations for different associations of food insecurity on child outcomes by gender that have been found in the literature[3,4,6,9] through parenting. The association between food insecurity in early childhood and harsh disciplinary practices, for example, could be a mechanism through which boys and girls with food-insecure parents are more susceptible to problems in behaviors, school performance, and health compared to their peers with food-secure parents.

The children in this study were from a birth cohort born in the United States in 2001 and may not be representative of children born at other times or in other places.[58] Despite its rich data about parents' and children's experiences in early childhood, the ECLS-B did not measure parental anxiety and stress distinct from a parental depression.[59] Lack of this measure limits having full understand of parental mental health as a mechanism through which food insecurity relates to parenting behaviors. Also, there was no information about parent-child interactions in a feeding context or mealtime, and so possible associations of food insecurity with these parenting behaviors were not examined.

Conclusions

Earlier and concurrent food insecurity were linked with suboptimal parenting in structuring a general and food-related living environment for young children, particularly for girls and by the age of 5, through an increased risk of using harsh discipline, lack of rules about foods, and irregular meal routines. Further investigations on the potential mechanisms for the relationship of earlier and concurrent food insecurity with parenting in early childhood and how these mechanisms change as the children reach age 5 are needed.

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2. Manuscript 2

CHILD DIFFICULTY IN SELF-REGULATION MODIFIES ASSOCIATIONS OF FOOD AND GENERAL PARENTING PRACTICES WITH CHILD DIETARY BEHAVIORS IN YOUNG CHILDREN[2]

[2] Nguyen HT, Frongillo EA, Blake CE, Shapiro CJ, Frith AL. To be submitted to a journal to be decided.

ABSTRACT

Background: Healthy eating in early childhood is important in preventing excess weight gain and development of obesity and obesity-related chronic diseases at young ages and later in adulthood. Parents play a key role in the development of children's eating behaviors through their parenting.

Objectives: This study aimed to understand the relationship of parenting in food-related and non-food-related settings with dietary intake of young children and the role of child self-regulation in this relationship.

Methods: Data were from the Early Childhood Longitudinal Study – Birth Cohort. Parent-child dyads with non-missing outcomes were included into the analysis. Analyses were done separately for boys and girls. Regression models with full information maximum likelihood were used accounting for clusters in Stata. The child's dietary outcomes were weekly frequency of intake of sugar-sweetened beverages, sweet foods and desserts, salty snack foods, fruits, and vegetables in year 5. Each child dietary outcome was regressed on food parenting variables at age 4 (i.e., rules about foods, and meal routines of eating as a family and at a regular time) and covariates. General parenting variables at age 4 (i.e., parent-child interaction, difficulty sticking with rules, harsh discipline, rules about watching television, and rules about bedtime), child difficulty in self-regulation at age 4, and their interactions were then added sequentially.

Results: Better food parenting practices at age 4 were associated with less frequent intake of unhealthy and more frequent intake of healthy foods and beverages in both boys and girls at age 5, with some differences by gender. General parenting practices at age 4 were associated with dietary behaviors differently for boys and girls.

Difficulty in self-regulation at age 4 significantly modified the association between parenting practices and child's dietary behaviors for boys (evening meals at a regular time and intake of sweet foods and desserts) and girls (parent-child interaction and intake of sugar-sweetened beverages; difficulty sticking with rules and intake of sweet foods and desserts; rules about foods and intake of fruits and vegetables; and harsh discipline and intake of fruits).

Conclusions: Better food parenting and general parenting practices at age 4 were associated with children's healthy dietary behaviors at age 5, and the child's difficulty in self-regulation plays an important role in modifying this association, particularly in girls. Both parents and children could be active agents in the development of children's dietary behaviors. Further investigations are needed to identify interventions and programs targeting both parents and children to promote positive parenting in food and non-food settings and support children with difficulty in self-regulation.

Introduction

Healthy eating in early childhood is important in preventing excess weight gain and development of obesity and obesity-related chronic diseases at young ages and later in adulthood.[1–6] In the United States, one in every five children aged 2-5 years is either overweight or obese,[7,8] and the prevalence of overweight and obesity in adulthood is even more striking: 68.5%, i.e. two in every three adults aged 20 and above.[7] Improving eating behaviors and diet quality of the population at all ages is at the center of national strategies to curb the excess-weight epidemic.[9–11] Despite multiple efforts at different levels and settings, the diet quality of Americans remains far away from the optimal recommendations as seen in the American average score of Healthy Eating Index – which was only 59 out of 100, according to the National Health and Nutrition Examination Survey, 2013-2014 – and the diet quality of children is even lower than the average (i.e., 53 out of 100 for children aged 6-17).[12] Helping children develop healthy eating behaviors and consume healthy diets daily is essential for not only their growth and development but also the national population health and socio-economic development.[13,14]

Children's eating behaviors develop in early childhood, and parents play a key role in this process through their parenting – that is the way they create an environment to nurture the children through their daily interactions and practices.[15,16] In the literature of child development and nutrition, parenting is a broad and multi-dimensional concept that embodies varied aspects of child care and nurturing in varied settings (e.g., food-related or non-food-related), and is inclusive of overall styles as well as context-specific behaviors.[15,17–26] Children, on the other hand, vary in responding to the environment

depending on their self-regulation capacity – that is the capacity to attend and adapt to situational demands occurring from the inner self or the external environment.[27,28] Child self-regulation is of both nature and nurture, being a product of personality traits (often referred as temperament) and the socialization process where the child learns and changes in response to the social context he/she is in.[29,30] This socialization process is particularly supported and guided by parenting in early childhood. The development of child behaviors in early childhood is therefore a function of both parenting practices and child self-regulation.[31,32]

Recent literature suggested an association of selected parenting aspects (e.g., quality of parent-child interaction and setting up rules for house routines) and child self-regulation with child's nutrition status (e.g., weight and body mass index) in early childhood.[15,31–36] There is, however, a gap in our understanding about the relationship of parenting and child self-regulation with child eating behaviors in early childhood. To bridge this knowledge gap, we aimed to understand the relationship of parenting practices in both food-related and non-food-related settings with dietary intake of young children and the role of child self-regulation in this relationship. In this study, we referred to parenting in food-related and non-food-related settings as *food parenting* and *general parenting*, respectively. For food parenting, we examined rules about foods and meal routines, i.e., having evening meals as a family and having evening meals at a regular time. For general parenting, we examined parents' behaviors in parent-child interactions, firmness and harshness in discipline, and having rules about watching television and bedtime. Given that previous literature suggested these relationships might differ by

child gender,[34,36–40] we conducted analyses separately for boys and girls to test four hypotheses:

1) Food parenting practices in setting rules about the child's food intake and maintaining meal routines at age 4 are associated with the child's healthy dietary intake at age 5.
2) Beyond food parenting practices, general parenting in daily interactions, disciplines, and house rules at age 4 is independently associated with the child's dietary intake at age 5.
3) Child difficulty in self-regulation at age 4 is independently associated with his or her dietary intake at age 5; and
4) Child difficulty in self-regulation modifies the relationship of general and food parenting at age 4 with the child's dietary intake at age 5.

