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Tired, Hungry, and Grumpy: Understanding the Direct and Indirect Relationships among Child Temperament, Sleep Problems, Feeding Styles, and Weight Outcomes

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UNDERSTANDING THE DIRECT AND INDIRECT RELATIONSHIPS

AMONG CHILD TEMPERAMENT, SLEEP PROBLEMS,

FEEDING STYLES, AND WEIGHT OUTCOMES

by

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TIRED, HUNGRY, AND GRUMPY:

UNDERSTANDING THE DIRECT AND INDIRECT RELATIONSHIPS AMONG CHILD TEMPERAMENT, SLEEP PROBLEMS, FEEDING STYLES, AND WEIGHT OUTCOMES

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Research indicates that temperament is related to later obesity risk in both childhood and adulthood (e.g., Anzman-Frasca et al., 2012; Darlington & Wright, 2006), but less research has examined the mechanisms underlying this relationship. It is likely that temperament influences factors that increase one’s risk for obesity, such as parental feeding practices and child sleep problems. As such, the primary aim of the present study was to provide rigorous concurrent and longitudinal examinations of temperament, feeding practices, sleep problems, and child zBMI in a sample of healthy preschool children. In addition, the moderating role of SES was examined. A secondary aim of this study was to conduct confirmatory factor analysis on two measures assessing feeding practices and childhood sleep problems.

Preschoolers aged 3 to 5 (49.5% female, 75.7% European American) presenting to a pediatric dentistry office were recruited to participate in the study (*N* = 297). Measures of child temperament, sleep, and parental feeding practices were collected Time 1 (T1) and again six months later at Time 2 (T2) (*N* = 188). Moreover, child and parent demographics, as well as objective measurements of child height and weight were assessed at both time points.

Robust maximum likelihood confirmatory factor analyses were conducted on the Parental Feeding Style Questionnaire (Wardle et al., 2002) and the Children's Sleep Habits Questionnaire-Preschool Version (Goodlin-Jones et al., 2008). Results provided preliminary support for a five-factor solution for each measure. Next, path analyses were conducted with both concurrent and longitudinal data. Overall, results indicate that greater reactivity/negativity is associated with parental feeding styles (i.e., emotional feeding) and children's sleep problems both concurrently and longitudinally. zBMI was not significantly predicted by temperament, sleep, or feeding styles, however, and SES did not moderate any of the paths.

Results indicate the importance for obesity prevention and treatment efforts to include a focus on child temperament, sleep, and parental feeding practices. In addition to providing important treatment implications, results provide a variety of areas for future research to further examine how temperament, feeding, and sleep relate and increase risk for obesity.

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CHAPTER 1: INTRODUCTION

Childhood obesity rates have notably increased over the past three decades, resulting in nearly one out of every three children now classified as overweight or obese (Ogden, Carroll, Kit & Flegal, 2014). These children are at risk for a multitude of both physical (e.g., Type 2 diabetes mellitus, hypertension, and asthma) and psychosocial issues (e.g., stigmatization, low self-esteem, and depression and/or anxiety; Gupta, Goel, Shah, & Misra, 2012; Sanchez-Villegas et al., 2010). Given the far-reaching effects of childhood obesity, much research has focused on identifying risk-factors, ranging from environmental factors such as easy access to fast food and convenience stores (e.g., Rahman, Cushing, & Jackson, 2011) and genetic links (e.g., Rooney, Mathiason, & Schauberger, 2011) to individual characteristics such as food preferences and physical activity patterns (e.g., Wardle, Guthrie, Sanderson, Birch, & Plomin, 2001). Despite the burgeoning research in this area, however, there continues to be a need for the identification of early-life risk factors, especially child-level factors that interact with parenting characteristics to influence a child's weight trajectory (Zeller & Daniels, 2004).

One risk factor that is particularly relevant in regard to children's individual differences is temperament. Numerous studies have linked temperament styles characterized as "difficult" (i.e., high in negativity and low in self-regulatory abilities) to greater body-mass-index (BMI) (e.g., Agras, Hammer, McNicholas, & Kraemer, 2004; Carey, 1985; Darlington & Wright, 2006; Pulkki-Råback, Elovainio, Kivimäki, Raitakari, & Keltikangas-Järvinen 2005). Yet, the mechanisms underlying this relationship are less clear. In fact, in recent years, researchers (Anzman-Frasca, Stifter, & Birch, 2012) have called for an empirical examination of the potential mediators and moderators of the relationship between temperament and weight outcomes over time. Given that the temperament characteristics associated with greater BMI are the same traits associated with poor sleeping patterns (e.g., Bruni et al., 2006; Kushnir, Gothelf, & Sadeh, 2014; Moore, Slane, Mindell, Burt, & Klump, 2011) and obesogenic parental feeding styles (Blisset & Farrow, 2007; McMeekin et al., 2013; Vollrath, Tonstad, Rothbart, & Hampson, 2011), an examination of the role that both play in the relationship between temperament and BMI is warranted.

