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A Naturalistic Examination of Dietary Lapses in Low-Income, Treatment-Seeking Families with Obesity

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by

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ABSTRACT OF THE DISSERTATION

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Professors Denise Wilfley and Thomas Rodebaugh, Co-Chairs

Socioeconomic disparities in childhood obesity prevalence and treatment response are well-documented and may be partially explained by moments of non-adherence to dietary intentions (i.e., dietary lapses). The current study employed a naturalistic design to characterize the frequency and momentary context of parent dietary lapses and explore their effects on child dietary lapses and parent-child weight change among low-income families participating in 3-month family-based behavioral obesity treatment (FBT). 19 parent-child dyads completed 3 separate 1-week periods of ecological momentary assessment to examine socioenvironmental and intrapersonal cues of parent dietary lapses as well as the frequency of parent-child dietary lapses throughout 3-month FBT. Parent and child height and weight were objectively measured at baseline, month 2, and month 3 of FBT. Both parent and child dietary lapses decreased throughout FBT. Within-person parent stress and unhealthy food presence as well as between-person parent hunger and craving predicted a parent dietary lapse. Contrary to study hypotheses, parents who reported more frequent dietary lapses demonstrated greater weight change during FBT, as did their children. Parent lapse severity was not associated with a child lapse. Findings highlight socioenvironmental and intrapersonal targets to support family eating self-regulation,

as well as opportunities to optimize FBT for families from low-income households who are at risk for worsened treatment response.

Chapter 1: Introduction

1.1 Prevalence and Correlates of Childhood Obesity

Over the past four decades, the number of youth in the United States with obesity has more than tripled (Fryar et al., 2018). Recent epidemiological data indicate that 19.7% of youth aged 2-19 have obesity (Stierman et al., 2021). Childhood obesity is associated with poor physical health outcomes, including increased risk for cardiovascular disease, type 2 diabetes, sleep apnea, and asthma (Freedman et al., 2007; Reilly & Kelly, 2011). Youth with obesity also experience poor psychosocial outcomes, including elevated symptoms of depression (Quek et al., 2017), disordered eating (Hayes et al., 2018), poor quality of life (Buttitta et al., 2014), and weight-related victimization (Puhl & Lessard, 2020). Excess weight in childhood tends to track into adolescence and adulthood (Simmonds et al., 2016; Singh et al., 2008; Whitaker et al., 1997), which may exacerbate the severity and/or chronicity of weight-related comorbidities. Given the numerous health and psychosocial consequences associated with childhood obesity, it is crucial to identify high-risk subgroups of youth who may benefit from targeted interventions.

1.2 Socioeconomic Status and Childhood Obesity

Youth from low-income households are one such subgroup (Cunningham et al., 2014). Low socioeconomic status, broadly defined as lower household family income, parental occupation, and/or parental education (Shavers, 2007), is associated with excess weight and fat mass among youth (Bridger Staatz et al., 2021). National survey data indicate that 19.9% of youth from the lowest income bracket (≤130% of federal poverty line) have obesity compared to 10.9% of youth from the highest income bracket (>350% of federal poverty line) (Ogden, 2018). Further, the prevalence of childhood obesity significantly decreases overtime with increasing family income (Stierman et al., 2021) and parental education (Ogden, 2018).

Socioeconomic status may also have a greater effect on childhood obesity above and beyond other related demographic variables linked to elevated childhood obesity risk, such as minoritized racial and ethnic identity (Anderson et al., 2022; Rogers et al., 2015; Rossen, 2014). One cross-sectional study found that the association between race/ethnicity and odds of childhood obesity was not significant after adjusting for family income (Rogers et al., 2015). Another cross-sectional study found that racial and ethnic disparities in childhood obesity were attenuated after accounting for socioeconomic status, neighborhood deprivation, and their interactions (Anderson et al., 2022). Given the disproportionate rates of obesity among youth from low-income households, examining whether socioeconomic status impacts response to childhood obesity treatment is necessary to optimize treatment outcomes for low-income youth.

1.3 Socioeconomic Disparities in Response to Family-Based Behavioral Obesity Treatment

Family-based behavioral obesity treatment (FBT) is a multi-component intervention that facilitates parent-child weight change by addressing dietary intake, physical activity, and parenting skills (Coppock et al., 2014). FBT is considered a first line treatment for childhood obesity due to its long-term effects on parent and child weight change (Wilfley et al., 2007, 2017). FBT teaches parents how to modify the home food environment to support healthy choices using techniques such as stimulus control, monitoring, creating mealtime routines, and modeling positive health behavior changes. Parents are also taught how to problem solve treatment barriers, including preplanning and helping their child generalize new health behaviors to settings outside of the home. Last, parents are encouraged to praise child approximations to health behavior change, have frequent family meals, and meet regularly with their child. Studies have shown that several of the core components of FBT such as improvements in parent monitoring, increased access to nutrient-dense foods, and reduced access to energy-dense foods in the home food environment are associated with greater child weight change following FBT (Boutelle et al., 2021).

Nevertheless, compared to families from high-income households, some data suggest that families from low-income households demonstrate suboptimal short-term weight change following FBT (Davison et al., 2021; Ligthart et al., 2017). One longitudinal study found that lower family income was associated with less weight change following 4-month FBT, although differences in weight change by family income were not sustained following 8-month maintenance (Davison et al., 2021). Results from a systematic review of 26 studies showed that low family income was associated with higher drop-out from pediatric behavioral weight management interventions and worse adherence to treatment targets (Ligthart et al., 2017). Relatedly, studies suggest that families from low-income households experience unique barriers to health behavior change (D. J. T. Campbell et al., 2014; Williams et al., 2010), which may impact adherence to treatment targets and subsequently increase risk for suboptimal treatment response.

1.4 Dietary Adherence: A Primary FBT Target

In the context of FBT, adherence to change in dietary intake (i.e., dietary adherence) is a primary focus of treatment given that dietary change is a key driver of long-term weight loss (Epstein, 1993; Wrotniak et al., 2005). Dietary adherence is defined as planning to minimize consumption of "red" foods/day (i.e., energy-dense foods) and planning to increase consumption of "green" foods/day (i.e., nutrient-dense foods) (Valoski & Epstein, 1990). FBT facilitates dietary adherence at the parent and the child level given the role of parents in modeling healthy eating habits and structuring the home food environment (Faith et al., 2012; Wood et al., 2020). Data also show that families demonstrate similar dietary changes throughout FBT (Best et al., 2016), highlighting the relevance of targeting dietary adherence within parent-child dyads. Results from FBT studies indicate that parent and child adherence to specific treatment targets predicts short- and long-term weight change (Saelens & McGrath, 2003; Steele et al., 2009; Theim et al., 2013). Further, parent adherence *alone* is predictive of child weight change (Boutelle et al., 2021; Steele et al., 2009), which may be due, in part, to maximizing opportunities for children to adhere to specific treatment targets. Delivery of FBT to parents only has also been shown to be equally effective as standard FBT in improving parent and child weight and dietary intake (Boutelle et al., 2017). Thus, parent dietary adherence may represent an important pathway to improve child dietary adherence and promote weight change.

1.5 Goal-Conflict Theory of Self-Regulation

Despite the scaffolding in place for families to adhere to dietary recommendations during FBT, incidental breaks in dietary adherence (i.e., dietary lapses) are common and occur between 3 to 12 times per week in treatment-seeking adults with obesity (Carels et al., 2001, 2004; Forman et al., 2017; Goldstein, Zhang, et al., 2018). According to goal-conflict theory of self-regulation, dietary adherence is governed by two incompatible goals: the desire to eat energy-dense foods and the desire to lose weight (Stroebe et al., 2008, 2013). In effect, dietary lapses occur due to momentary failure to inhibit responsiveness to an abundance of socioenvironmental cues and intrapersonal cues that undermine eating self-regulation (Stroebe et al., 2008). In support of this theory are findings from laboratory studies that show that adult dieters exposed to diet-congruent food cues (e.g., fruits, vegetables) consume less energy from a snack than when exposed to diet-incongruent food cues (e.g., sweets) (Buckland et al., 2013) and control cues (e.g., household object) (Buckland et al., 2014). Thus, the preponderance of diet-incongruent foods cues in the food-rich environment may make it especially challenging to adhere to dietary recommendations. Overtime, repeated exposure to socioenvironmental and intrapersonal cues may lead to a cascade of dietary lapses (i.e., relapse), causing a return to unhealthy eating behaviors and abandonment of weight loss goals entirely (Marlatt, 1985).

1.6 Definitions of Dietary Lapses

Dietary lapses have been inconsistently defined. Drawing from seminal work in the addiction literature (Shiffman, 1982, 1984), Grilo and colleagues (Grilo et al., 1989) were the first to propose an empirically-derived classification of dietary lapses. In this study, participants were asked to describe a discrete eating event during which they experienced a lapse. Two themes emerged: lapses were described as either a time when participants ate more calories than intended or when they ate a food they did not intend to eat (i.e., "a forbidden food"). More recent studies have defined dietary lapses as "an incident where you felt you broke your diet" (Carels et al., 2001), "an incident where you ate a larger portion than intended", "ate at an unplanned time", and/or "ate a food you intended to avoid" (Forman et al., 2017). In a follow-up study examining the various dietary lapse types described by Foreman and colleagues (Forman et al., 2017), Goldstein and colleagues (Goldstein, Dochat, et al., 2018) found that lapse types were distinct in terms of their antecedents, timing, and location Further, eating during unplanned times and eating more than planned were associated with lesser weekly weight change (Goldstein, Thomas, et al., 2021) and ultimate weight change (Goldstein, Dochat, et al., 2018), suggesting that dietary lapses characterized by eating outside of pre-planned times as well as the size of the lapse may be especially important to target during treatment.

1.7 Predictors of Dietary Lapses and Relation to Weight Change in Adults

Consistent with goal-conflict theory of self-regulation, studies in adult samples with obesity show that external factors such as the presence and availability of energy-dense foods in the immediate environment are associated with the occurrence of a dietary lapse (Forman et al., 2017; Goldstein, Zhang, et al., 2018; McKee et al., 2014; Thomas et al., 2011). Intrapersonal cues, including affective cues (i.e., negative mood) and physiological cues (i.e., stress, hunger, and craving) have also been prospectively associated with the occurrence of a dietary lapse among adults (Carels et al., 2001, 2004; Crochiere et al., 2022; Forman et al., 2017; Goldstein, Dochat, et al., 2018; Goldstein, Zhang, et al., 2018; McKee et al., 2014). The array of potential triggers for dietary lapses suggests that dietary lapses are highly context specific and vary within individuals (Goldstein, Zhang, et al., 2018). Indeed, state-like contextual factors (e.g., state stress, state negative affect) have been shown to explain the most variance in weekly weight loss among treatment-seeking adults with obesity (Thomas et al., 2022).

Although dietary adherence is a primary target of weight management interventions, findings in adult samples are mixed regarding whether dietary lapses are associated with suboptimal weight change following treatment; while some studies support a negative association between dietary lapses and weight change (Forman et al., 2017; Goldstein, Dochat, et al., 2018; Goldstein, Thomas, et al., 2021), others do not (Goldstein, Brick, et al., 2021). Mixed findings may reflect study differences in *when* dietary lapses occur during treatment. Studies in adults and youth indicate that early weight change in the first 1-2 months of treatment predicts long-term treatment response (Goldschmidt et al., 2011; Nackers et al., 2010; Tronieri et al., 2018). Thus, dietary lapses that occur during the first few months of treatment may impede ultimate weight loss. Indeed, once study found that more frequent dietary lapses at baseline were associated with lesser early 4-week weight change and lesser overall 12-month weight change (Forman et al., 2017).