Methods

Conceptual framework:

Our conceptual framework is that, in early childhood, food parenting can work together with general parenting to create a structured healthy environment for boys and girls. Food parenting means having rules about the foods the child may eat and having meal routines of eating as a family and at a regular time. General parenting means parents' acting supportively in parent-child interaction, being firm and not harsh in discipline, and setting house rules about watching television and bed time. Such environment is important to support healthy eating behaviors in these children, resulting in less frequent intake of sugar-sweetened beverages, sweet foods and desserts, and salty snacks, and more frequent intake of fruits and vegetables. The child's difficulty in self-

regulation can independently relate to his or her frequent intake of foods and beverages. Furthermore, the effect of food and general parenting (in creating the structured healthy environment) on the child's dietary intake can differ upon the difficulty in self-regulation of the child. Confounders for such relationship could be parent's age, weight, marital status, race or ethnicity, and mental health (parent's factors); child's age, school attendance, health status, birth weight, and multiple birth status (child's factors); socio-economic status, number of siblings, language speaking at home, food assistance, non-parental care, region of residence, and urbanity (contextual factors). (**Figure 4.6**)

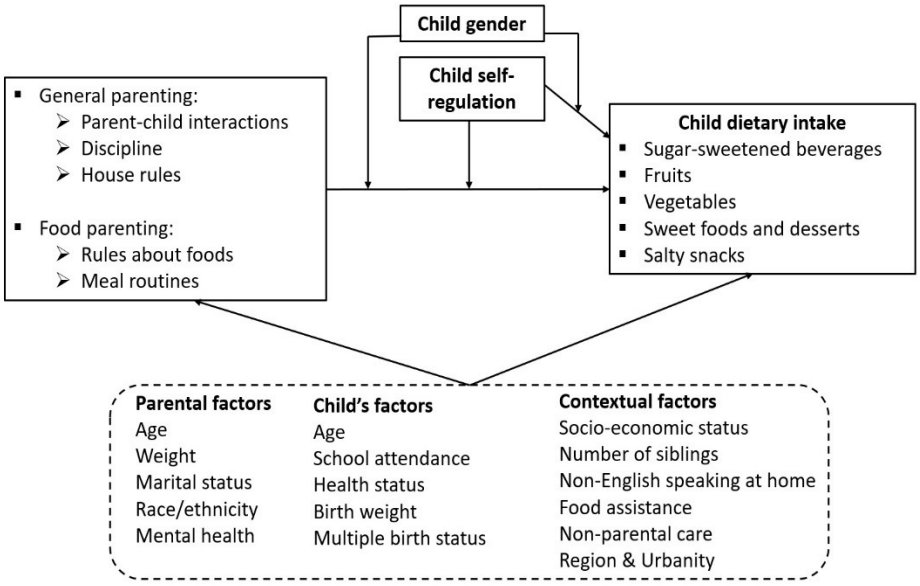

Figure 4.6 Conceptual framework for the relationships of parenting and child self-regulation with child dietary intake

Data source and sample sizes:

Our analyses used data from the Early Childhood Longitudinal Study–Birth Cohort (ECLS-B). The ECLS-B collected data of children born in 2001 in the United States in five waves, i.e., the 9-month, 2-year, preschool, and kindergarten waves 2006 and 2007.[41] (Information about data collection in these waves has been described

elsewhere).[42] We used the data from the parent's interviews and child development assessments when the children were about 4 years and 5 years old in the preschool and kindergarten 2006 waves. The parent respondents were mostly mothers (93.0% in the kindergarten 2006 wave), though fathers, non-parent relatives, and non-relative caregivers were also included. We included all parent-child dyads with no missing data for the outcome variables at age 5. Stratified by child gender, our final sample sizes were 3,250 boys and 3,150 girls, 99.9% of the data collected for the kindergarten wave 2006 when the children were about 5 years old.

Outcome variables at age 5:

Child's dietary intake**:** Parents were asked how often the child had eaten or drunk sugar-sweetened beverages, sweet foods and desserts, salty snack foods, fruits, and vegetables during the previous 7 days "from the time the child got up until he or she went to bed," inclusive of "food eaten at home, preschool or school, restaurants, play dates, anywhere else, and over the weekend."[43(p81)] Sugar-sweetened beverages were inclusive of soda pop and fruit drinks that are not 100% fruit juice; sweet foods and desserts were inclusive of candy, ice cream, cookies, brownies, and other sweets; salty snack foods were inclusive of potato chips, corn chips, pretzels, popcorn, or crackers; fruits were inclusive of fresh fruit, applesauce, canned peaches, canned fruit cocktail, frozen berries, or dried fruit; and vegetables were not inclusive of French-fries and other fried potatoes.

The frequency of intake of these foods and beverages over 7 days were originally reported as: 1= once a day, 2= two times a day, 3= three times a day, 4= four or more times a day, 5= one to three times during the past 7 days, 6= four to six times

during the past 7 days, 7= never during the past 7 days. We recoded them to reflect the average frequency of the dietary intake within a week: 0= 0 time per week if no consumption, 2= 2 times per week if consumed one to three times during the past 7 days, 5= 5 times per week if consumed four to six times during the past 7 days, 7= 7 times per week if consumed once a day, 14= 14 times per week if consumed two times a day, 21= 21 times per week if consumed three times a day, 28= 28 times per week if consumed four or more time a day. The squared roots of the frequencies were used in analyses to adjust for the skew distributions.

Parenting variables at age 4:

Parent-child interaction was videotaped in a 10-minute Two Bags Task. In this task, five parent scales and three child scales were coded on a 7-point Likert-scale ranging from very low (1) to very high (7).[44] We used the five parent scales, i.e., parental emotional supportiveness, parental stimulation of cognitive development, parental intrusiveness, parental negative regard, and parental detachment. These parent scales were combined into a total parent scale using factor analysis (Cronbach's alpha = 0.639). Higher total parent scale scores reflect more parental emotional supportiveness and less adverse interactions.

Difficulty sticking with rules: Parents were asked to rate on 5-point Likert-scale if they had "little or no difficulty sticking with his/her rules for the child even when close relatives, including grandparents, are there": 1= exactly like me, 2= very much like me, 3= somewhat like me, 4= not much like me, or 5= not at all like me.[45] This item was recoded to reflect if the parent had difficulty sticking with rules: 1= yes if the response was 4 – 5 and 0= no if the response was 1 – 3.

Harsh disciplinary practices**:** A binary variable was created to indicate if parents used any harsh disciplinary practices amongst spanking, hitting the child, making fun of him or her, and yelling or threatening when the child got angry and misbehaved (Yes/No).

Rules about watching television and rules about bed time: Parents were asked if they had rules about which television programs the child can watch and rules about what time the child went to bed (Yes/No).

Rules about foods: Parents were asked if they had rules about what kinds of food the child ate (Yes/No).

Evening meals as a family and evening meals at a regular time: Parents were asked to report the number of days in a typical week when "at least some of the family ate the evening meal together" (range 0-7) and the number of day in a typical week when "the evening meal was served at a regular time" (range 0-7). Using the cut-off at 5 days,[33] we recoded these items as whether the families had routines to eat the evening meals as a family and at a regular time: 1= yes if 5 days or more in a week, 0= no if less than 5.

Other variables:

Child difficulty in self-regulation at age 4**:** Seven items from the Preschool and Kindergarten Behavior Scales–Second Edition (PKBS-2) and Social Skills Rating System (SSRS) were selected. The selection was based on the items' face validity that could conceptually operationalize the two sub-constructs of self-regulation, i.e., attention and self-regulatory capacity. Regarding attention, there were 3 items: 1) child has difficulty in concentrating, 2) child pays attention well, and 3) child keeps working until finished.