A thorough examination of the relationships among temperament, sleep, feeding practices, and child BMI requires the consideration shared risk factors. Shared risk factors are child, parental, or environmental characteristics that may place a child at greater risk for difficult temperamental characteristics, poor sleep patterns, obesogenic parental feeding styles, and a higher BMI. Thus, a shared risk factor would account for the relationships among these constructs, suggesting that relationships among temperament, sleep, feeding styles, and BMI are not causal but simply the result of this underlying factor (or “third variable”). Though many shared risk factors and potential covariates will be examined in the proposed study, the role of socioeconomic status (SES) is of particular interest, given that low SES has been associated with difficult temperament and behavioral problems (e.g., Jansen et al., 2009), sleep problems (Buckhalt, 2011), obesogenic parental feeding styles (e.g., Blisset & Haycraft, 2008), and high BMI (McLaren, 2007). Therefore, determining whether the relationships among temperament, sleep problems, feeding styles, and BMI are simply the result of this shared risk factor is necessary to derive meaningful implications from the proposed study.

Prior to examining the substantive hypotheses of the proposed study, validation of measures designed to assess the proposed study’s key constructs (i.e., child sleep and parental feeding styles) will be conducted using confirmatory factor analysis. Validation of key predictors is essential in ensuring that the predictors measured are “accurate” (i.e., measuring what they are intended to measure) and reliable (both over time and across groups). Evidence of both validity and reliability will strengthen confidence in the proposed study’s findings, as any differences found over time and across groups can be attributed to actual differences rather than just instability in the measurements. As discussed by Brown (2006), validity and reliability as assessed by confirmatory factor analysis is important for longitudinal studies.

The purpose of the current study, therefore, is to validate existing measures on children’s sleep (Children’s Sleep Habits Questionnaire – Preschool Version; Goodlin-Jones, Sitnick, Tang, Liu, & Anders, 2008) and parental feeding practices (Parental Feeding Styles Questionnaire; Wardle, Sanderson, Guthrie, Rapoport, & Plomin, 2002) and examine both the concurrent and longitudinal relationships among temperamental characteristics (i.e., reactivity/negativity and effortful control), sleep problems, parental feeding styles, and child BMI in children three- to five-years of age. Moreover, the moderating role of SES will be examined to determine whether the relationships among child temperament, sleep problems, parental feeding practices and BMI are different for children from low or high SES families and whether the relationships simply reflect a shared risk factor. The following sections summarize the literature on the established relationships among these constructs and provide an empirical rationale for the proposed study’s substantive aims and hypotheses, outlined in detail in the *Specific Aims and Hypotheses* section.

Temperament: Terminology and Conceptualization

Various perspectives regarding temperament and its structure exist, though nearly all acknowledge its multidimensional nature. For example, Buss and Plomin (1975) assert that temperament consists of differences in three areas: emotionality, activity, and sociability, whereas Thomas and Chess (1977) defined temperament as made up of multiple components including motoric activity, mood expression, adaptability, persistence, and distractibility. Complementary to these earlier multi-dimensional perspectives, Rothbart and Bates (2006) established the broadest, most encompassing definition of temperament, stating that temperament is made up of individual differences in both reactivity and effortful control/self-regulation (hence forth referred to as effortful control). Reactivity refers to how easily an infant and/or child is aroused both affectively and physically, including arousal thresholds, intensity of arousals, and both rise and recovery times (Rothbart & Bates, 2006). Typically, highly reactive children are those characterized by high negativity (e.g., sadness, anger/frustration, low levels of soothability). The effortful control component of temperament refers to both the conscious and unconscious processes that are used to modulate the reactive component of temperament (Rothbart & Bates, 2006). Importantly, temperamental self-regulation is global in nature, consisting not only of behavioral or affective regulation, but also physiological and attentional self-regulation (Rothbart & Bates, 2006; Vohs & Baumeister, 2011).