1.8 Predictors of Dietary Lapses and Relation to Weight Change in Youth

No studies have examined predictors of dietary lapses in pediatric samples. However, substantial evidence suggests that the parent feeding environment provides an important social context for shaping a child's ability to self-regulate energy intake (Grammer et al., 2022; Savage et al., 2007). In particular, the transition from early childhood (ages 1-5) to middle childhood (ages 6-10) is a crucial period for influencing healthy eating self-regulation, as children begin to gain autonomy and competence in determining what, how much, and whether they decide to eat, while still relying on parents to provide support and structure over the home food environment (Balantekin et al., 2020). Positive food parenting practices such as increasing access to nutrient-dense foods and reducing access to energy-dense foods in the home, parent modeling of nutrient-dense food intake, and monitoring are correlated with child intake of nutrient-dense foods (Ong et al., 2017; Yee et al., 2017) as well as the rate of child weight change following FBT (Boutelle et al., 2021). Further, the concordance between parent and child diet quality is stronger in younger children (<10 years) than older children (>10 years) (Wang et al., 2011), suggesting that younger children may be especially reliant on parent involvement to make healthy choices. Given the role of parents in shaping child eating self-regulation and the resemblance between parent and child dietary intake, it is plausible that failed attempts by the parent to self-regulate their own eating behavior in response to intrapersonal and socioenvironmental cues could trigger a dietary lapse in the parent and subsequently in the child.

Although no studies have examined dietary lapses in relation to weight change in youth, dietary adherence and weight change are strongly correlated within parent-child dyads. One study found that shared dietary changes within parent-child dyads partially explained correlated weight loss maintenance following FBT (Best et al., 2016). Further, parent weight change is a robust predictor of child weight change following FBT (Boutelle et al., 2012), and child weight change predicts parent weight change following FBT and maintenance (Fowler et al., 2021). Given the interdependence between parent-child dietary adherence and weight change, it follows that the risk dietary lapses may pose to treatment response at the parent level may also occur at the child level.

1.9 Elevated Risk for Dietary Lapses among Families from Low-Income Households

1.9.1 Intrapersonal Factors

Families from low-income households may be at elevated risk for dietary lapses due to the salience of intrapersonal and socioenvironmental cues in their natural environment that thwart attempts to self-regulate eating behavior. Intrapersonal factors such as stress (American Psychological Association, 2017) and negative affect (Lorant et al., 2003; Weinberger et al., 2018) disproportionately impact individuals with limited financial resources. Parents from low-income households report frequent daily stressors and cumulative stressful life events stemming from financial hardship, limited opportunities for socioeconomic advancement, and discrimination (Dunkel Schetter et al., 2013). Socioeconomic disadvantage has also been associated with higher incidence of major depressive disorder (Kessler et al., 2012; Pabayo et al., 2014; Patel et al., 2018) and more severe depressive symptoms (Ettman et al., 2020). Poverty-related stressors are also putative risk factors for the onset and maintenance of depression (Santiago et al., 2011), indicating that stress and depressive symptoms may co-occur in parents from low-income households.

Within the context of the feeding environment, longitudinal observational data indicate that parents from low-income households demonstrate inconsistent feeding practices across mealtimes, suggesting that they may be susceptible to situational factors that undermine self-regulatory processes involved in child feeding (Silva Garcia et al., 2018). Indeed, situational factors including high levels of parent stress and negative mood have been shown to predict same-day pressure-to-eat feeding practices and the availability of energy-dense foods at mealtimes (Berge, Tate, et al., 2017). The type of stressor has also been shown to predict same-day unhealthy parent feeding practices. Parent-reported interpersonal conflict and financial stress were associated with same-day unhealthy feeding practices, including serving more fast food and pre-prepared foods at meals, respectively (Berge, Tate, Trofholz, Fertig, et al., 2018). Moments of unhealthy parent feeding practices could represent high-risk periods for parent dietary lapses and could contribute to parent and child weight gain over time. Further, the lack of available resources to manage stress and negative mood could also contribute to poor parental perceived self-efficacy to adhere to FBT dietary targets and impact parent and child treatment response. Indeed, higher parental self-efficacy has been associated with better child response to FBT among families across the socioeconomic strata (Goldschmidt et al., 2014). However, few studies have examined whether or how socioenvironmental and intrapersonal cues affect dietary adherence and overall weight change on a momentary level.

1.9.2 Socioenvironmental Factors

Families from low-income households are more likely to live in under-resourced neighborhoods, where there is a high concentration of establishments that sell energy-dense foods (i.e., food swamps) and a low concentration of establishments that sell affordable and available nutrient-dense foods (i.e., food deserts) (Gordon-Larsen, 2014; Larson et al., 2009). The presence and availability of energy-dense foods and prohibitive cost of nutrient-dense foods in the food-rich environment have been associated with poor diet quality and increased energy intake in youth and adults (Darmon & Drewnowski, 2015; Hager et al., 2017; Raffensperger et al., 2010). In turn, greater access to low-cost, energy-dense foods in under-resourced neighborhoods may negatively impact dietary adherence and lead to suboptimal FBT response. Among families participating in FBT, living farther away from convenience stores and supermarkets that sold energy-dense foods was associated with greater child weight change at two-year follow-up (Epstein et al., 2012).

Families from low-income households may also experience periods of food insecurity, defined as limited or unreliable access to affordable and nutritious food (Anderson, 1990). Studies in adults and youth have shown an adverse effect of food insecurity on diet quality (Hanson & Connor, 2014; Landry et al., 2019), likely due to the need to rely on low-cost, energy-dense foods in times of scarcity. As a result, families who experience food insecurity may have difficulties adhering to FBT-specific dietary recommendations due to the lack the financial resources to alter the home food environment. Indeed, findings from an FBT study in adolescents found that food-secure households, but not food-insecure households, reported improvements in the home food environment and dietary quality following 4-month FBT (Adams et al., 2022).

Food insecurity may also augment parent feeding practices at mealtimes. Parents from food-insecure households have been shown to engage in restrictive feeding practices (i.e., controlling what or how much a child eats), which may reflect a need to disperse food across a stretch of time or divide food between the parent and child (Bauer et al., 2015; Berge et al., 2020). Consistent with data that have documented a link between food insecurity and binge eating (Hazzard et al., 2020; Stinson et al., 2018), restrictive feeding practices within the context of food insecurity may trigger a dietary lapse once families encounter relative food abundance.

1.10 Ecological Momentary Assessment to Assess Dietary Lapses

Ecological momentary assessment (EMA) may improve current understanding of the momentary processes that lead to dietary lapses in families from low-income households. EMA is an ecologically valid assessment tool that collects repeated measures of real-time behavioral data in the natural environment (Shiffman et al., 2008). Multiple assessments are administered typically via smartphone over the entirety of a day to capture fluctuations in discrete events (e.g., dietary lapses) and to characterize antecedents, correlates, and consequences associated with the event. Extant methods for measuring dietary adherence have employed retrospective self-report following obesity treatment (Shim et al., 2014; Theim et al., 2013), which limits understanding of momentary predictors of dietary lapses in a real-world setting. Given that dietary lapses are highly context specific (Goldstein, Zhang, et al., 2018), EMA may better capture and characterize the real-time sequalae leading to a dietary lapse via repeated-measure assessments. Further, examining person-specific cues for dietary lapses within families may better elucidate the high degree of variability in obesity treatment response (Thomas et al., 2022) and aid in the development of targeted treatment approaches.

Despite its promising utility, few EMA studies have characterized dietary lapses in obesity-treatment-seeking adults or examined their association with weight change (Carels et al., 2001, 2004; Crochiere et al., 2022; Forman et al., 2017; Goldstein, Brick, et al., 2021; Goldstein, Dochat, et al., 2018; Goldstein et al., 2022; Goldstein, Thomas, et al., 2021; Goldstein, Zhang, et al., 2018). Further, no studies have examined dietary lapses in the context of the family, yet alone in families from low-income households who are particularly vulnerable to dietary nonadherence. Contextualizing determinants of parent dietary lapses and examining their effects on child dietary lapses and parent-child weight change in the context of FBT could inform targeted approaches to support family eating self-regulation in groups at risk for suboptimal treatment response. To address these critical gaps, this study employed EMA methods to achieve the following aims:

1.11 Specific Aims

1.11.1 Specific Aim 1

Characterize the frequency, nature, and momentary context of parent dietary lapses. Consistent with self-regulation theories, I hypothesize that parent dietary lapses and child dietary lapses will decrease over the course of three-month FBT (Hypothesis 1a); parent-reported intrapersonal and socioenvironmental cues will predict the occurrence of a parent dietary lapse (Hypothesis 1b).

1.11.2 Specific Aim 2

Examine the effect of parent dietary lapses on parent-child weight change. First, I hypothesize that parent-child dyads will demonstrate significant reductions in weight between each major timepoint (Hypothesis 2a). I also hypothesize that the magnitude of parent and child weight change will be moderated by the frequency of parent dietary lapses. Specifically, parents who report more frequent dietary lapses will demonstrate less weight change across FBT compared to parents who report less frequent dietary lapses (Hypothesis 2b); children of parents with more frequent dietary lapses will also demonstrate less weight change across 3-month FBT compared to children of parents with less frequent dietary lapses (Hypothesis 2c).

1.11.3 Specific Aim 3 (Exploratory)

Explore the association between parent dietary lapse severity and the occurrence of a child dietary lapse. Finally, I hypothesize that parent dietary lapse severity will be positively associated with parent-report of a child dietary lapse at the concomitant timepoint (Hypothesis 3a; exploratory).

Chapter 2: Method

2.1 Participants and Recruitment

Parent-child dyads (*N* = 19) were recruited between May 2022 to November 2022 from an ongoing FBT trial ("parent trial") (Wilfley et al., 2021) conducted at participating pediatric primary care clinics at Children's Mercy Hospital in Kansas City, Missouri and Freeman Health System in Joplin, Missouri. Participants who were already participating in the parent trial were contacted via phone/email to assess study interest and were screened for eligibility. Children were considered eligible if they were 5-12 years old at baseline, comfortable speaking English, able to provide verbal informed assent, recipients of Missouri Medicaid, willing to change diet, physical activity, and weight, had a BMI $\geq 95^{th}$ percentile for their age and sex. Parents were considered eligible if they were participating in the parent trial with the participating child, had a mobile device with text messaging capabilities, and consented to receive text messages. Participants were excluded if they did not have reliable access to a mobile device with texting capabilities or did not consent to the texting protocol. At the time of recruitment, a total of 46 parent-child dyads from the parent trial were contacted of whom 1 did not meet eligibility criteria due to lack of reliable cell phone, 6 withdrew from the parent study, and 20 were not interested. The study protocol was approved by Washington University Institutional Review Board in August 2021. Recruitment materials are presented in Appendix A.

2.2 Procedure

An overview of the procedure is presented in Appendix B. Participants engaged in an initial 1-hour virtual baseline session consisting of consent/assent, and training in the EMA protocol (visit 1). During visit 1, the study team member and the participant completed an EMA practice survey together to ensure the participant understood the survey questions (Appendix C).

The day after the baseline session, participants completed a 1-day practice period (day 1 of EMA) during which they practiced answering three surveys at random times once in the morning, afternoon, and evening. Following the practice period, participants were contacted by a study team member to answer questions and address any technical challenges (visit 2). Participants were given another opportunity to practice if adherence was poor (i.e., < 2 out of 3 surveys completed). Following visit 2, participants continued to receive the surveys for one week (including the practice day) and then again for one week at month 2 and month 3. Participants received a mid-week text to bolster adherence and provide information on their progress. Participants were also contacted the day before month 2 and month 3 to remind them of the study protocol.

2.2.1 EMA Protocol

To complete the surveys, participating parents received a link via text message that uploaded to the EMA web-based program, ReTAINE (Sanford Health, 2023). At each 1-week survey period (i.e., month 1 [baseline], month 2, month 3), participating parents reported on their own dietary lapses at 3 random intervals throughout the day. Each survey contained questions on momentary intrapersonal cues (i.e., negative mood, stress, hunger, craving), socioenvironmental cues (i.e., presence of unhealthy foods, lack of access to healthy foods, affordability of health foods), and questions on the location of the lapse, type of eating episode (i.e., meal or snack), level of fullness, and lapse severity. Participating parents were also asked to report on any child dietary lapses by proxy. Parents were chosen as informants given data that show moderate agreement between parent-reported child dietary intake via EMA and objectively 24-hour child dietary recall (Loth et al., 2021). Surveys remained active for 1 hour before they expire to account for times in which participating parents were unable to respond. Participating parents were compensated $1 per survey responded to for a maximum of $63 over the course of the 3 study periods. To incentivize excellent adherence, parents who completed ≥66.7% of the surveys (14 out of 21 surveys/week) at any given study period were entered once into a $100 drawing. Probability of winning the lottery increased based on the frequency of which participants completed ≥ 66.7% of the surveys. At the end of the study, participants received a $25 grocery store gift card and personalized feedback based on their survey responses.