Regarding self-regulatory capacity, there were 4 items: 1) child has temper tantrums, 2) child was overly active, 3) child works or plays independently, and 4) child acted impulsively. These items were coded on a 5-Likert scale: 1= never, 2= rarely, 3= sometimes, 4= often, 5= very often. These items were combined using factor analysis to reflect the child's difficulty in self-regulation (Cronbach's alpha = 0.718).

Parent covariates at age 5 were parent's age (in years), weight (in kilograms), marital status (1= married, 2= separated/divorced/widowed, 3= never married, and 4= non-bio or adoptive parent), race/ethnicity (1= non-Hispanic White, 2= non-Hispanic Black or African American, 3= Hispanic, 4= Native American, Pacific Islander, or more than 1 race, non-Hispanic), and depression status measured by the 12-item version of the Center for Epidemiologic Study Depression Scale (CES-D) (1= non-depressed, 2= mildly depressed, 3= moderately depressed, and 4= severely depressed).

Child covariates at age 5 or at birth were child's age (months), school attendance (1= Yes, 0= No), health status (1= Poor or fair, 0= Excellent, very good, or good health), birth weight (1= Normal, 2= Moderate low, and 3= Very low), and multiple birth status (1= Singleton, 2= Twin, and 3= Higher order).

Contextual covariates at age 5 were household's socio-economic status (a composite score), number of siblings (in integer number), primary language speaking at home other than English (0= English and 1= Other than English), received the Special Supplemental Nutrition Program for Women, Infants, and Children in the previous 12 months (1= yes, 0= no), non-parental care (hours per week), household region (1= Northeast, 2= Midwest, 3= South, 4= West), and urbanity (1= yes, 0= no). The ECLS-B provided a composite score for the *household's socio-economic status*

computed from: mother/female guardian's education, father/male guardian's education, mother/female guardian's occupation, father/male guardian's occupation, and household income.[46] This score ranged from -2.31 to 2.09, higher score for higher socio-economic status.

Analytic methods:

Data analyses were conducted in Stata 14.2. The sample's characteristics by child gender was obtained with univariate analyses. Using the *sem* procedure with the *mlmv* option and cluster control in Stata, four main regression models with full information maximum likelihood were built to test the research hypotheses for boys and girls separately. Model 1 regressed the child's dietary outcomes on food parenting variables and covariates. Model 2 added general parenting variables. Model 3 additionally included the child's difficulty in self-regulation. Model 4 added interactions of the child's difficulty in self-regulation and parenting variables. Each interaction in Model 4 was entered separately; only significant interactions remained in the model. Instead of using sampling weights, the variables relating to oversampling (i.e., race and ethnicity, child birth weight, and multiple birth status) were included into the models.[47] In these models, the square roots of the frequency of the child's dietary intake were used and standardized coefficients were reported. When the interactions were significant, the model was re-run for unstandardized coefficients. These were used to calculate the estimated frequency of intake at different values of the variables in the interactions: at 0 and 1 for binary variables; at mean and at mean ± 1.282 SD for continuous variables to enable comparisons across the middle 80% of the sample distribution.

Results

Sample characteristics

At age 5, the mean frequent intake of sugar-sweetened beverages in boys (4.63 times per week) was higher than girls (4.14 times per week), and the mean frequent intake of fruits and vegetables in boys (9.62 and 8.80 times per week, respectively) was lower than girls (9.96 and 9.45 times per week, respectively, $p<0.05$); the differences were small. Parents were not much different in their general parenting and food parenting practices for boys and girls at age 4 except more harsh discipline used for boys (60.1%) than girls (57.1%) ($p<0.05$). The score of the child's difficulty in self-regulation at age 4 ranged from -2.11 to 3.35 in boys and from -2.11 to 3.24 in girls; boys had a higher mean score (0.137) than girls (-0.149) ($p<0.05$). At age 5, most of the boys and girls attended school. The mean age of their parents were about 33 years old. Both samples were diverse in parents' marital status, race/ethnicity, depression status, and household's residential regions and areas (**Table 4.6**).

Food parenting at age 4 and child dietary intake at age 5

Having rules about food and evening meal routines at age 4 were associated with less frequent intake of unhealthy and more frequent intake of healthy foods and beverages in both boys and girls at age 5 adjusting for covariates, with some differences between genders (**Table 4.7, Model 1**). For boys, the association of having rules about foods at age 4 was significant with the frequent intake of both unhealthy and healthy dietary items at age 5, i.e., sugar-sweetened beverages, fruits, and vegetables (βs= -0.115 SD, 0.0503 SD, 0.0452 SD, respectively, all $p<0.05$). For girls, having rules about foods at age 4 was significantly associated with the frequent intake of only unhealthy dietary

Table 4.6 Descriptive statistics by child gender. Early Childhood Longitudinal Study–Birth Cohort, 2001-2006.

Variables	Boys (n=3,250) Mean (SD) [Range] or %	Girls (n=3,150) Mean (SD) [Range] or %
Child's dietary intake at age 5		
Sugar-sweetened beverages (time per week)	4.63 (6.18)* [0 – 28]	4.14 (5.63)* [0 – 28]
Sweet foods and desserts (time per week)	6.14 (5.60) [0 – 28]	6.03 (5.42) [0 – 28]
Salty snack foods (time per week)	4.43 (4.65) [0 – 28]	4.35 (4.49) [0 – 28]
Fruits (time per week)	9.62 (7.07)* [0 – 28]	9.96 (6.83)* [0 – 28]
Vegetables (time per week)	8.80 (6.42)* [0 – 28]	9.45 (6.60)* [0 – 28]
General parenting at age 4		
Parent in parent-child interaction (factor score)	-0.0351 (0.547) [-4 – 2]	-0.0509 (0.559) [-5 – 2]
Difficulty sticking with rules	14.3	15.3
Harsh disciplinary practices	60.1*	57.1*
Rules about watching TV	90.6	90.5
Rules about bed time	89.5	88.4
Food-related parenting at age 4		
Rules about food	74.4	75.8
Evening meals as a family	75.5	74.1
Evening meals at a regular time	66.7	67.0
Child's difficulty in self-regulation at age 4		
Self-regulation difficulty (factor score)	0.137 (0.855)* [-2.11 – 3.35]	-0.149* (0.820) [-2.11 – 3.24]
Child's covariates at age 5 or at birth		
Age at age 5 (months)	65.2 (3.79) [56.8 – 74]	65.1 (3.78) [56.7 – 74.5]
School attendance at age 5	91.3	91.9
Poor health at age 5	2.66	3.00
Birthweight: Normal	79.9*	76.5*
Birthweight: Moderately low	10.8*	13.2*
Birthweight: Very low	9.26*	10.3
Multiple birth status: Singleton	89.7	89.5
Multiple birth status: Twin	9.50	9.52
Multiple birth status: Higher order	0.77	0.97
Parent's covariates at age 5		
Age (years)	33.6 (6.89) [18 – 71]	33.7 (7.16) [20 – 83]
Weight (kilograms)	73.7 (18.3) [36.9 – 137]	74.2 (19.1) [40 – 137]
Marital status: Married	68.0	67.2
Marital status: Separated/Divorced/Widowed	9.84	10.4
Marital status: Never married	19.7	19.7
Marital status: Non-bio or adoptive parent	2.55	2.75
Race: White, non-Hispanic	43.0	43.8
Race: Black or African American, non-Hispanic	15.2	16.3
Race: Hispanic, race or no race specified	18.1	17.5
Race: Asian, non-Hispanic	15.1	13.5
Race: Native American, Pacific Islander, or more than 1 race, non-Hispanic	8.62	9.07
Depression: Non-depressed	59.6	60.9
Depression: Mildly depressed	25.0	23.2