Individual differences in both reactivity and effortful control aspects of temperament are present early in the first year of life and are thus, posited to be biologically based and rather enduring overtime (Rothbart & Bates, 2006). However, the developmentally dynamic nature of temperament and its ability to change has also been acknowledged (Goldsmith et al., 1987). In fact, at the 1987 round table discussion on the nature of temperament, all major temperament researchers agreed that the expression of temperament is dependent on the environment and past experiences (Goldsmith et al., 1987), and this perspective has been reiterated in the most recent definition of temperament (Shiner, Buss, McClowry, Putnam, Saudino, & Zentner, 2012). Indeed, research examining continuity and change of both the reactivity and regulatory components of temperament found that family functioning and parental competence predicted a significant amount of change (36% of the variance) in temperamental characteristics (Braungart-Rieker & Stifter, 1997). Moreover, Lengua and Kovacs (2005) found that temperament and parenting have bi-directional influences on one another, such that a child's negative reactivity invokes inconsistent parental discipline, which in turn, increases child negative reactivity over time. Other research demonstrates the malleable nature of children's effortful control (Kochanska & Aksan, 2006). Together, these findings demonstrate that the expression of temperament can change based on parenting practices and other environmental and individual factors and is, thus, a suitable target for intervention.

Temperament in the proposed study is conceptualized according to the Rothbart and Bate's (2006) formulation of temperament given their emphasis on reactivity and effortful control, both of which are relevant to the risk of obesity (Darlington & Wright, 2006; Schlam, Wilson, Shoda, Mischel, & Ayduk, 2013). Indeed, both temperamental effortful control and reactivity affect the development of later self-control abilities (Wills & Dishion, 2010). A child with effective effortful control abilities is better able to learn, self-sooth, and adapt to new situations. A child who is not highly reactive will likely have a more positive relationship with parents and will free up attentional resources to learn how to manage difficult emotions (Southam-Gerow & Kendall, 2002). Thus, low reactivity and high effortful control abilities lay the foundation for later self-control abilities, such as self-monitoring, delay of gratification, and emotion regulation (Raffaelli, Crockett, & Shen, 2005), factors related to obesity (Schlam et al., 2013). However, these more complex self-control abilities are not easily assessed in children under the age of five (Wills & Dishion, 2010). The underlying temperamental characteristics, however, such as reactivity and global effortful control are measureable (Wills & Dishion, 2010). Thus, given that temperamental reactivity and effortful control are measurable, modifiable, and related to later self-control abilities, these temperamental characteristics will be the focus of this study.

Relationship between Temperament and Child BMI

Numerous studies have demonstrated relationships among both the reactivity/negativity and effortful control components of temperament and infant and child weight. The first study to examine the relationship between temperament and infant weight gain (Carey, 1985) indicated that those rated highest on the reactivity/negativity component of temperament were also those characterized as the most rapid weight gainers between six and 12 months of age. Further corroborating these findings, Riese (1994) examined temperamental differences in infant twins discordant for weight (i.e., 15% difference) and found that the larger twin was consistently rated as more difficult to soothe, more negative/irritable, and more active during their sleep. More recent longitudinal studies with infants confirm these findings, with a more difficult/negative temperament associated with rapid weight gain in the first six months of life (Darlington & Wright, 2006; Niegel, Ystrom, & Vollrath, 2007).

Researchers have also explored, albeit to a lesser extent, the relationship between temperamental characteristics and BMI beyond infancy. For example, Anzman & Birch (2009) found that infants who were more easily soothed had healthier skinfold thicknesses in childhood, whereas Agras and colleagues (2004) found that negativity at five years of age predicted one's risk for obesity four and a half years later. Pulkki-Råback and colleagues (2005) examined the relationship between negative emotionality and BMI over the course of 18 years and found that negative emotionality in middle childhood predicted increases in BMI in adulthood, even after controlling for numerous childhood and adulthood risk factors for obesity. Combined, therefore, the majority of studies on this topic with both infants and children suggest that negative reactivity in childhood is related to later obesity risk in both childhood and adulthood.

In addition to reactivity/negativity, the effortful control/self-regulation component of temperament has also been implicated in obesity development (Johnson & Birch, 1994). In fact, self-regulation has been the focus of much research in both children and adults that suggests that overweight and obese individuals likely have diminished capabilities to self-regulate, especially in regard to their eating behavior (Fisher & Birch, 2002; Johnson & Birch, 1994). Importantly, however, self-regulation of eating behavior is not unique in its relationship to obesity-risk, as failure to self-regulate in behavioral tasks unrelated to eating (e.g., waiting to touch a toy) are also associated with weight gain throughout childhood and adolescence (Francis & Susman, 2009). Other longitudinal research confirms these findings, demonstrating that deficits in self-regulatory abilities in middle childhood are related to greater weight gain in adolescence (Anzman-Frasca et al., 2012; Evans, Fuller-Rowell, & Doan, 2012).