2.3 Feasibility

Prior to study initiation, the EMA protocol was presented to members of the community participatory research coalition at Children's Mercy Hospital to receive feedback on study feasibility for families from low-income households. The following changes were implemented in line with member feedback: the number of EMA surveys was reduced from 5 to 3 per day; compensation was increased from 50 cents to 1 dollar per survey; a gift card to a local grocery store was added as an additional incentive; survey length was reduced from 4 minutes to 1 minute per survey; survey language was made appropriate for 6^{th} grade literacy level; the 100% practice day adherence target was eliminated to prevent dropout prior to study initiation; a mid-week text was added to check in with participants and share their progress; participants and their FBT coach received a summary of their completed survey responses and personalized feedback at the end of the study.

2.4 Measures

2.4.1 Demographics

Participant race, ethnicity, age, sex, education level, and food insecurity status were collected at baseline.

2.4.2 Food Insecurity

Parent-reported food insecurity in the past 12 months was assessed using the 6-item U.S. Household Food Security Survey Module, an abbreviated version of the original 18-item measure (Blumberg et al., 1999). The 6-item measure has excellent sensitivity (97.7%) (Blumberg et al., 1999) and has been used in prior research assessing relations between food insecurity and eating behavior in low-income families (Berge, Trofholz, et al., 2017). Affirmative responses (i.e., answering "yes", "sometimes", "often", "almost every month", and "some months but not every month") are summed to form a total score. A total score of 0-1 indicates high food security status, a score of 2-4 indicates low food security status, and a score of 5-6 indicates very low food security status.

2.4.3 Body Composition

Trained research staff collected baseline in-person average height (cm) and body weight (kg) measurements taken in triplicate by calibrated stadiometer and scale, respectively. Body weight measurements at month 2 and month 3 were collected via portable scale provided to participants for at-home measurement and were monitored over video call with research staff to ensure accuracy. Parent BMI [kg/m^2] and child percent overweight [percentage above the median BMI for age and sex based on CDC 2000 growth charts (Kuczmarski et al., 2002)] at baseline, month 2, and month 3 were calculated accordingly. Child percent overweight was selected as opposed to other body weight metrics due to its superior sensitivity to weight change at the higher end of the weight spectrum (Paluch et al., 2007).

2.4.4 EMA Measures

Table 1 provides an overview of survey questions and response items.

Table 1. *Overview of EMA Survey Questions and Response Items*

Construct	Survey Item	Response Options
Parent Negative Affect	• Please rate how you feel RIGHT NOW. ○ Upset ○ Hostile ○ Ashamed ○ Nervous ○ Afraid	• Response: 0 = Not at all 1 = A little 2 = Quite a bit 3 = Extremely
Parent Perceived Stress	• How confident do you feel in your ability to handle all of the demands on you RIGHT NOW? • How much do you feel like difficulties are piling up so high that you cannot overcome them RIGHT NOW?	• Response: 0 = Not at all 1 = A little 2 = Quite a bit 3 = Extremely
Parent Hunger and Craving	• How hungry are you RIGHT NOW? • How strongly are you craving certain foods RIGHT NOW?	• Response: 0 = Not at all 1 = A little 2 = Quite a bit 3 = Extremely
Food Environment	• Since the last text, have you been around unhealthy foods? • Since the last text, have you had access to healthy foods? • Since the last text, have you had enough money to buy healthy foods?	• Response: 0 = No 1 = Yes
Dietary Targets	• How many red foods do you and your child plan to eat today?	• Response: Parent red foods = 0-20 Child red foods = 0-20
Parent Dietary Lapses (Presence/Absence)	• Since the last text, have you had anything to eat? • Think back to the most recent time you ate since the last text: ○ Was it a meal or a snack? ○ During this meal or snack, did you eat more red foods than planned?	• Response: Had anything to eat 0 = No 1 = Yes; if "Yes", follow the next questions • Response: Meal or snack 1 = Meal 2 = Snack • Response: Dietary lapses 0 = No 1 = Yes: If "Yes" to one or more dietary lapse, follow the next questions

Parent Dietary Lapses (Context)	• Where were you eating? • How full did you feel after eating? • How much of the red food did you eat?	• Response: Location 1 = Home 2 = Work 3 = Restaurant 4 = Fast-food chain 5 = Social event 6 = Other • Response: Fullness 0 = Not at all 1 = A little 2 = Quite a bit 3 = Extremely • Response: Red portion 0 = Not at all more 1 = A little more 2 = Quite a bit more 3 = A lot more
Child Dietary Lapses (Presence/Absence)	• Since the last text, do you know if your child ate more red foods than they planned? • Were you eating with your child?	• Response: Dietary lapses 0 = No 1 = Yes: If "Yes" to one or more dietary lapse, follow the next questions • Response: Eating with Child 0 = No 1 = Yes
Child Dietary Lapses (Context)	• Was your child eating a meal or snack? • Where was your child eating? • How much of the red food did your child eat?	• Response: Meal or snack 1 = Meal 2 = Snack • Response: Location 1 = Home 2 = School 3 = Restaurant 4 = Fast-food chain 5 = Social event 6 = Other • Response: Red portion 0 = Not at all more 1 = A little more 2 = Quite a bit more 3 = A lot more

2.4.4.1 Parent Negative Affect. Separate parent negative affective states were assessed using the five negative affect items from the International Positive and Negative Affect Schedule Short Form (I-PANAS-SF), an abbreviated version of the original 20-item PANAS (Thompson, 2007). Participating parents were asked to report the extent to which they feel upset, hostile, ashamed, nervous, or afraid at that moment. Response items range from 0 (*Not at all*) to 3 (*Extremely*). The I-PANAS-SF demonstrates excellent convergent and criterion validity compared to the original PANAS (Thompson, 2007).

2.4.4.2 Parent Stress. Parent perceived stress levels was assessed using two items adapted from the four-item Perceived Stress Scale (PSS-4) (Cohen et al., 1983). Participating parents were asked to report their current perceived confidence in handling demands (*How confident do you feel in your ability to handle all of the demands on you right now?*) and ability to control important things in their life (*How much do you feel like difficulties are piling up so high that you cannot overcome them right now?*). Response items range from 0 (*Not at all*) to 3 (*Extremely*). Response items for perceived confidence in handling demands were reverse scored, such that a 0 indicated feeling *extremely* confident in handling demands, and a 3 indicated feeling *not at all* confident. The PSS-4 has acceptable validity and reliability (Cohen et al., 1983) and has been used in prior EMA research examining stress and eating behavior in parent-child dyads (Dunton et al., 2015).

2.4.4.3 Parent Hunger, Craving, and Fullness. Participating parents were asked to rate their momentary hunger (*How hungry are you right now?)* and craving (*How strongly are you craving certain foods right now?)* on a scale from 0 (*Not at all*) to 3 (*Extremely*). These items have been used in a prior EMA study that examined dietary lapses in treatment-seeking adults with obesity (Forman et al., 2017).

2.4.4.4 Food Environment. Participating parents were asked to report on the presence of unhealthy foods in their environment (*Since the last text, have you been around unhealthy foods?*), the availability of healthy foods in their environment (*Since the last text, have you had* *access to healthy foods?*), and healthy food affordability (*Since the last text, have you had enough money to buy healthy foods?*) on a scale from 0 (*No*) to 1 (*Yes*). These items are consistent with those included in a prior EMA protocol examining eating behavior in low-income families (Berge, Trofholz, et al., 2017).

2.4.4.5 Parent and Child Dietary Lapses. Dietary lapses during eating events were defined in accordance with the Traffic-Light Eating Plan (Valoski & Epstein, 1990), an approach to dietary modification used in FBT to help families limit high energy-dense foods (i.e., red foods) and increase nutrient-dense foods (i.e., green foods). The current study specifically focused on assessing red food dietary lapses given data that show that reducing energy-dense foods during FBT is associated with sustained improvements in diet and child weight at 2-year follow-up (Epstein et al., 2008). Further, EMA data in adults show that lapses characterized by eating outside of planned meals/snacks are associated with less early weight change, suggesting this type of lapse may be especially important to target during treatment (Goldstein, Thomas, et al., 2021). To contextualize dietary lapses, participating parents were asked to report how many red foods they and their child plan to eat that day. They were then asked to think back to the most recent eating event since the last survey and report whether they or their child ate more red foods than planned (*During this meal or snack, did you/your child eat more red foods than planned?*) on a scale from 0 (*No*) to 1 (*Yes*). If a participating parent had not eaten since the last survey, this observation was coded as a 0. Details regarding the location of the dietary lapse, level of fullness, and perceived severity of the lapse were also assessed (Table 1).

2.5 Statistical Analyses

Multi-level modeling was used due to the nested structure of the data (nested within parent-child dyad). Due to the likely insufficient power to detect random effects around the slope, models were fit with fixed effects as described below and random intercept only. Because no studies have examined factors related to dietary lapses within parent-child dyads, covariates were not included in the analyses for specific aims 1 and 3. For specific aim 2, likelihood ratio tests were conducted to compare model fit among models that included variables known to impact weight change (sex, age, race, ethnicity, food insecurity, study site, household income, baseline weight). Models that included only baseline weight status (grand-mean centered) as a covariate had superior model fit. Analyses made use of all available demographic data (100% of all observations) and EMA data (84.6% of all observations). Missing EMA data were handled with maximum likelihood estimation without imputation given that the pattern of missing data was due to complete survey non-response. Diagnostic tests confirmed model assumptions, as appropriate. Analyses were conducted in R (version 4.0.3) using the lme4 package for multi-level modeling (Bates et al., 2015).

2.5.1 Analyses for Specific Aim 1

Separate generalized linear mixed models with a Poisson distribution for count data first evaluated between-person and within-person change in parent dietary lapses and child dietary lapses throughout 3-month FBT. Models were fit with random intercept and fixed effect of time. Then, separate generalized linear mixed models with a binomial distribution examined the between-person and within-person effects of intrapersonal and socioenvironmental cues of parent dietary lapses. These models were fit with random intercept and fixed effects of time, between-person centered socioenvironmental and intrapersonal cues, and person-level centered socioenvironmental and intrapersonal cues.

2.5.2 Analyses for Specific Aim 2

Separate linear mixed models first examined parent and child weight change at each major study period (baseline to month 2, baseline to month 3, month 2 to month 3). Models were fit with random intercept and fixed effects of time and baseline weight as a covariate. Sedak corrections were applied to follow-up contrasts to adjust for multiple comparisons. Then, separate linear mixed models evaluated the effect of parent dietary lapses on parent and child weight change across 3-month FBT. Models were fit with random intercept and fixed effects of time, grand-mean centered dietary lapses, time by dietary lapses interactions, and baseline weight as a covariate. To probe the cross-level interactions, simple slope analyses were conducted to evaluate the association between time and weight at varying levels of parent dietary lapses (1 SD below the grand mean, 1 SD above the grand mean). Post hoc follow-up analyses using Kendall's rank correlations were also conducted to examine whether the total number of EMA surveys completed per day was associated with the number of daily parent and child dietary lapses recorded.

2.5.3 Analyses for Specific Aim 3 (Exploratory)

Kendall's rank correlation was first conducted to examine the association between severity of parent dietary lapses and the occurrence of child dietary lapses at the concomitant timepoint. To further explore whether the association between severity of parent dietary lapses and the occurrence of child dietary lapses varied between and within families, a generalized linear mixed model with a binomial distribution was conducted with random intercept and fixed effects of time, between-person centered parent dietary lapse severity, and person-level centered parent dietary lapse severity.