Variables	Boys (n=3,250) Mean (SD) [Range] or %	Girls (n=3,150) Mean (SD) [Range] or %
Depression: Moderately depressed	9.96	9.43
Depression: Severely depressed	5.43	6.49
Contextual covariates at age 5		
Household's socio-economic status	-0.00699 (0.846) [-2.31 – 2.09]	-0.00842 (0.861) [-2.31 – 2.09]
Number of siblings	1.46 (1.11) [0 – 8]	1.49 (1.17) [0 – 9]
Language speaking at home other than English	22.5	21.1
Received WIC in the preceding 12 months	21.6	22.6
Received food stamps	23.3	24.3
Non-parental care arrangement (hours/week)	11.1 (15.5) [0 – 141]	10.45 (15.2) [0 – 130]
Household region: Northeast	14.4	13.4
Household region: Midwest	22.4	22.9
Household region: South	35.4	37.0
Household region: West	27.9	26.6
Urban	83.2	82.6
Rural	16.8	17.4

* $p<0.05$ in t-test or chi-square test by child's gender

Note: Sample sizes were rounded to the nearest 50.

items at age 5, i.e., sugar-sweetened beverages, sweet foods and desserts, and salty snack foods (βs= -0.0776 SD, -0.0452 SD, -0.0437 SD, all $p<0.05$). The magnitude of the association between having rules about foods at age 4 and the frequent intake of vegetables at age 5 in girls (β= 0.0371 SD) was close to that in boys (β= 0.0452), but unlike boys, that association in girls was not statistically significant at $p<0.05$.

Compared to not having a routine of eating evening meals as a family at age 4, having this routine was significantly associated with less frequent intake of sugar-sweetened beverages and more frequent intake of vegetables at age 5 in boys (βs= -0.037 SD and 0.0551 SD, respectively, both $p<0.05$), accounting for all covariates. In girls, having this routine was significantly associated with more frequent intake of fruits and vegetables at age 5 (βs= 0.0794 and 0.0729, both $p<0.05$), holding covariates constant. The association of having a routine to eat evening meals at a regular time at age 4 was

Table 4.7 Standardized coefficients of food and general parenting from multivariable regressions with the squared roots of child dietary intake. Stratified by child gender. Cluster control. Full information maximum likelihood method. Early Childhood Longitudinal Study – Birth Cohort, 2001-2006.

	Sugar-sweetened beverages		Sweet foods and desserts		Salty snack foods		Fruits		Vegetables	
	Std. Coef.		Std. Coef.		Std. Coef.		Std. Coef.		Std. Coef.	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Model 1: Food parenting & covariates										
Rules about food (Y/N)	**-0.115**	**-0.0776**	-0.0161	**-0.0452**	-0.0202	**-0.0437**	**0.0503**	0.00164	**0.0452**	0.0371
Evening meal routine as a family (Y/N)	**-0.0370**	-0.0158	-0.0200	0.00368	-0.0112	0.000986	0.0178	**0.0794**	**0.0551**	**0.0729**
Evening meal routine at a regular time (Y/N)	-0.0223	-0.0262	**-0.0455**	0.00256	-0.0345	-0.00675	**0.0704**	0.0104	**0.0635**	**0.0412**
Model 2: Adding general parenting										
Rules about food (Y/N)	**-0.102**	**-0.0575**	-0.0185	-0.0326	-0.0178	-0.0350	0.0329	`-0.00864	0.0211	0.0272
Evening meal routine as a family (Y/N)	**-0.0361**	-0.0117	-0.0190	0.00867	-0.00991	0.00321	0.0165	**0.0737**	**0.0535**	**0.0687**
Evening meal routine at a regular time (Y/N)	-0.0195	-0.0190	**-0.0452**	0.00657	-0.0351	-0.00446	**0.0642**	0.0077	**0.0588**	**0.0417**
Parent in parent-child interaction (factor score)	-0.0408	-0.0203	0.0227	-0.0422	0.00350	-0.0262	0.0178	0.0438	**0.0476**	0.0404
Difficulty sticking with rules (Y/N)	0.0105	0.00221	0.0104	0.0328	0.00406	-0.0142	-0.00772	**-0.0421**	-0.0111	-0.0235
Harsh disciplinary practices (Y/N)	**0.0535**	**0.0437**	**0.0547**	**0.0580**	**0.0496**	0.0305	**-0.0765**	**-0.0686**	-0.0292	**-0.0335**
Rules about watching television (Y/N)	-0.0167	**-0.0379**	0.000375	-0.00703	-0.0223	-0.0175	0.0251	0.0111	**0.0490**	0.0355
Rules about bed time (Y/N)	-0.0210	**-0.0442**	0.0152	-0.0260	0.0258	-0.0138	0.0363	0.0089	0.0366	-0.0132

Note: Std. Coef. = Standardized Coefficient; Coefficients were **bold** if p-value <0.05.
Parent's covariates: Parent's age, weight, marital status, race, and depression status;
Child's covariates: Child age, school attendance, perceived child health, child birthweight, and multiple birth status;
Contextual covariates: Household's socio-economic status, number of siblings, primary language at home was not English, received WIC, received food stamps, non-parental care, region, and urbanity.

significant with less frequent intake of sweet foods and desserts, more frequent intake of fruits and vegetables at age 5 in boys (βs= -0.0455 SD, 0.0704 SD, and 0.0635 SD, respectively, all $p<0.05$), and more frequent intake of vegetables at age 5 in girls (β= 0.0412 SD, $p<0.05$), as compared to not having this routine, holding covariates constant. Having evening meals at a regular time at age 4 was associated with less frequent intake of salty snack foods at age 5 in boys (β= -0.0345 SD), yet the association was not statistically significant ($p>0.05$).

The pattern of the relationship between food parenting at age 4 and the child's dietary intake at age 5 remained when additionally accounting for general parenting, even though the magnitude of the associations was attenuated and, in some cases, no longer statistically significance (**Table 4.7, Model 2**). For example, having rules about foods at age 4 continued to be associated with healthier dietary behaviors in boys and girls at age 5 after accounting for general parenting and covariates, compared to not having such rules. The association of having rules about foods at age 4 remained significant with the frequent intake of sugar-sweetened beverages at age 5 in both boys (β= -0.102 SD, $p<0.05$) and girls (β= -0.0575 SD, $p<0.05$). The significant association of having rules about foods, however, did not hold with the frequent intake of fruits and vegetables at age 5 in boys (βs= 0.039 SD and 0.0211 SD, both $p>0.05$) and with the frequent intake of sweet foods and desserts, and salty snack foods at age 5 in girls (βs= -0.0326 SD and -0.0350 SD, respectively, both $p>0.05$). For meal routines, all the significant associations remained after additionally accounting for general parenting.

General parenting at age 4 and child dietary intake at age 5:

After accounting for food parenting and covariates, the overall pattern was that positive parenting in general settings at age 4 (i.e., high parent scores in parent-child interaction and having rules about watching television and bed time) was associated with less frequent intake of unhealthy and more frequent intake of healthy dietary items at age 5 in boys and girls; meanwhile, general parenting that was challenged or negative at age 4 (i.e., having difficulty sticking with rules and using harsh disciplinary practices) was associated with less healthy dietary behaviors at age 5. Gendered differences were also noted (**Table 4.7, Model 2**). Higher parent scores in parent-child interaction at age 4 was associated with less frequent intake of sugar-sweetened beverages in boys (β= -0.0408 SD), less frequent intake of sweet foods and desserts in girls (β= -0.0422 SD), more frequent intake of fruits in girls (β= 0.0438 SD), and more frequent intake of vegetables in boys and girls (βs= 0.476 SD and 0.0404 SD, respectively) at age 5. Among these associations, only that with the frequency of intake of vegetables in boys was significant (β= 0.0476 SD, $p<0.05$).