A variety of explanations have been put forth as to why temperamental characteristics and BMI are related. First, it is possible that children who are highly reactive and/or have low effortful control abilities may elicit a “feeding-to-soothe” response from their parents via their frequent displays of distress (Anzman-Frasca et al., 2012). This feeding strategy, often termed “emotional feeding,” may disrupt children’s innate ability to eat in response to hunger and satiety cues, making it more likely that they will instead eat in response to emotions (Anzman-Frasca et al., 2012). Moreover, children who have difficulty with global self-regulatory abilities may also experience difficulties resisting highly palatable (i.e., high fat, high sugar) foods (Anzman-Frasca et al., 2012). Alternatively, a third variable may be influencing both temperament and weight outcomes, such as poor sleep patterns. The following sections, therefore, summarize how both parental feeding styles and sleeping patterns may be implicated in this relationship.

Relationships among Temperament, Parental Feeding Practices, and BMI

One potential mechanism underlying the relationship between temperament and BMI is parental feeding practices. Children characterized as having a difficult temperament are more likely to experience feeding difficulties, such as picky eating and food refusals (Haycraft, Farrow, Meyer, Powell, and Blissett, 2011; Jacobi, Agras, Bryson, and Hammer, 2003), expressions of distaste (Forestell & Mennella, 2012), and a higher frequency of tantrums in response to feeding (McMeekin et al., 2013). Such behaviors elicit specific feeding styles from parents, such as using food to placate (McMeekin et al., 2013) or to discipline (i.e., withholding food as a punishment for misbehavior and using food as a reward for good behavior; Wardle et al., 2002). Blissett and Farrow (2007) also demonstrated that parents reported being less restrictive with children rated as more difficult, further suggesting that these parents were potentially using food as a method to appease their children. Such strategies were evident in another study, which found that highly reactive/negative children were more likely to be fed sweet foods and drinks at night by their mothers (Vollrath et al., 2011). Though fewer studies have examined the relationship between the effortful control component of temperament and parental feeding practices, Tan and Holub (2011) found that parents were more likely to use highly restrictive feeding practices with children who had lower self-regulatory abilities, such as inhibitory control. Moreover, Horn and colleagues (2011) conducted a sibling study and found that parents used more restrictive feeding styles for the sibling who was rated as less persistent (i.e., more distractible).

A number of limitations, however, should be considered when interpreting the results of the above studies. First, only one study (Blisset & Farrow, 2007) was longitudinal and thus, findings from the other studies provide no casual evidence for the relationship between temperament and feeding practices. Moreover, some of these studies (Blisset & Farrow, 2007; Horn et al., 2011) failed to control for important potential confounders of the relationship between child temperament and parental feeding practices, such as socioeconomic status and parental weight, which is particularly problematic given that research suggests that feeding practices differ by SES (Baughcum et al., 2001) and between obese and non-obese mothers (Wardle et al., 2002). Moreover, Vollrath and colleagues (2011) controlled for a number of important confounders, such as child's weight-for-height, but this was not measured objectively and it has been well-documented that parents are poor reporters of the child's weight status (Lundahl, Kidwell, & Nelson, 2014). Thus, while research is beginning to suggest links between temperament and feeding practices, more rigorous, longitudinal research is needed to better explicate this relationship.

Despite these limitations, however, the literature on temperament and parental feeding styles suggests that the reactivity/negativity component of temperament may be associated with emotional and instrumental feeding styles, whereas poor self-regulatory abilities may be associated with more restrictive feeding styles. In regard to the latter, numerous studies have found evidence that parental restriction of children's food intake actually is counterproductive and increases weight gain over time (see Clark, Goyder, Bissell, Blank, & Peters, 2007 for a review). This relationship is hypothesized to reflect the interfering effect that parental restriction has on children's innate ability to self-regulate their own food intake (Anzman & Birch 2009). Indeed, research indicates that parental restriction predicts girls' eating in the absence of hunger (Faith, Scanlon, Birch, Francis, & Sherry, 2004). Despite the amount of research that confirms these findings, however, others have found that maternal control and/or restriction of their children's eating actually predicts weight loss over time (Faith et al., 2003; Robinson, Kieman, Matheson, & Haydel, 2001). Moreover, very limited research has explored the effect that emotional and instrumental feeding styles have on children's weight outcomes over time and the one study that has indicates no relationship (Wardle et al., 2002). Thus, findings on the effect of parental feeding styles on children's weight outcomes remain rather inconsistent or reflect null relationships, suggesting that the effect of parental feedings on child BMI may depend on or interact with other factors, such as child temperament and/or sleep patterns.