Chapter 3: Results

3.1 Participant Characteristics

Across study sites, most parent-child dyads (*N* = 19) identified as female (57.9% for children, 89.5% for parents), non-Hispanic (84.2% for children and parents), and Caucasian (68.4% for children and parents). At baseline, children were mean 9.11 years of age (*SD* = 2.08), and parents were mean 35.4 years of age (*SD* = 5.22). Most parents reported a high school diploma or GED (57.9% for mothers, 36.8% for fathers) as their highest level of education. Most households were classified as food secure (68.4%). Participating families were equally represented across pediatric practices in urban Kansas City, MO (47.4%) and rural Joplin, MO (52.6%). Baseline child mean percent overweight was 61.4 (*SD* = 28.2), and parent mean BMI was 40.2 kg/m^2 (*SD* = 9.03). Across EMA surveys at baseline, the mean number of red foods parents planned to eat on a given day was 2.47 (*SD* = 1.13), and the mean number of red foods their child planned to eat was 2.53 (*SD* = 1.13). Across EMA surveys at baseline, parents reported a mean of 3.37 (*SD* = 2.06) dietary lapses and a mean of 4.32 (*SD* = 2.96) dietary lapses on behalf of their child. Parent and child sample demographics are presented in Appendix C and D, respectively. Parent and child weight and dietary lapses over the three study periods are presented in Table 2. Parent and child dietary lapse characteristics over the three study periods are presented in Tables 3 and 4, respectively.

Table 2. *Parent-Child Dietary Lapses and Weight at Each Major EMA Study Period*

	Baseline	Month 2	Month 3
	M (SD)	M (SD)	M (SD)
Parent Dietary Lapses	3.37 (2.06)	2.63 (2.01)	2.37 (2.27)
Child Dietary Lapses	4.32 (2.96)	4.00 (3.68)	4.00 (3.86)
Parent BMI	40.2 (9.03)	39.7 (8.78)	39.6 (8.94)
Child Percent Overweight	61.4 (28.2)	61.2 (28.0)	60.7 (26.8)

Note. M, mean. SD, standard deviation.

Table 3. *Parent Dietary Lapse Characteristics at Each Major Study Period*

	Baseline	Month 2	Month 3
	%	%	%
Eating Event			
Meal	66.7	83.3	61.1
Snack	33.3	11.1	11.1
Lapse Location			
Fast-Food Chain	11.1	22.2	11.1
Home	50.0	33.3	38.9
Restaurant	22.2	22.2	5.6
Work	11.1	0	0
Social Event	0	5.6	0
Other	5.6	11.1	16.7
Fullness			
Not at all	5.6	5.6	11.1
A little	27.8	16.7	22.2
Quite a bit	33.3	44.4	11.1
Extremely	33.3	27.8	27.8
Lapse Severity			
Not at all more than planned	27.8	22.2	22.2
A little more than planned	38.9	61.1	44.4
Quite a bit more than planned	27.8	27.8	5.6
A lot more than planned	5.6	5.6	0

Note. Percentages are based on available data at each study period from parents who reported at least one dietary lapse and thus do not add up to 100%.

Table 4. *Child Dietary Lapse Characteristics at Each Major Study Period*

	Baseline	Month 2	Month 3
	%	%	%
Eating Event			
Meal	78.9	57.9	52.6
Snack	21.1	26.3	26.3
Lapse Location			
Fast-Food Chain	10.5	5.3	0
Home	57.9	42.1	47.4
Restaurant	5.3	15.8	10.5
School	5.3	5.3	0
Social Event	5.3	5.3	10.5
Other	15.8	10.5	10.5
Lapse Severity			
Not at all more than planned	26.3	31.6	42.1
A little more than planned	63.2	47.4	26.3
Quite a bit more than planned	0	5.3	10.5
A lot more than planned	10.5	0	0

Note. Percentages are based on available data at each study period from parents who reported at least one child dietary lapse and thus do not add up to 100%.

3.2 EMA Adherence

A total of 1012 out of 1197 possible EMA surveys (84.6%) were completed over the course of the three study periods. On average, 87.4% (*SD* = 0.12, range = 62% - 100%) of EMA surveys were completed at baseline, 80.0% (*SD* = 0.16, range = 48% - 100%) of EMA surveys were completed at month 2, and 86.4% (*SD* = 0.13, range = 57% - 100%) of EMA surveys were completed at month 3.

3.3 Specific Aim 1: Change in Frequency of Parent and Child Dietary Lapses

Across all EMA surveys, parents reported a total of 159 dietary lapses (64 at baseline, 50 at month 2, 45 at month 3), and a total of 234 child dietary lapses (82 at baseline, 76 at month 2, 76 at month 3). The interclass correlation coefficients of the unconditional models for parent dietary lapses and child dietary lapses were 0.87 and 0.75, respectively, indicating that most of the variance in parent and child dietary lapses occurred at the between-person level. A depiction of within-person variability in parent and child dietary lapses of 4 families is presented in Figure 1.

There was a significant effect of time on the likelihood of a parent dietary lapse, (*B* = -0.18, *SE* = 0.02, 95% CI [-0.22, -0.14], *p* < .001), such that the odds of a parent dietary lapse decreased over the course of 3-month FBT (OR: 0.84, 95% OR CI [0.80, 0.87]). Similarly, there was a significant effect of time on the likelihood of a child dietary lapse, (*B* = -0.04, *SE* = 0.02, 95% CI [-0.07, -0.004], *p* = .03), such that the odds of a parent-reported child dietary lapse decreased over the course of 3-month FBT (OR: 0.96, 95% OR CI [0.93, 1.00]). Change in the predicted probabilities of parent and child dietary lapses throughout 3-month FBT are presented in Figure 2 and 3, respectively.