The magnitude of the association of difficulty sticking with rules at age 4 and the frequent dietary intake at age 5 in boys was small (the absolute value of the coefficient $|\beta| <0.02$ SD) and not statistically significant ($p>0.05$). In girls, difficulty sticking with rules at age 4 was associated with more frequent intake of sweet foods and beverages (β= -0.0328, $p>0.05$) and less frequent intake of fruits (β= -0.0421 SD, $p<0.05$) at age 5. Comparing to not using harsh disciplinary practices at age 4, using harsh disciplinary practices at this age was associated with increased frequent intake of

unhealthy and decreased frequent intake of healthy dietary items at age 5 in both boys and girls; and the associations were significant for most outcomes: sugar-sweetened beverages (βs= 0.0535 SD and 0.0437 SD in boys and girls, respectively, both $p<0.05$), sweet foods and desserts (βs= 0.0547 SD and 0.0580 SD in boys and girls, respectively, both $p<0.05$), salty snack foods (β= 0.0496 SD, $p<0.05$ in boys and β= 0.0305 SD, $p>0.05$ in girls), fruits (βs= -0.0765 SD and -0.0686 SD in boys and girls, respectively, both $p<0.05$), and vegetables (βs= -0.0392 SD, $p>0.05$ in boys and β= -0.0335 SD, $p<0.05$ in girls).

Compared to not having rules about watching television, having these rules at age 4 was significantly associated with less frequent intake of sugar-sweetened beverage in girls (β= -0.0379 SD, $p<0.05$) and more frequent intake of vegetables in boys (β= 0.0490 SD, $p<0.05$) at age 5. Having rules about watching television was also associated with more frequent intake of vegetables in girls but not significant (β= 0.0355 SD, $p>0.05$). On the other hand, having rules about bed time at age 4 was significantly associated with decreased frequent intake of sugar-sweetened beverage at age 5 in girls only (β= -0.0442 SD, $p<0.05$), compared to not having these rules. Having rules about bed time at age 4 was associated with increased frequent intake of fruits and vegetables at age 5 in boys (βs= 0.0363 SD and 0.0366 SD, respectively), compared to not having these rules; these associations were not significant ($p>0.05$).

Some exceptions along the above pattern was noted. In boys, higher parent score in parent-child interaction at age 4 was associated with *increased* frequent intake of sweet foods and desserts at age 5 (β= 0.0227 SD); having rules about bed time at age 4 was associated with *increased* frequent intake of sweet foods and desserts and salty snack

foods at age 5, compared to not having such rules (βs= 0.0152 SD and 0.0258 SD, respectively). In girls, having rules about bed time at age 4 was associated with *decreased* frequent intake of vegetables at age 5, compared to not having rules about bed time (β= -0.0132 SD). All of the associations were, however, small (|β|<0.03 SD) and insignificant (p>0.05).

Role of child difficulty in self-regulation at age 4:

In boys, more difficulty in self-regulation at age 4 was independently associated with their less frequent intake of vegetables at age 5 (β= -0.0422 SD, p<0.05), holding food parenting, general parenting, and covariates constant (**Table 4.8**). Boys' difficulty in self-regulation at age 4 had a significant interaction with having evening meals at a regular time at age 4 for frequency of intake of sweet foods and desserts (-0.671 SD, p<0.05), after accounting for other parenting practices and covariates (**Table 4.8**). Among boys with average or more difficulty in self-regulation, the association of having evening meals at a regular time at age 5 with the frequent intake of sweet foods and desserts at age 5 was inverse, whereas the association was slightly positive among boys with little difficulty in self-regulation (**Figure 4.7**).

In girls, difficulty in self-regulation at age 4 was independently associated with the frequent intake of salty snack foods (β= 0.0528 SD, p<0.05), accounting for food parenting, general parenting, and covariates. For all other dietary outcomes, i.e. sugar-sweetened beverages, sweet foods and desserts, fruits, and vegetables, the interaction between difficulty in self-regulation and parenting practices was significant (**Table 4.8**). Higher parent score in parent-child interaction was associated with lower frequent intake of sugar-sweetened beverages among girls with average and less difficulty in self-

Table 4.8 Standardized coefficients of food and general parenting, child self-regulation, and interactions if significant from multivariable regressions with the squared roots of child dietary intake. Stratified by child gender. Cluster control. Full information maximum likelihood method. Early Childhood Longitudinal Study – Birth Cohort, 2001-2006.

	Sugar-sweetened beverages		Sweet foods and desserts		Salty snack foods		Fruits		Vegetables	
	Std. Coef.		Std. Coef.		Std. Coef.		Std. Coef.		Std. Coef.	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Food parenting										
Rules about food (Y/N)	**-0.101**	**-0.0552**	-0.0177	-0.0314	-0.0172	-0.0335	0.0323	-0.0139	0.0194	0.0237
Evening meal routine as a family (Y/N)	**-0.0359**	-0.0126	-0.0179	0.0072	-0.00973	0.00210	0.0162	**0.0744**	**0.0529**	**0.0688**
Evening meal routine at a regular time (Y/N)	-0.0188	-0.0158	-0.0360	0.0108	-0.0345	-0.000100	**0.0636**	0.0033	**0.0572**	0.0388
General parenting										
Parent in parent-child interaction (factor score)	-0.0408	-0.0225	0.0234	-0.0388	0.00364	-0.0213	0.0172	0.0427	**0.0468**	0.0378
Difficulty sticking with rules (Y/N)	0.0100	0.00041	0.0104	**0.0368**	0.00368	-0.0148	-0.00732	**-0.0406**	-0.0099	-0.0233
Harsh disciplinary practices (Y/N)	**0.0511**	**0.0370**	**0.0529**	**0.0532**	**0.0478**	0.0226	**-0.0747**	**-0.0500**	-0.0236	-0.0272
Rules about watching television (Y/N)	-0.0165	**-0.0391**	0.0007	-0.0063	-0.0222	-0.0166	0.0250	0.0118	**0.0486**	0.0350
Rules about bed time (Y/N)	-0.0206	**-0.0436**	0.0159	-0.0248	0.0261	-0.0138	0.0360	0.00974	0.0358	-0.0122
Difficulty in self-regulation & Interactions										
Child's difficulty in self-regulation (DiSR)	0.0183	**0.0511**	**0.0708**	0.0247	0.0135	**0.0528**	-0.0143	-0.0156	**-0.0422**	0.0333
DiSR*Parent in parent-child interaction		**0.0444**								
DiSR*Rules about foods								**-0.0910**		**-0.0759**
DiSR*Harsh disciplinary practices								**0.0743**		
DiSR*Difficulty sticking with rules				**0.0441**						
DiSR*Evening meal routine at a regular time			**-0.0671**							

Note: Std. Coef. = Standardized Coefficient, DiSR = Child's difficulty in self-regulation; Coefficients were **bold** if p-value <0.05
Parent's covariates: Parent's age, weight, marital status, race, and depression status. Child's covariates: Child age, school attendance, perceived child health, child birthweight, and multiple birth status. Contextual covariates: Household's socio-economic status, number of siblings, primary language at home was not English, received WIC, received food stamps, non-parental care, region, and urbanity.