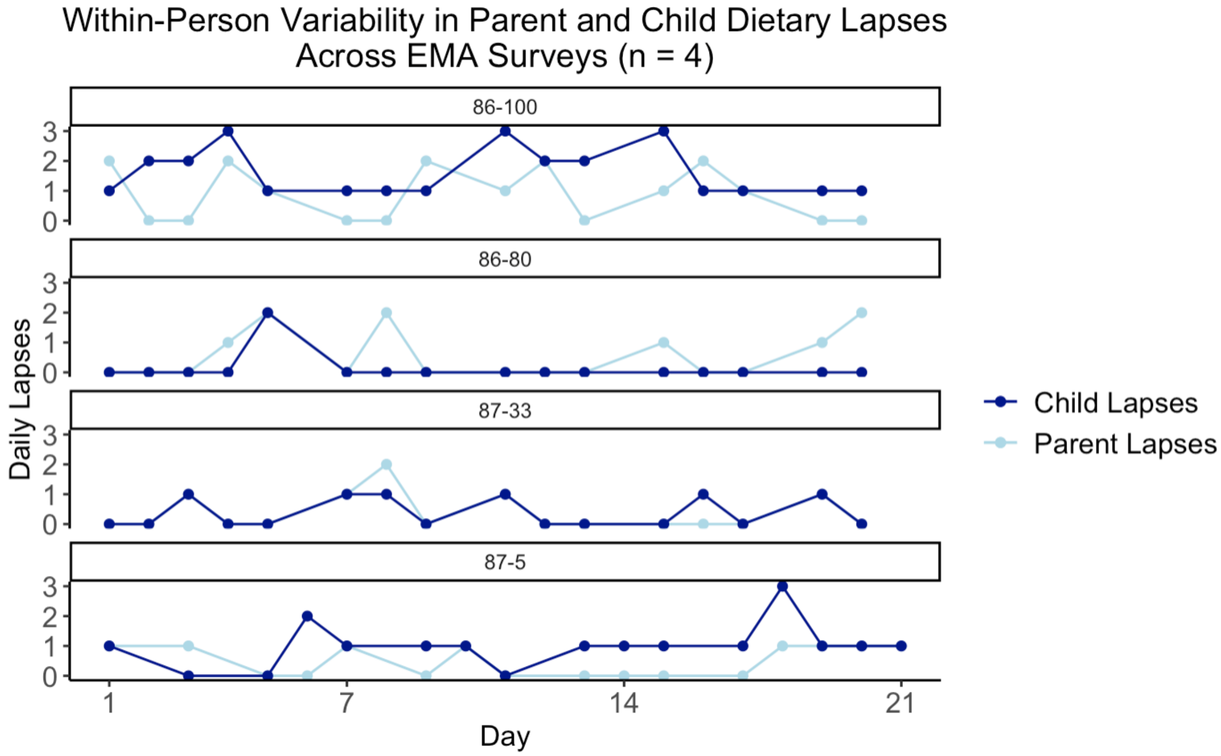

Figure 1. *Within-Person Variability in Parent and Child Dietary Lapses*

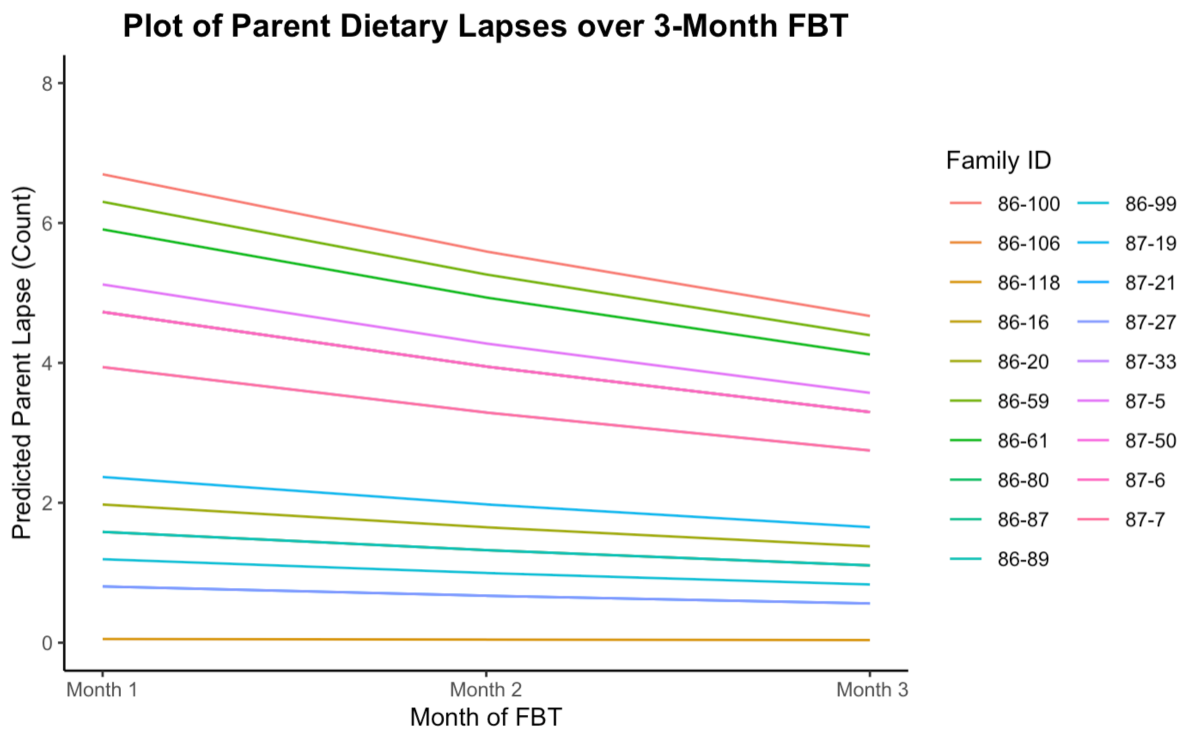

Figure 2. *Change in Predicted Probability of Parent Dietary Lapses*

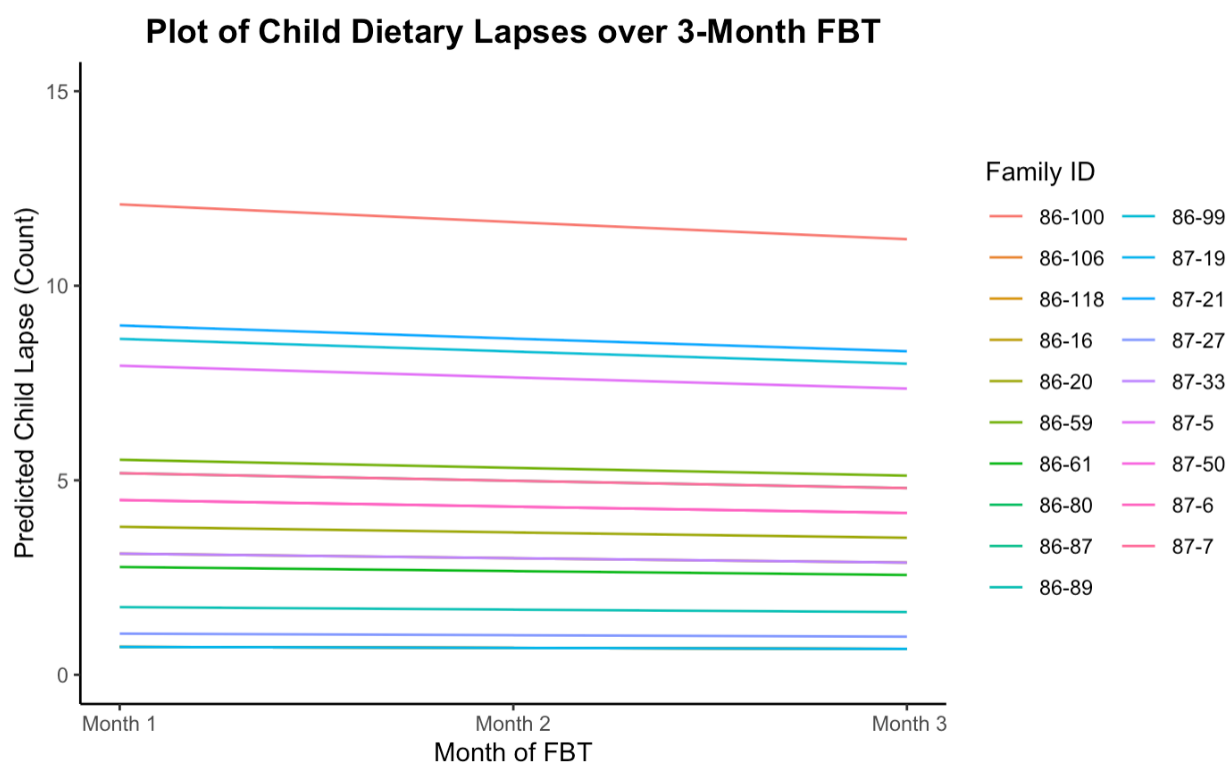

Figure 3. *Change in Predicted Probability of Child Dietary Lapses*

3.4 Specific Aim 1: Parent Dietary Lapse Cues

Table 5 provides descriptive statistics for cues of parent dietary lapses at the sample level. Table 6 summarizes results from the generalized linear mixed models of parent dietary lapse cues.

Table 5. *Parent Dietary Lapse Cues at the Sample Level*

	M (SD)
Intrapersonal Cues	
Upset	0.38 (0.81)
Hostile	0.13 (0.49)
Ashamed	0.13 (0.48)
Nervous	0.39 (0.82)
Afraid	0.30 (0.75)
Stress - confidence with demands	1.12 (0.95)
Stress - control over demands	0.90 (0.98)
Hunger	0.53 (0.75)
Craving	0.34 (0.69)
Socioenvironmental Cues	
Unhealthy food presence	0.68 (0.47)
Access to healthy foods	0.86 (0.35)
Afford healthy foods	0.83 (0.37)

Note. M, mean; SD, standard deviation.

Table 6. *Between-Person and Within-Person Effects of Dietary Lapse Cues*

	B	SE	Z Value	OR	95% OR CI	*p*
Between-Person Effects						
Intrapersonal Cues						
Upset	0.81	0.42	1.93	2.24	0.99, 5.08	.05
Hostile	0.34	0.77	0.45	1.41	0.31, 6.35	.65
Ashamed	1.11	0.59	1.89	3.02	0.96, 9.53	.06
Nervous	0.37	0.38	0.99	1.45	0.70, 3.00	.32
Afraid	0.42	0.40	1.07	1.53	0.70, 3.33	.29
Stress - confidence with demands	0.35	0.28	1.23	1.41	0.82, 2.45	.22
Stress - control over demands	0.33	0.27	1.25	1.40	0.83, 2.36	.21
Hunger	1.88	0.86	2.20	6.57	1.23, 35.19	.03
Craving	1.57	0.59	2.68	4.80	1.53, 15.12	.01
Socioenvironmental Cues						
Unhealthy food presence	1.15	0.89	1.29	3.15	0.55, 18.15	.20
Access to healthy foods	-1.68	1.41	-1.19	0.19	0.01, 2.94	.23
Afford healthy foods	-1.46	1.02	-1.43	0.23	0.03, 1.71	.15
Within-Person Effects						
Intrapersonal Cues						
Upset	0.15	0.12	1.24	1.16	0.92, 1.47	.22
Hostile	0.22	0.20	1.07	1.24	0.84, 1.85	.29
Ashamed	0.11	0.20	0.57	1.12	0.76, 1.66	.57
Nervous	0.002	0.14	0.02	1.00	0.76, 1.32	.99
Afraid	0.02	0.16	0.15	1.02	0.75, 1.40	.88
Stress - confidence over demands	0.29	0.14	1.98	1.33	1.00, 1.77	.04
Stress - control over demands	0.10	0.14	0.75	1.11	0.85, 1.44	.45
Hunger	0.09	0.15	0.59	1.09	0.82, 1.45	.56
Craving	0.02	0.13	0.12	1.02	0.79, 1.31	.90
Socioenvironmental Cues						
Unhealthy food presence	2.77	0.36	7.67	16.03	7.88, 32.58	<.001
Access to healthy foods	0.03	0.26	0.13	1.03	0.62, 1.74	.90
Afford healthy foods	0.18	0.28	0.66	1.20	0.70, 2.06	.51

Note. SE, standard error; OR, odds ratio; CI, confidence interval. Models were fit separately with each corresponding between-person and within-person cue.

3.4.1 Intrapersonal Cues

3.4.1.2 Negative Affect. Neither within-person nor between-person upset, hostility, shame, nervousness, or afraid was significantly associated with the likelihood of a parent dietary lapse.

3.4.1.3 Perceived Stress. Within-person, but not between-person, confidence in handling demands was significantly associated with the likelihood of a parent dietary lapse (*B* = 0.29, *SE* = 0.14, 95% CI [0.00, 0.57], *p* = .04) (Figure 4). Controlling for average levels of between-person perceived confidence, parents who reported feeling less confident in handling demands on a given day were more likely to report a daily dietary lapse (OR: 1.33, 95% OR CI [1.002, 1.77]). Neither between-person nor within-person ability to control important things in life was significantly associated with the likelihood of a parent dietary lapse.

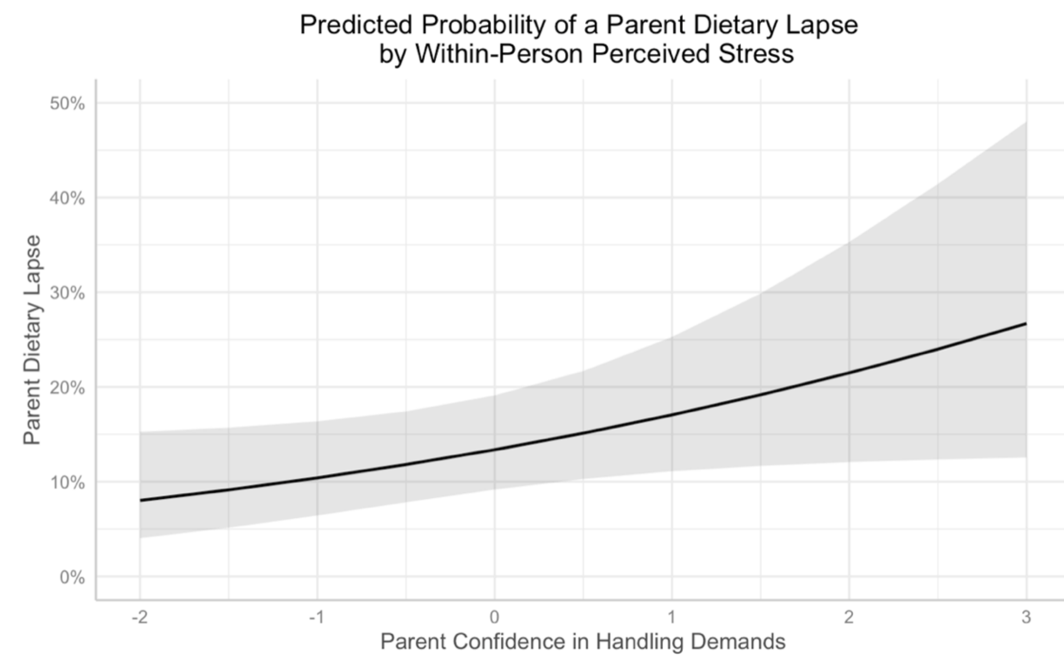

Figure 4. Predicted Probability of a Parent Dietary Lapse by Within-Person Perceived Stress

Note. Confidence in handling demands is reversed scored, such that higher values = lower confidence.

3.4.1.4 Hunger. Between-person hunger was significantly associated with the likelihood of a parent dietary lapse (*B* = 1.88, *SE* = 0.86, 95% CI [0.12, 3.72], *p* = .03) (Figure 5). On average, parents who reported greater daily hunger also tended to be more likely to report a daily dietary lapse (OR: 6.57, 95% OR CI [1.23, 35.19]). Within-person hunger was not significantly associated with the likelihood of a parent dietary lapse.

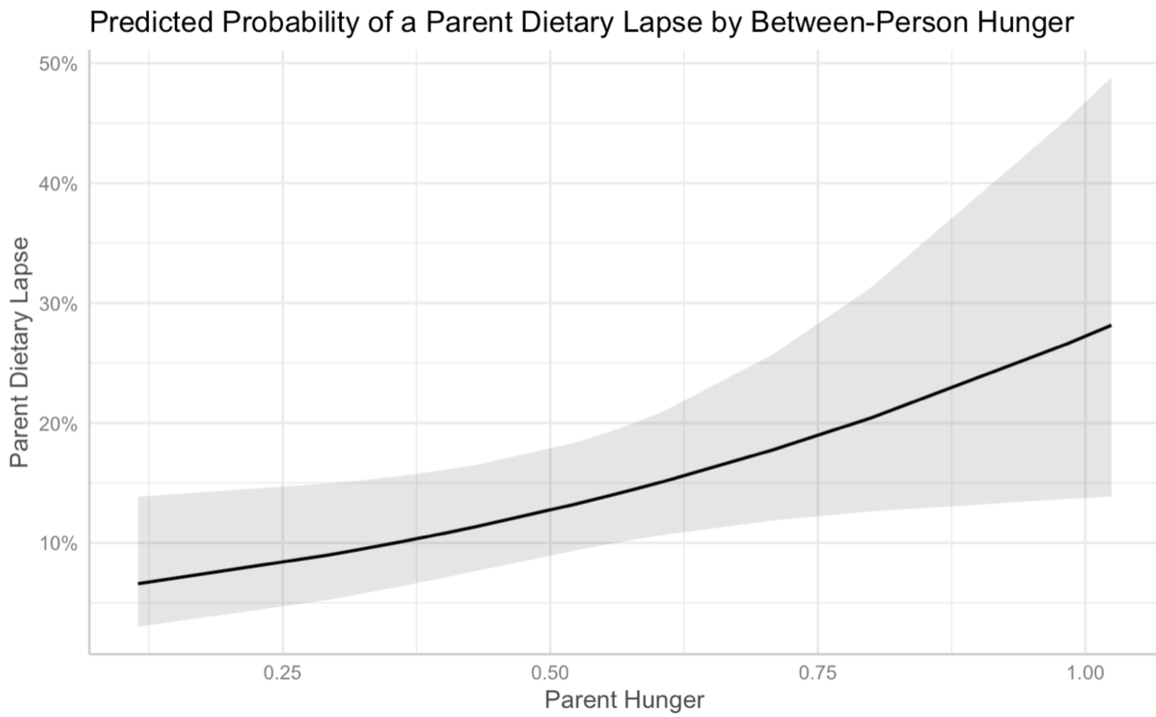

Figure 5. *Predicted Probability of a Parent Dietary Lapse by Between-Person Hunger*

3.4.1.5 Craving. Between-person craving was significantly associated with the likelihood of a parent dietary lapse ($B = 1.57$, $SE = 0.59$, 95% CI [0.40, 2.86], $p = .01$) (Figure 6). On average, parents who reported greater daily hunger also tended to be more likely to report a daily dietary lapse (OR: 4.80, 95% OR CI [1.53, 15.12]). Within-person craving was not significantly associated with the likelihood of a parent dietary lapse.