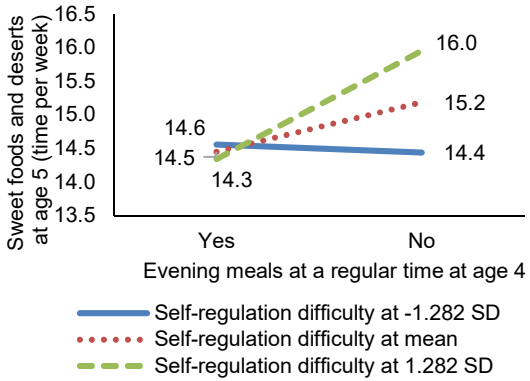

Figure 4.7 Association of having evening meals at a regular time at age 4 and the frequent intake of sweet foods and desserts in boys at age 5 by child difficulty in self-regulation.

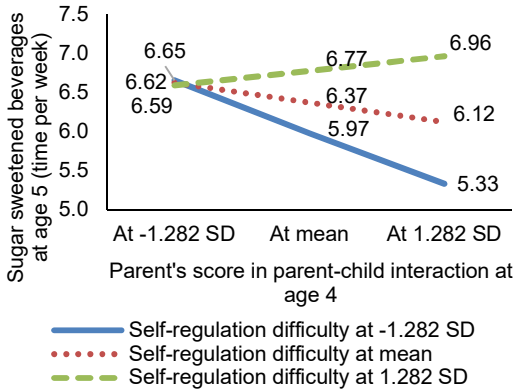

Figure 4.8 Association of parent's behaviors in parent-child interaction at age 4 and the frequent intake of sugar-sweetened beverages in girls at age 5 by child difficulty in self-regulation

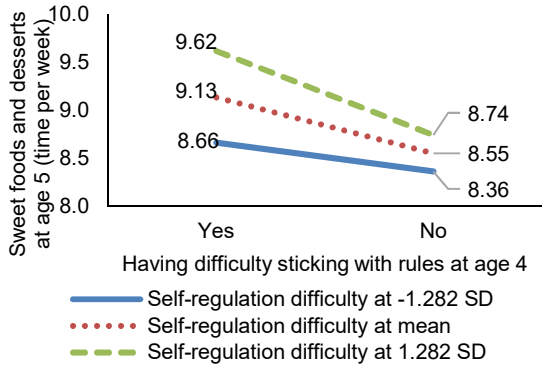

Figure 4.9 Association of having difficulty sticking with rules at age 4 and the frequent intake of sweet foods and desserts in girls at age 5 by child difficulty in self-regulation

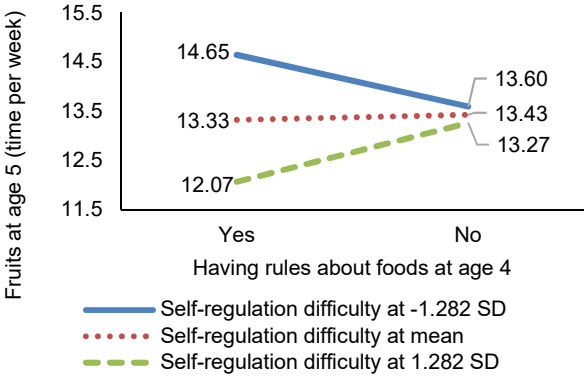

Figure 4.10 Association of having rules about foods at age 4 and the frequent intake of fruits in girls at age 5 by child difficulty in self-regulation.

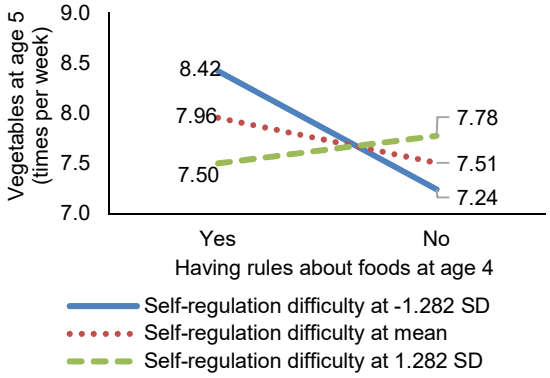

Figure 4.11 Association of having rules about foods at age 4 and the frequent intake of vegetables in girls at age 5 by child difficulty in self-regulation.

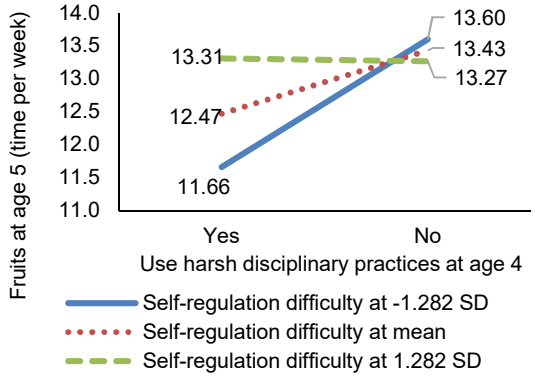

Figure 4.12 Association of using harsh disciplinary practices at age 4 and the frequent intake of fruits in girls at age 5 by child difficulty in self-regulation.

regulation only; among girls with self-regulation above average, it was associated with higher frequent intake of sugar-sweetened beverages (**Figure 4.8**). Girls whose parents had difficulty sticking with rules at age 4 had more frequent intake of sweet foods and desserts at age 5, compared to their peers whose parents had no difficulty sticking with rules at age 4; this positive association was larger as the girl's difficulty in self-regulation increased (**Figure 4.9**). Compared to not having rules about foods at age 4, having these rules was associated with increased frequency of intake of fruits and vegetables for girls having little difficulty in self-regulation only; for girls having more severe difficulty in self-regulation, having these rules was associated with less frequent intake of fruits and vegetables, holding other parenting practices and covariates constant (**Figure 4.10 & 4.11**). Using harsh disciplinary practices at age 4 was associated with less frequent intake of fruits at age 5, compared to not using this discipline, among girls with average or less difficulty in self-regulation, but not girls having more severe difficulty in self-regulation, holding other parenting practices and covariates constant (**Figure 4.12**).

Discussion

Positive parenting practices at age 4 were associated with healthy patterns of dietary intake at age 5 and negative practices at age 4 were associated with unhealthy patterns of dietary intake at age 5 in both boys and girls, with some differences by gender. Some associations were modified by child difficulty in self-regulation at age 4, particularly in girls.

Having rules about foods had the strongest association with less frequent intake of sugar-sweetened beverages, and the association of evening meal routines of eating as a family and at a regular time were largest with increased frequent intake of fruits and

vegetables. Having rules stipulating the foods the child eats clarifies parent's expectations about what the child should or should not eat.[26] Having rules about foods is a covert restriction in food parenting where the food environment is structured by "limiting opportunities for consumption," rather than explicit, coercive control of the child dietary intake."[26(p100)] While coercive control by restricting food intake may lead to increased desire and intake of palatable food,[48,49] moderate restriction and non-directive practices to create a healthy food environment seem necessary to facilitate healthy dietary intake in young children.[50,51] Distinguishing food parenting practices that are coercive control from those creating a structured healthy food environment such as having rules about what kinds of foods the child can eat is important in understanding food parenting and its impacts on child's dietary behaviors.