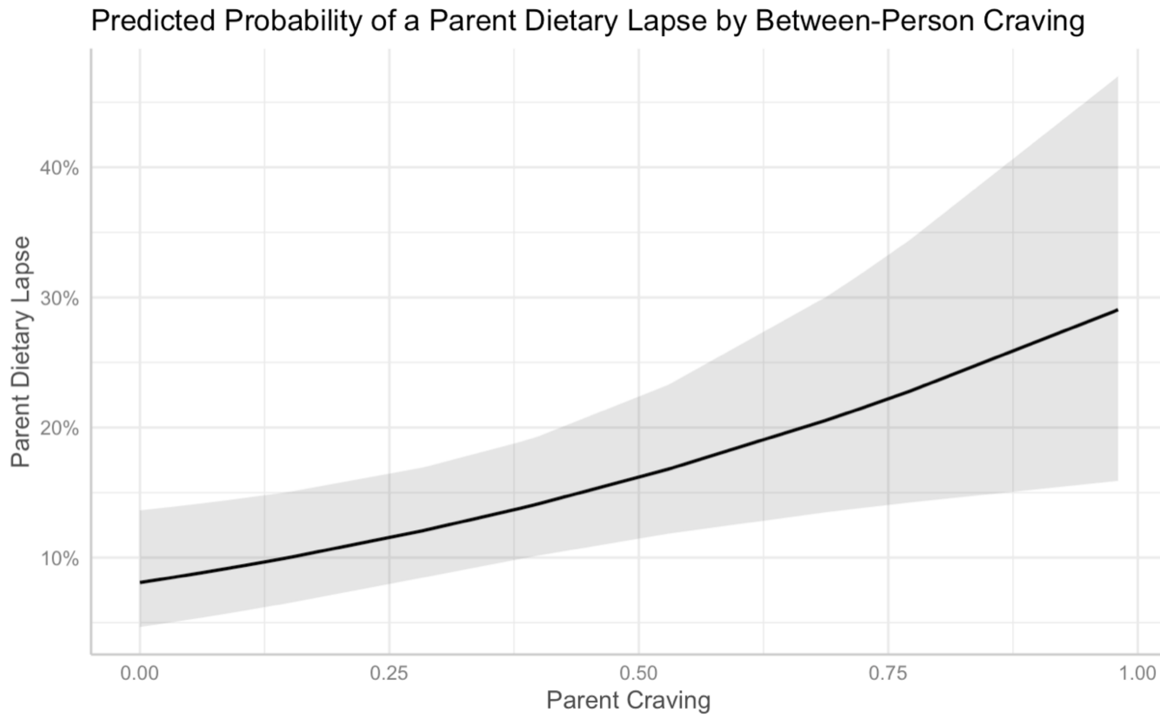

Figure 6. *Predicted Probability of a Parent Dietary Lapse by Between-Person Craving*

3.4.2 Socioenvironmental Cues

3.4.2.1 Presence of Unhealthy Foods. Within-person, but not between-person, presence of unhealthy foods was significantly associated with the likelihood of a parent dietary lapse (B = 2.77, SE = 0.36, 95% CI [2.10, 3.55], p < .001) (Figure 7). Parents who reported having unhealthy foods in their surroundings on a given day were more likely to report a daily dietary lapse, controlling for average levels of unhealthy food presence (OR: 16.03, 95% OR CI [7.88, 32.58]).

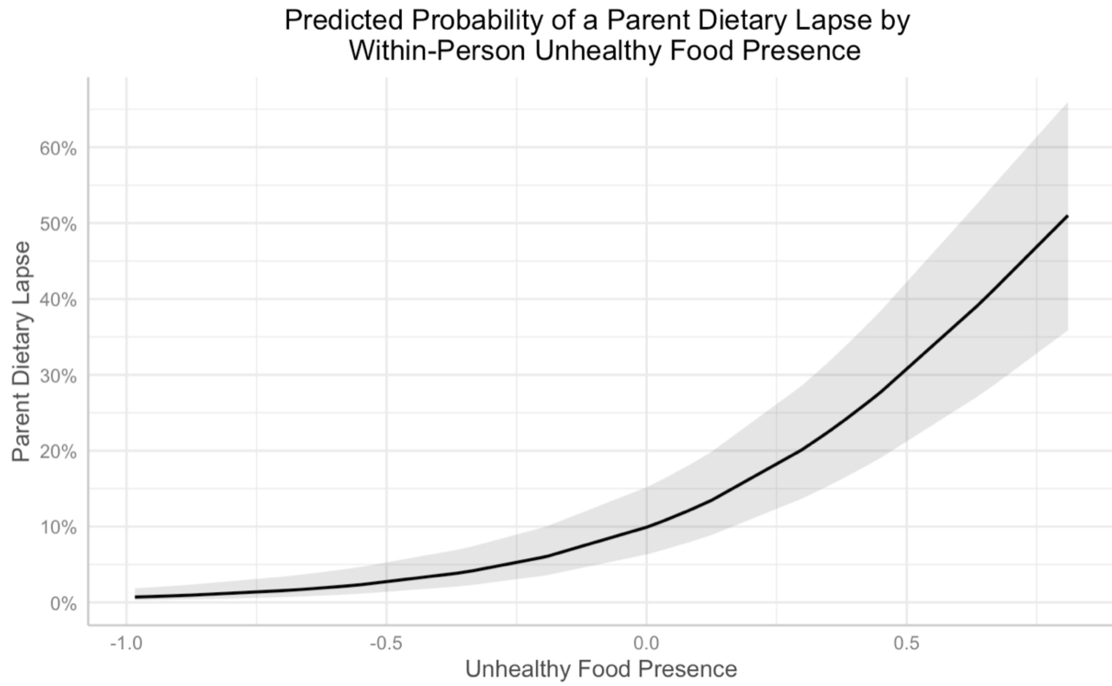

Figure 7. *Predicted Probability of a Parent Dietary Lapse by Within-Person Presence of Unhealthy Foods*

3.4.2.2 Access to Healthy Foods. Neither within-person nor between-person access to healthy foods was significantly associated with the likelihood of a parent dietary lapse.

3.4.2.3 Affordability of Healthy Foods. Neither within-person nor between-person ability to afford healthy foods was significantly associated with the likelihood of a parent dietary lapse.

3.5 Specific Aim 2: Parent-Child Dietary Lapses and Parent-Child Weight Change

Parents demonstrated significant reductions in BMI from baseline to month 2 (Least Square M = 0.44, SE = 0.03, 95% CI: [0.36, 0.52], $p < .001$), baseline to month 3 (Least Square M = 0.53, SE = 0.03, 95% CI: [0.46, 0.62], $p < .001$), and month 2 to month 3 (Least Square M = 0.09, SE = 0.03, 95% CI: [0.01, 0.17], $p < .001$). Children also demonstrated significant reductions in percent overweight from baseline to month 3 (Least Squares M = 0.69, SE = 0.23, 95% CI: [0.16, 1.22], $p = .01$) but not from baseline to month 1 (Least Squares M = 0.18, SE =

0.23, 95% CI: [-0.35, 0.71], *p* = .71), or month 2 to month 3 (Least Squares *M* = 0.51, SE = 0.23, 95% CI: [-0.01, 1.04], *p* = .06).

Results of the adjusted linear mixed-effects models are presented in Table 7. The magnitude of weight change for parents (*B* = -0.08, *SE* = 0.01, 95% CI [-0.10, -0.06], *p* < .001) as well as for children (*B* = -0.11, *SE* = 0.05, 95% CI [-0.23, -0.003], *p* = .04) was moderated by the frequency of parent dietary lapses (Figures 8 and 9). Parents with above average dietary lapses relative to the grand mean demonstrated significantly greater weight loss compared to parents with below average dietary lapses (Least Squares *M* = -0.34, SE = 0.03, 95% CI: [-0.40, -0.27], *p* < .001). Children of parents with above average dietary lapses relative to the grand mean also demonstrated significantly greater weight loss compared to children of parents with below average dietary lapses (Least Squares *M* = -0.48, SE = 0.24, 95% CI: [-0.95, -0.01], *p* = .04). Results of the post hoc analyses indicated significant, albeit small, positive correlations between the number of completed daily EMA surveys and the number of recorded daily parent dietary lapses (r_τ = 0.08, *p* < .01) and child dietary lapses (r_τ = 0.09, *p* < .01).

Table 7. *Mixed Effects Models Examining Weight Change as a Function of Dietary Lapses*

	B	**SE**	**T Value**	**95% CI**	***p***
Change in Parent Weight as a Function of Parent Dietary Lapses					
Intercept	39.76	2.05	19.36	35.63, 43.88	<.001
Time	-0.18	0.02	-10.88	-0.21, -0.15	<.001
Parent Dietary Lapses	0.24	0.01	16.72	0.21, 0.27	<.001
Time x Parent Dietary Lapses	-0.08	0.001	-10.09	-0.10, -0.06	<.001
Change in Child Weight as a Function of Parent Dietary Lapses					
Intercept	62.42	6.32	9.87	49.73, 75.12	<.001
Time	-0.49	0.12	-4.12	-0.72, -0.26	<.001
Parent Dietary Lapses	-0.20	0.10	-1.87	-0.40, 0.01	.06
Time x Parent Dietary Lapses	-0.11	0.06	-2.02	-0.23, -0.003	.04

Note. Models adjusted for parent and child baseline weight. Parent dietary lapses are grand mean centered.