While rules about foods specify *what* to eat, meal routines of eating at a regular time and as a family contributes to the structured food environment by identifying *when* and *with whom* the child eats. Meal routines, particularly family meals or eating with other family members, have been associated with improved diet quality in older children and adolescents,[52–55] possibly through psycho-social and nutritional mechanisms such as familial conversations, perceived connectedness, shared nutrition, and a sense of rituals.[56] A regular eating schedule creates a predictable routine that help reduce daily hassle and stress, facilitate child's regulatory processes, and promote healthy developmental behaviors.[57] This study provides evidence for a positive association of having meal routines –eating evening meals as a family and at a regular time – with the frequent intake of vegetables in both boys and girls in early childhood, and association of these

two food parenting practices with the child's frequent intake of fruits that differed by gender.

General parenting practices establish an overall socio-emotional environment for the child's living and development through daily interaction, discipline, and house rules. Parent's practices such as being supportive and sensitive in parent-child interaction or having rules about television watching and bedtime could positively constitute the child' living environment; parent's difficulty sticking with rules and using harsh disciplinary practices are likely to form negative conditions. Our findings supported the independent association of these practices with child dietary behaviors beyond food parenting practices, even though the significance of the association differs for the dietary behaviors and child's gender. Using harsh discipline stood out for being the only parenting practice that was significantly associated with most of the examined dietary outcomes in boys and girls and for having the strongest association magnitude compared to other general parenting practices. Harsh disciplinary practices are inclusive of both physical and psychological aggressions or violence.[59–61] Using just one or more harsh disciplinary practices has destructive impact on child's cognition,[62,63] behavior,[64] psycho-social development,[65–68] educational attainment,[69,70] and health.[71] Our study provides evidence that using harsh disciplinary practices was negatively and strongly associated with healthy dietary behaviors in young children, independent of positive parenting practices in both food-related and general settings.

While parents play an important role in establishing the overall and food-related environment for the child's development of eating behaviors, children themselves interactively contribute to this process. Child's difficulty in self-regulation modified the

relationship of food and general parenting practices with child dietary behaviors, particularly in girls. Some associations were in the expected directions only in girls with less difficulty in self-regulation but not in girls with more difficulty in self-regulation. Other associations were in the expected direction only in girls with more difficulty in self-regulation. The inconsistent directions of the associations by child difficulty in self-regulation suggest a complex interactive relationship of parenting practices and child's difficulty in self-regulation with child's dietary intake where opposite directional associations can take place depending on the child's difficulty in self-regulation. Implementation of a given parenting practice might have a different effect on the eating behaviors of children depending on difficulty in self-regulation.

Many previous studies about parenting and child's nutrition focused on parenting styles – i.e., a generalized categorization of parenting patterns as an intersection of two dimensions: responsiveness (or supportiveness) and demandingness (or control).[20,23,25,72–74] These studies give valuable understanding about overall parenting patterns and their associations with child's nutrition or health outcomes, but are limited in bringing in-depth understanding about specific practices that may help improve child's dietary behaviors. By examining specific parenting practices in both food-related and general settings, our study brings insights about what helps by understanding unique and combined contribution of specific parenting practices in creating a healthy structured environment for the development of the child's eating behaviors. Helping parents to avoid harsh disciplinary practices, set rules about food, and maintain meal routines are specific parenting practices relating to better child's dietary behaviors. These findings suggest the need to expand the focus on the immediate eating environment and food-

related practices to the overall structure of the child's living environment to successfully improve young children's eating behaviors. Furthermore, through examining the child's difficulty in self-regulation and its interaction with parenting practices, our study provides understanding about how the child might play a role in modifying the effect of parenting practices on shaping his or her eating habits. Accounting for both parents and children, our study brings a more comprehensive understanding about the development of child dietary behavior, compared to other studies where either parents' or children's role are examined. This knowledge suggests that both parents and children be active agents in the development of children's dietary behaviors. Further investigations are needed to identify interventions and programs targeting both parents and children to promote positive parenting in food and non-food settings and support children with difficulty in self-regulation.

This study used a large, longitudinal national data set of children from 4 to 5 years of age. The outcome measure, i.e., the weekly frequency of the child's dietary intake, did not give information about the amount of foods or beverages consumed, which might result in biased judgement about the child's diet quality because not only the frequency but also the total amount of the food and beverage intake that constitute the diet quality (e.g., the diet quality of a child having more frequent intake of vegetable but in a minimal amount might not be better than that of a child having less frequent intake of vegetable but in a large amount). Regarding measuring the child's difficulty in self-regulation, we used selected items from the validated Preschool and Kindergarten Behavior Scales–Second Edition and Social Skills Rating System, and these items tapped aspects of young children's self-regulation in paying attention and regulating emotions

and behaviors. These items demonstrated good internal reliability, but the composite measure of child difficulty in self-regulation has not been validated. Children included in our samples were born in 2001 in the United States. Despite the diversity of the children's households in terms of socio-economic conditions and cultures, generalization of the study's results to children in places other than the United States might not hold well.

Conclusions

Better food parenting and general parenting practices at age 4 were associated with children's healthy dietary behaviors at age 5, and the child's difficulty in self-regulation plays an important role in modifying this association, particularly in girls. Both parents and children could be active agents in the development of children's dietary behaviors. Further investigations are needed to identify interventions and programs targeting both parents and children to promote positive parenting in food and non-food settings and support children with difficulty in self-regulation.

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CHAPTER 5

CONCLUSIONS AND IMPLICATIONS

In this chapter, we first summarize major findings of the dissertation to highlight the overall conclusions we reached from the analyses. We then describe the strengths, limitations, and implications our research and its findings. Finally, our recommendations for future research are introduced.

1. Summary of major findings

Our research was guided by two specific aims. Specific aim 1 was to understand how food insecurity and its change over time relate to parenting in early childhood. With this aim, we hypothesized that both earlier and concurrent food insecurity were associated with suboptimal parenting. In Chapter 4, manuscript 1, earlier food insecurity was associated with using harsh disciplinary practices in year 5, having rules about food in year 4, and having evening meals at a regular time in years 2 and 4 among parents of girls. Among parents of boys, earlier food insecurity was associated with having evening meals at a regular time in years 2 and 4. Concurrent food insecurity was associated with parenting in years 2 and 4 for boys and girls but not in year 5. The magnitude of the associations over time of earlier and concurrent food insecurity with harsh disciplinary practices, rules about food, and meal routines were generally greater for girls than boys.

Specific aim 2 was to understand the relationship of parenting in food-related and non-food-related settings with dietary intake of young children and the role of child self-regulation in this relationship. In Chapter 4, manuscript 2, better food parenting practices

at age 4 were associated with less frequent intake of unhealthy and more frequent intake of healthy foods and beverages in both boys and girls at age 5, with some differences by gender. General parenting practices at age 4 were associated with dietary behaviors differently for boys and girls. Difficulty in self-regulation at age 4 significantly modified the association between parenting practices and child's dietary behaviors for boys (evening meals at a regular time and intake of sweet foods and desserts) and girls (parent-child interaction and intake of sugar-sweetened beverages; difficulty sticking with rules and intake of sweet foods and desserts; rules about foods and intake of fruits and vegetables; and harsh discipline and intake of fruits).

In early childhood, earlier and concurrent food insecurity were linked with suboptimal parenting in structuring a general and food-related living environment for young children, particularly for girls and by the age of 5, through increased use of harsh discipline, lack of rules about foods, and irregular meal routines. Better food parenting and general parenting practices at age 4 were associated with children's healthy dietary behaviors at age 5, and the child's difficulty in self-regulation plays an important role in modifying this association, particularly in girls. Further investigations on the potential mechanisms for the relationship of earlier and concurrent food insecurity with parenting in early childhood and how these mechanisms change as the children reach age 5 are needed. Given both parents and children could be active agents in the development of children's dietary behaviors, further investigations may help identify interventions and programs targeting both parents and children to promote positive parenting in food and non-food settings and support children with difficulty in self-regulation.

2. Strengths and limitations

Our research used a large, longitudinal national dataset representative for children born in 2001 in the United States, i.e., the Early Childhood Longitudinal Study–Birth Cohort (ECLS-B). The ECLS-B longitudinal data enabled us to conduct our investigation of the relationships of interest over time. Previous studies about these relationships are predominantly cross-sectional, which limits our understanding about the dynamic changes of the relationships over time. By using longitudinal analysis to achieve specific aim 1, for example, our research supports plausible causal inferences and provides in-depth understanding about temporal associations of food insecurity with parenting in early childhood. The ECLS-B sample was large and representative for children born in 2001 from households of diverse socio-economic conditions and cultures, giving our research strong analytical power to achieve great accuracy and external validity.[141] Given that the ECLS-B collected rich information about the living, learning, developmental, and health-related experiences of target children and their parents using strict procedures for assuring data quality, we were able to control for a wide range of potential confounders for the relationships of interest and strengthen the research's internal validity.[141] Missing data were often an issue in longitudinal studies, including the ECLS-B. We used regression models with full information maximum likelihood estimation implemented in a structural equation modeling procedure in Stata to minimize the effect of missing data during longitudinal data collection by retrieving as much information as possible from observations with missing values instead of omitting them completely.[136]

Despite its rich data about parents' and children's experiences in early childhood, the ECLS-B did not measure parental anxiety and stress distinct from parental

depression.[142] For specific aim 1, lack of this measure limits having full understand of parental mental health as a mechanism through which food insecurity relates to parenting behaviors. Also, there was no information about parent-child interactions in a feeding context or mealtime, and so possible associations of food insecurity with these parenting behaviors were not examined. For specific aim 2, the outcome measure, i.e., the weekly frequency of the child's dietary intake, did not give information about the amount of foods or beverages consumed, which might result in biased judgement about the child's diet quality because not only the frequency but also the total amount of the food and beverage intake that constitutes the diet quality (e.g., the diet quality of a child having more frequent intake of vegetables but in a minimal amount might not be better than that of a child having less frequent intake of vegetables but in a large amount). Regarding measuring the child's difficulty in self-regulation, we used selected items from the validated Preschool and Kindergarten Behavior Scales–Second Edition and Social Skills Rating System, and these items tapped aspects of young children's self-regulation in paying attention and regulating emotions and behaviors. These items demonstrated good internal reliability, but the composite measure of child difficulty in self-regulation has not been validated. Given that our analytical samples were parents and children from a birth cohort born in the United States in 2001, generalization of our findings to parents and children in places other than the United States might not hold well. Parental data for this research is mostly from mothers. Our findings, therefore, might apply better to maternal parenting than paternal parenting.

3. Implications

Our research has both scholarly and practical implications. For specific aim 1, we specify parenting practices with which food insecurity is significantly associated and different patterns of these associations by time and child gender. The associations of earlier and concurrent food insecurity with parenting open up plausible explanations for different associations of food insecurity with child outcomes by gender that have been found in the literature[3,4,6,9]. The association between food insecurity in early childhood and harsh disciplinary practices, for example, could be a mechanism through which boys and girls with food-insecure parents are more susceptible to problems in behaviors, school performance, and health compared to their peers with food-secure parents. By examining the associations of food insecurity and parenting over time, we advance the knowledge of the temporal associations between food insecurity and parenting in early childhood. Further investigations, however, are needed to establish their causal relationship. To understand how parenting might develop differently throughout early childhood as an impact of food insecurity, we need to learn more about the mechanisms through which food insecurity is associated with parenting and how these mechanisms change as the child get older. Understanding such mechanisms may help shed light on the differences in the associations of food insecurity and parenting by child gender and age periods. This knowledge will also enable us to prioritize resources and design appropriate policies and programs to support the parents with food insecurity and reduce the risk of suboptimal parenting in early childhood. By highlighting the associations of food insecurity with parenting in the child's early life, this research expands the concern about adverse living conditions beyond economic and material challenges, urging the need to

pay more attention to the psycho-social dynamics of family life, especially under the impact of food insecurity.

For specific aim 2, by examining specific parenting practices in both food-related and general settings, we bring insights about what helps by understanding the unique and combined contributions of specific parenting practices in creating a healthy structured environment for the development of the child's eating behaviors. This knowledge helps settle uncertainty about the relationship among general parenting, food parenting, and child nutritional outcomes.[17,75] Parenting practices in both general and food-related settings could relate to young children's dietary behaviors. Helping parents to avoid harsh disciplinary practices, set rules about food, and maintain meal routines are specific parenting practices relating to better child's dietary behaviors. These findings suggest the need to expand the focus on the immediate eating environment and food-related practices to the overall structure of the child's living environment to successfully improve young children's eating behaviors. Through examining the child's difficulty in self-regulation and its interaction with parenting practices, we provide understanding about how the child might play a role in modifying the effect of parenting practices on shaping his or her eating habits. This knowledge suggests that both parents and children be active agents in the development of children's dietary behaviors. Further investigations are needed to identify interventions and programs targeting both parents and children to promote positive parenting in food and non-food settings and support children with difficulty in self-regulation.

4. Recommendations for future research

Future research is recommended to extend our investigation to fathers and other caregivers. Fathers, either in single- or both-parent families, might play an important role in parenting young children and influencing their psycho-social and behavioral development. To date, understanding about the role of fathers on child development is limited and few studies have been devoted to understanding fathers in households with food insecurity. In the United States, 21.7% of the father-single households were food insecure in 2016.[143] A recent study found that fathers in food-insecure households may have a higher risk of serious psychological distress compared to mothers.[144] Understanding paternal parenting in households with food insecurity and its impacts on child development is important.

Future research with improved measures of child dietary intake, child food environment, and child self-regulation will strengthen our research findings and provide more comprehensive understanding about the development of dietary behaviors of young children. If data of frequencies and quantities of child dietary intake are collected both at home and outside home, assessment of the child dietary quality will be more rounded. More information about the child's general and food environment, e.g., strategies and practices of parents and the influence of children in constructing such environment, can bring insights about the development of child dietary behaviors and potential windows of opportunities for improving child nutrition.

Future research across cultures and in low- and middle-income countries is recommended to expand our knowledge beyond the context of the United States. In low- and middle-income countries, childhood obesity is a rising problem while undernutrition

remains a burden.[145–148] Heavy focus on economic advancement and widened disparity gaps between rich and poor people have posed unprecedented challenges to these countries. Country and culture-specific studies examining non-economic factors such as individual experience of food insecurity and its impacts on the health and well-being of the population, including parents and children, are rare. In 2017, 769.4 million people around the world experienced severe food insecurity, and a majority of them were in Sub-Saharan Africa and Southern Asia.[149] Evidence of the association between food insecurity and subjective well-being among individuals in a recent global study is available.[150] Potential mechanisms through which food insecurity could lead to obesity in low- and middle-income countries have recently been identified.[151] Understanding food insecurity, parenting, and child dietary behaviors in low- and middle-income countries with dynamic economic and nutritional transition will advance scholarly and practical knowledge to improve dietary behaviors, diet quality, and well-being of individuals and achieve the global sustainable development goals.[152]

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