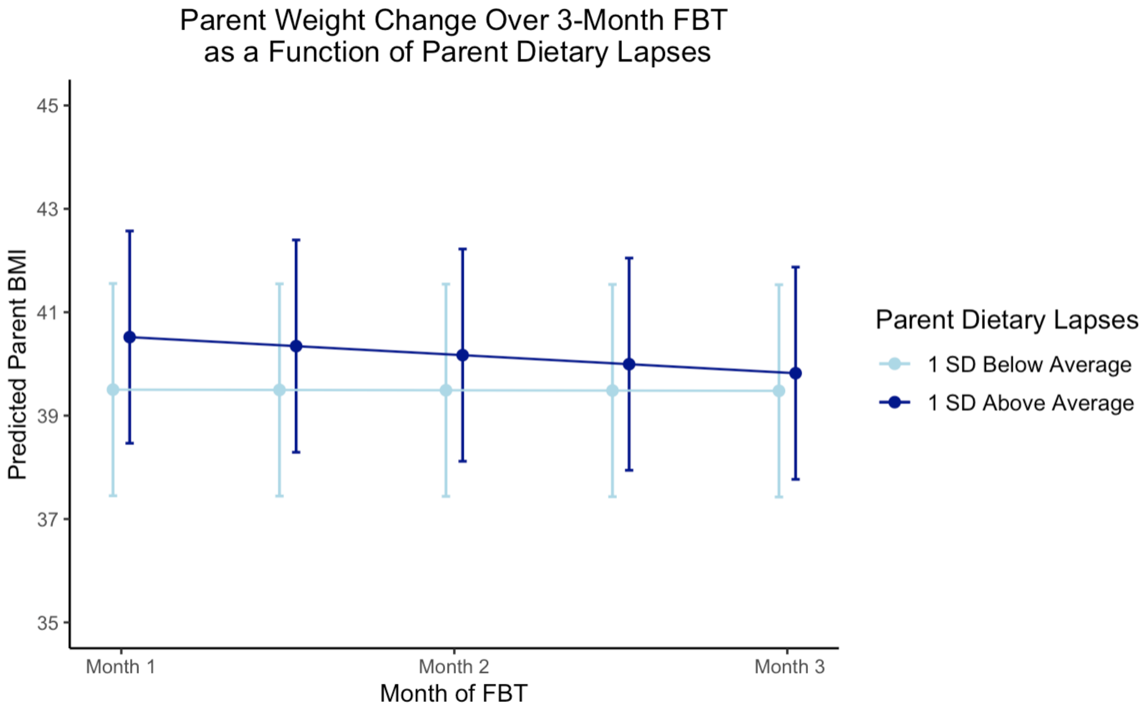

Figure 8. *Parent Weight Change over 3-Month FBT as a Function of Parent Dietary Lapses*

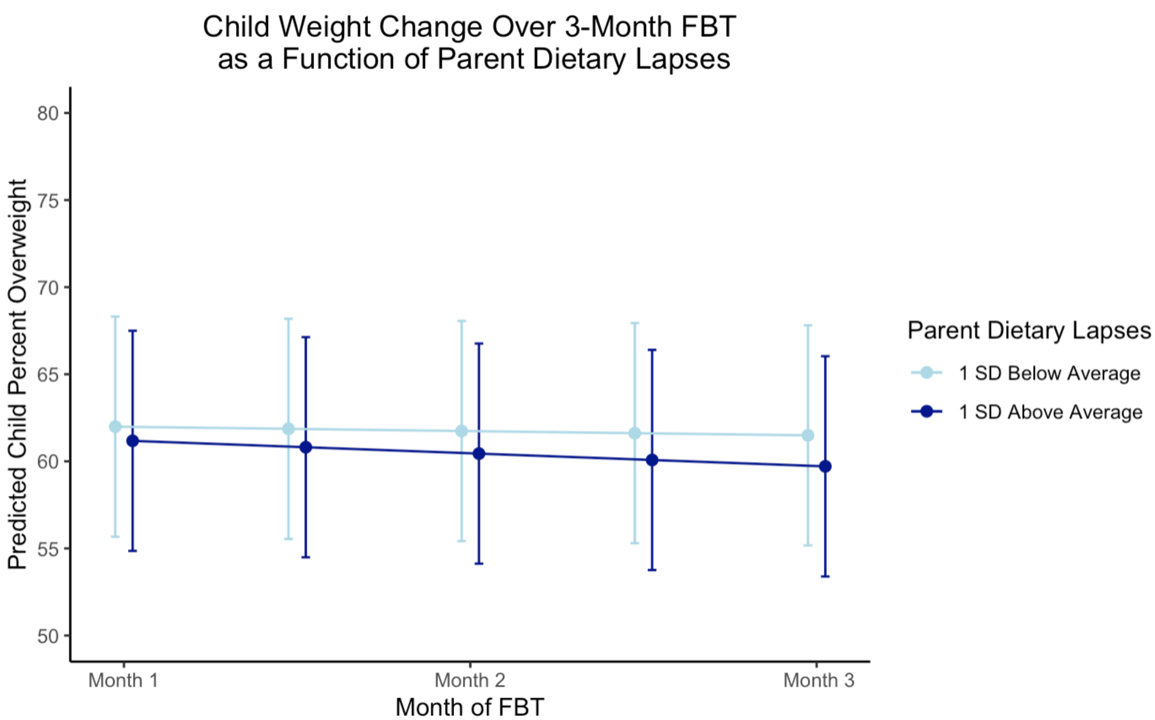

Figure 9. *Child Weight Change over 3-Month FBT as a Function of Parent Dietary Lapses*

3.6 Specific Aim 3: Parent Dietary Lapse Intensity and Child Dietary Lapse Occurrence

There was a non-significant positive correlation between parent dietary lapse intensity and the occurrence of a child dietary lapse at the concomitant timepoint (r_τ = 0.12, *p* = .11). Results from the multi-level model also indicated a non-significant association between parent dietary lapse intensity and child dietary lapse occurrence when accounting for differences between families (*B* = 0.71, *SE* = 0.38, 95% CI [-0.12, 1.53], *p* = .06) and within families (*B* = 0.01, *SE* = 0.27, 95% CI [-0.53, 0.55], *p* = .96).

Chapter 4: Discussion

The current study was designed to better understand the context in which parent and child dietary lapses occur in families from low-income households as well as to evaluate the impact of dietary lapses on parent-child weight change throughout 3-month FBT. Study findings extend the literature on modifiable risk factors for childhood obesity by revealing precise moments to support family eating self-regulation. The following sections summarize the results and provide suggestions for future research.

4.1 Parent and Child Dietary Lapse Frequency

On average, parents reported between 2 to 3 dietary lapses/week on their own behalf and 4 to 5 dietary lapses/week on behalf of their child. Although no other studies have quantified dietary lapses within families, EMA studies in treatment-seeking adults with obesity tend to report a higher average weekly lapse rate (4 to 12 times/week) (Carels et al., 2001; Forman et al., 2017; Goldstein et al., 2020). Study differences in lapse rate may reflect how well participants can assess, and subsequently correct, moments of dietary non-adherence. In the current study, a dietary lapse (i.e., eating more red foods than planned) was defined within the context of FBT. This operational definition was informed by prior research that found an association between dietary lapses characterized by eating outside of pre-planned meals/snacks and less early weight change (Goldstein, Thomas, et al., 2021). However, this study was conducted with a community sample of adults who were not exclusively low-income. Although families are encouraged to pre-plan their meals and snacks throughout FBT, it is possible that families from low-income households experience unique barriers to pre-planning (e.g., unreliable access to healthy foods, irregular schedules). Thus, other operational definitions may better capture the eating behaviors of low-income families. Engaging FBT participants in the design of future dietary lapse studies could help propose alternative definitions and provide further context on the dietary lapse rate observed in the current study.

Future studies should also consider alternative methods of assessing child dietary lapses. Parents were chosen as informants in line with prior data that show moderate agreement between parent-reported child dietary intake via EMA and objectively 24-hour child dietary recall (Loth et al., 2021). However, child dietary lapses may have occurred outside of eating events with the parent, such as during school hours. FBT encourages parents to have regular check-ins with their child, which provides an opportunity for parents to be informed about child eating behaviors and problem solve barriers to dietary adherence. Future EMA studies should gather information regarding how the parent became aware of the child dietary lapse (e.g., observed the lapse, discussed the lapse during a regular check-in), which could improve reporting accuracy and reinforce use of FBT skills.

4.2 Change in Parent and Child Dietary Lapse

Consistent with study hypotheses, both parents and children demonstrated significant, albeit modest, reductions in dietary lapses throughout 3-month FBT. Parents demonstrated reductions in lapses at all three time points, whereas children only demonstrated reductions in lapses from baseline to month 3. In the absence of a control group, causal claims cannot be made regarding whether FBT directly led to dietary lapse reductions. However, findings may suggest that reductions in dietary lapses were associated with the application of FBT skills that promote awareness and modification of eating behavior, such as pre-planning, goal setting, and self-monitoring. An important future direction is to collect EMA data on daily use of FBT skills to evaluate whether skills acquisition is correlated with reductions in lapses throughout FBT. Future studies should also evaluate change in dietary lapses over a longer course of FBT. An EMA study in treatment-seeking adults showed decreases in dietary lapses from baseline to mid-treatment but increases from mid-treatment to post-treatment, which was likely due to decreased motivation as weight loss plateaued (Forman et al., 2017). Fluctuations in motivation may be more prevalent in families from low-income households if they lack adequate resources to sustain long-term behavior change or handle setbacks (Laroche et al., 2022). Thus, future studies should examine the long-term course of dietary lapses throughout FBT to identify key moments to support motivation and self-efficacy among families from low-income households.

4.3 Predictors of Parent Dietary Lapses

4.3.1 Intrapersonal Cues

Contrary to study hypotheses, none of the negative moods were associated with a parent dietary lapse. These findings contradict previous EMA studies of dietary lapses (Crochiere et al., 2022; Forman et al., 2017) that have shown that global negative affect predicts the onset of a dietary lapse. Affect regulation models posit that overeating serves as a maladaptive coping strategy for managing negative mood (Heatherton & Baumeister, 1991). Although few studies have examined specific negative affective states in relation to dietary lapses, EMA studies in adults with binge eating pathology consistently demonstrate that self-referential emotions increase prior to a binge episode and decrease relatively quickly following the binge episode (Berg et al., 2015; Fischer et al., 2017; Schaefer et al., 2020). Consistent with these findings, between-person shame was close to statistical significance in the current study. Thus, assessing a wider range of self-referential emotions (e.g., guilt, embarrassment, rejection) may be an important future direction.

As hypothesized, results also showed that within-person stress regarding feeling less confident in handling demands was associated with a parent dietary lapse. This finding is consistent with prior EMA studies that have shown a link between parent stress and unhealthy feeding practices (Berge et al., 2020; Berge, Tate, Trofholz, Fertig, et al., 2018). Self-determination theory posits that an individual is more likely to persist with a behavior if they feel a sense of autonomy in driving the behavior as well as control and competency in executing the behavior (Deci & Ryan, 2012; Hagger et al., 2014). It is plausible that stress could erode autonomous motivation in the moment and lead to a dietary lapse. Indeed, one EMA study found that momentary decreased confidence in meeting dietary goals was predictive of a dietary lapse among treatment-seeking adults with obesity (Crochiere et al., 2022). These findings underscore the importance of assessing parent self-efficacy throughout FBT as well as ensuring that families have adequate financial and social resources to make long-lasting health behavior changes.

Last, between-person hunger and craving were associated with a parent dietary lapse, indicating that parents who tended to report greater daily hunger or craving were also more likely to report a dietary lapse compared to those who reported less daily hunger or craving. These finding offer practical implications for FBT. Parents who report irregular schedules may need greater support around establishing regular meals and snacks, which is an important strategy to improve appetite control (La Bounty et al., 2011; Smeets & Westerterp-Plantenga, 2008).

Further, parents may need continued assistance with nutritional education and meal preparation throughout treatment. Since early treatment response is a robust predictor of overall treatment response (Goldschmidt et al., 2011; Nackers et al., 2010) hands-on support from a nutritionist could be especially helpful in the first months of FBT. A just-in-time intervention could be used adjunctively with FBT by delivering momentary prompts to remind parents to include protein and fiber at their next meal or by providing brief emotion regulation exercises to address craving (e.g., distraction, urge surfing).

4.3.2 Socioenvironmental Cues

Within-person presence of unhealthy foods was associated with increased likelihood for a daily dietary lapse, indicating that parents who reported having unhealthy foods in their surroundings on a given day were more likely to report a daily dietary lapse. This finding is consistent with goal-conflict theory of self-regulation, which posits that the presence of external diet-incongruent food cues in the immediate environment undermines eating behavior self-regulation (Stroebe et al., 2008, 2013). Prior studies have shown that the presence of unhealthy foods in the home is associated with less fruit and vegetable intake in children (K. J. Campbell et al., 2007; Couch et al., 2014). Further, an FBT study showed that reducing red foods in the home was associated with greater decreases in child weight and total fat intake (Hayes et al., 2019). Given that parent and child dietary lapses were more frequently recorded at home than any other location, engineering the home food environment to support dietary adherence may be especially important to prevent dietary lapses in low-income households. More data are needed to understand attitudes and perceived barriers to altering the home food environment in this population. For instance, its plausible that parents may be hesitant to implement strategies like stimulus control (e.g., limit red foods in the home) if they lack financial resources to alter the home food environment or if they experience food insecurity (Adams et al., 2022). Mixed-method designs could elucidate attitudes and perceived barriers towards implementing key dietary change strategies and highlight opportunities to tailor FBT accordingly.

Contrary to study hypotheses, access to healthy foods was not associated with a parent dietary lapse. This finding is consistent with some data that show that healthy food availability is not sufficient to explain nutrition disparities among families from low-income households (Allcott et al., 2019; Elbel et al., 2015; Lent et al., 2014), especially when energy-dense foods are still prevalent in the home environment. Improving dietary adherence in economically-disadvantaged populations likely requires addressing other key determinants of diet quality, such as food shopping preferences, food purchasing behaviors, and sociocultural food practices (French et al., 2019; Lin et al., 2014; Monterrosa et al., 2020).

Additionally, healthy food affordability was not associated with a parent dietary lapse. This finding may be due to the limited range of healthy food affordability in the current sample. The majority (61.8%) of families considered themselves food secure. The cost of healthy foods may not be a primary barrier to dietary adherence among families that are low-income but otherwise have reliable access to affordable, nutritious foods. However, an inability to afford healthy foods may trigger a dietary lapse among food-insecure families. Of importance, the prevalence of food insecurity in the current study (38.2%) was slightly higher than the national average for low-income households (range 26.5% - 32.1%) (Coleman-Jensen et al., 2022). Prior studies show that low-income, food-insecure households vary from low-income, food-secure households in terms of quantity and quality of food purchases (Gregory et al., 2019; Leung et al., 2014; Morales & Berkowitz, 2016). Compared to food-secure households, food-insecure households report greater consumption from energy-dense foods (Leung et al., 2014), have a greater probability of not purchasing fruit, dairy, and protein among their total food at home purchases (Gregory et al., 2019), and spend a greater proportion of their food at home budget at convenience stores (Gregory et al., 2019). Future studies should examine whether food insecurity status moderates the association between healthy food affordability and dietary lapses. Future research should also consider strategies to better connect food-insecure families participating in FBT with local food assistance programs.

4.4 Moderating Role of Parent Dietary Lapses in Relation to Parent-Child Weight Change

Contrary to study hypotheses, parents with more frequent dietary lapses demonstrated a greater rate of weight loss throughout 3-month FBT and had a child who demonstrated a greater rate of weight loss throughout 3-month FBT. These results contradict some prior EMA studies that show that more frequent dietary lapses are associated with less weight loss in treatment-seeking adults with obesity (Forman et al., 2017, 2019) as well as increased daily caloric intake and a greater likelihood to exceed their daily calorie goal (Goldstein et al., 2022). An alternative explanation is that frequent recording of dietary lapses may be a proxy for self-monitoring, which is a cornerstone of behavioral weight loss treatment (Burke et al., 2011). Results of the post-hoc test indicated that parents who responded to more daily EMA surveys also tended to report more parent and child dietary lapses. Parents who track dietary lapses more frequently may become more aware of eating behaviors that are incongruent with their dietary goals and may be more likely to adjust accordingly, which could drive greater relative weight loss. Indeed, a prior EMA study found that a greater number of weekly dietary lapses was associated with greater weekly weight loss among adults who completed a higher proportion of EMA surveys (Goldstein, Brick, et al., 2021). Future research should evaluate differences between frequent and non-frequent dietary lapse reporters in terms of FBT skill usage, caloric intake during the eating event, and size of the dietary lapse.

4.5 Association of Parent Dietary Lapse Intensity and Occurrence of Child Dietary Lapse

The correlation between parent dietary lapse severity and child dietary lapse occurrence was not significant even after accounting for between- and within-person effects in the multi-level model. EMA studies have shown that dietary lapses are highly idiographic (Goldstein et al., 2020; Thomas et al., 2022). Thus, it is possible that the lack of significant association is due to a high degree of variability in eating behavior across and within families. Future research should replicate these findings in a larger sample to evaluate the extent of concordance between parent lapse severity and child dietary lapse occurrence. Future research is also needed to contextualize how parent and child lapses may influence one another. For instance, parents who report more severe dietary lapses may "recover" from the distress by engaging in coercive feeding practices (e.g., pressure to eat, restriction) to prevent a child lapse at the same eating event. Pressure to eat and restriction have been consistently linked to poor child diet quality and facets of poor child eating self-regulation (Entin et al., 2014; Mou et al., 2021; Ventura & Birch, 2008). The atmosphere of the feeding environment may also pose risk for shared parent and child dietary lapses. One EMA study of low-income families found that parents who described a mealtime environment as tense or chaotic were more likely to report restricting child dietary intake during that eating event (Berge, Tate, Trofholz, Loth, et al., 2018). Thus, it is possible that parent attempts to gain control during a stressful eating event may backfire and lead to a parent and child dietary lapse in some families. Collecting EMA data on parent motivators for certain feeding practices as well as the atmosphere of the feeding environment could clarify the extent to which parent and child dietary lapses are related as well as inform targets for real-time intervention.

4.6 Strengths and Limitations

Study strengths include the use of an ecologically-valid assessment tool to characterize fluctuations in parent-child eating behavior rather than relying on biased retrospective recall, excellent EMA adherence (84.6%) comparable to studies of dietary lapses in more resourced samples (Forman et al., 2017), the objective assessment of body composition, and engaging community stakeholders to evaluate study feasibility for low-income households. There are several limitations worth noting. Recruitment challenges lead to under-enrollment of study participants, which likely impacted power to detect true effects. Results should be replicated in an adequately powered sample to ensure reliability of study findings. Moreover, parents were used as informants for child dietary lapses. Future studies should consider different strategies to improve the reporting accuracy of child dietary lapses. EMA surveys were administered only throughout the first 3 months of treatment to evaluate the impact of dietary lapses on early treatment response. Future work should extend EMA data collection to examine dietary lapse trajectories throughout a full course of FBT. Last, other dietary lapse definitions may better reflect the experiences of families from low-income households. Future studies should engage families as key stakeholders in defining and evaluating dietary lapses throughout FBT.

4.7 Conclusion

The current study is the first naturalistic examination of dietary lapses among families from low-income households participating in FBT. Results highlight the importance of targeting certain intrapersonal and socioenvironmental cues to prevent parent dietary lapses and demonstrate the impact of parent dietary lapses on early parent-child FBT response. Study findings will inform the future development of real-time childhood obesity interventions that can be disseminated to underserved families at risk for obesity treatment non-response.

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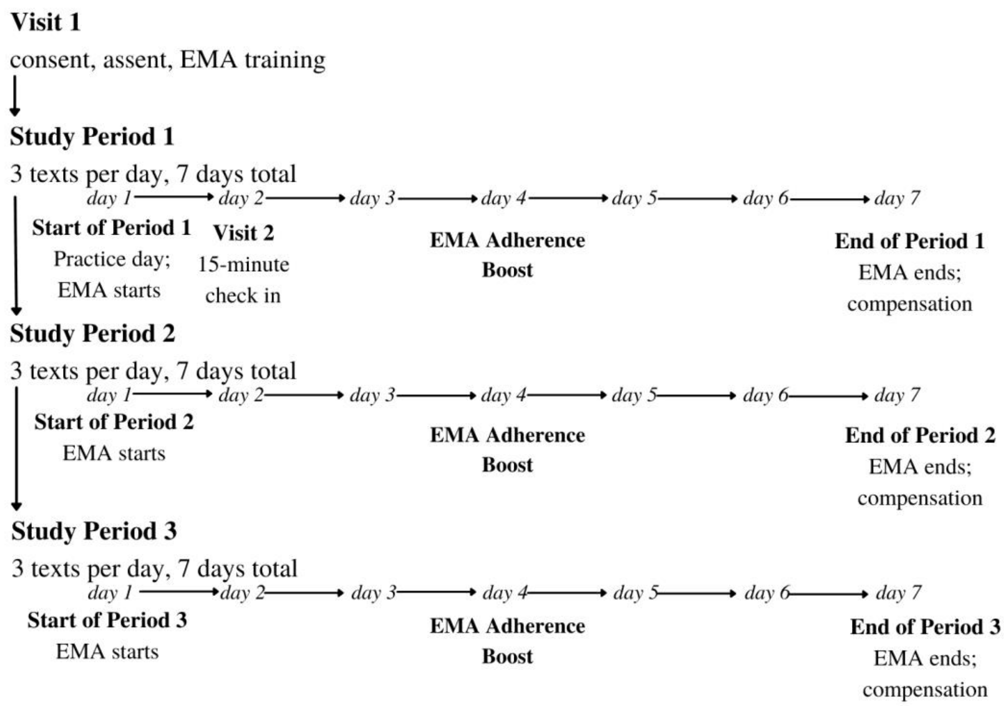
Appendices

Appendix A. *Recruitment Flyer*

Appendix B. *Overview of Study Protocol*



Appendix C. *Visit 1: Comprehension Check for EMA Surveys*

- Inform participant we will practice right now
- In admin ReTAINE portal, click on the participant's ID in the "Participants" panel, then click on the second tab titled "Signal Schedules."
    - Click "add signal schedule" and select Interval Contingent
    - Set the assessment to send only once, at the next minute, start and end dates are today
    - Make sure participant knows how to access assessment
    - Let them know that "You do not have to put honest answers right now since this is just practice"
- Have them enter the assessment, then ask:
    - Can you read the first question?
    - Does it make sense to you? Do you have any questions?
    - Do the answers make sense to you?
    - Can you answer the question (however you want), and move on?
    - Can you read the next question, etc. --> repeat
    - When you get to the question that asks whether you've eaten anything in the past two hours, please say yes
- You've been learning a lot about healthy eating habits and how foods are categorized as green, yellow, and red. Do you remember what red foods are?
    - Red foods are foods that are higher in calories but lower in nutrients. Red foods can fit into your daily eating plan but try to eat them less than you would eat green foods or yellow foods that are higher in nutrients and lower in calories.
    - Give an example of a red food: pizza.
    - Give an example of eating more red foods than planned: If you planned to eat one slice of pizza but you actually ate two, that's an example of eating more red foods than planned.
- Let's practice by thinking about the last meal or snack you ate today.
    - What did you eat during that meal or snack?
    - Based on the Traffic Light Eating Plan, it sounds like XX foods were red food/s.
    - How much of that red food did you plan to eat?
    - How much of that red food did you actually eat?
    - If ate more red foods: Okay, so it sounds like based on what you described, that you ate more of that red food than you planned. Does that sound right? That would be an example of a time when you ate more red foods than planned, so you would say "yes" for this question.
    - Okay, so it sounds like based on what you described, that you did not eat more of the red food than you had planned. Does that sound right? That would be an example of a time when you did not eat more red foods than planned, so you would say "no" for this question.
- Repeat the same protocol for the child.

Appendix D. *Participating Child Demographics*

Child Characteristics	**Percent or Mean (SD) (*N* = 19)**
Gender Identity	
Female	57.9%
Male	42.1%
Race	
Black or African American	26.3%
White	68.4%
Multi-Race	5.3%
Ethnicity	
Hispanic	15.8%
Non-Hispanic	84.2%
Age	9.11 (2.08) (range 5 - 12)

Appendix E. *Participating Parent Demographics*

Parent Characteristics	**Percent or Mean (SD) (*N* = 19)**
Gender Identity	
Female	89.5%
Male	10.5%
Race	
Black or African American	31.6%
White	68.4%
Multi-Race	0%
Ethnicity	
Hispanic	15.8%
Non-Hispanic	84.2%
Age	35.4 (5.22) (range 26 - 49)
Combined Household Income	
$999 or Less	21.1%
$1000 - $2500	21.1%
$2501 - 3800	31.6%
$3801 - 5000	15.8%
$5000 or More	10.5%
Household Food Insecurity Status	
High Food Security	68.4%
Low Food Security	15.8%
Very Low Food Security	15.8%
Highest Level of Education (Mother, Father)	
Less than High School Education	0%, 15.8%
Some High School	0, 15.8%
High School Diploma/GED	57.9%, 36.8%
Associates Degree or 1 -3 Years of College	26.3%, 26.3%
Bachelors Degree	5.3%, 0%
Graduate/Professional Degree	10.5%, 0%
Unknown	0%, 5.3%