Some research has begun to examine the role of parental feeding style as a potential moderator of the relationship between temperament and BMI. For example, Anzman and Birch (2009) examined the relationships among inhibitory control (a component of self-regulation), parental restrictive feeding practices, and children's change in BMI over time. Results revealed that girls experienced the greatest weight gain over time if they were low in inhibitory control and had parents who engaged in restrictive feeding practices, but importantly, neither inhibitory control nor parental feeding practices predicted change in BMI independently (Anzman & Birch 2009). Moreover, Rollins and colleagues (2014a, 2014b) found that children with lower self-regulatory capabilities were more susceptible to the effects that restrictive feeding had on their food intake (i.e., poor self-regulators ate more food when restricted) and weight gain, providing further evidence for the interactive nature of temperament and parental feeding styles. Lastly, other research demonstrates that the relationship between parental feeding to soothe and child weight is greatest for those children that are rated highest in negativity (Stifter, Anzman-Frasca, Birch, & Voegtline, 2011).

Together, the results from these studies suggest that perhaps temperament exerts its influence on obesity risk via parental feeding styles. However, the literature in this area is still very much preliminary and has a number of important limitations to consider. First, the majority of studies have examined only the interactive nature of self-regulatory components of temperament (e.g., inhibitory control) and parental restrictive feeding practices (Anzman & Birch, 2009; Rollins et al., 2014a, 2014b). However, children's negative reactivity impacts parental feeding strategies (Blisset & Farrow, 2007; Vollrath et al., 2011), specifically feeding to soothe. Thus, it is plausible that children who are rated high in negative reactivity and have parents who engage in emotional feeding will be at the greatest risk for weight gain over time. Indeed, Stifter and colleagues (2011) demonstrated this relationship cross-sectionally, but longitudinal investigations are lacking. Moreover, all but one study (Stifter et al., 2011) examined the role of temperament and parental feeding practices on weight outcomes in females only. Thus, very little is known about how these constructs affect the weight outcomes of males. Moreover, all of the cited studies are plagued by small sample sizes, limiting the studies' power to detect individual differences in the effect of child temperament and parental feeding practices on weight outcomes.

Relationships among Temperament, Sleep, and BMI

Though there is emerging evidence for the role of parental feeding styles in the relationship between temperament and BMI, no studies have examined the role of sleep in this relationship. However, much research indicates that infants and children with the same temperamental traits that elicit obesogenic parental feeding practices are also more likely to have sleep problems. For example, studies have found parent-reported difficult temperament to be associated with a greater number of night-wakings in infants and toddlers (Atkinson, Vetere, & Grayson, 1995; Keener, Zeanah, & Anders, 1988), poor sleep patterns as reported by parents (Bruni et al., 2006), and poor sleep quantity and quality as assessed via actigraphy (Sadeh, Lavie, & Scher, 1994). Moreover, in a sample of children with diagnosed sleep disorders (e.g., obstructive sleep apnea, parasmonias), Owens-Stively and colleagues (1997) found that temperamental difficulty was associated with more severe sleep disturbances. The relationship between reactivity/negativity and sleep problems has been demonstrated in adolescent samples as well (e.g., Moore et al., 2011).

In addition to reactivity/negativity component of temperament, the effortful control component of temperament also relates to child sleep problems. Aviezer and Scher (2013) demonstrated that lower effortful control was related to more mother-reported sleep problems in children ranging from nine months to four years old. Kushnir and colleagues (2014) also found that children who demonstrated the lowest abilities on measures of effortful control were the most likely to experience significant nighttime fears. Moreover, research utilizing both subjective (parent-report) and objective measures of self-regulation (vagal regulation as assessed via respiratory sinus arrhythmia) found that six- to 12-year old children with poorer self-regulatory abilities had more objectively assessed sleep problems, shorter sleep duration, and greater activity throughout sleep (El-Sheikh & Buckhalt, 2005). These latter results suggest that the link between child temperament and sleep patterns is not reflective simply of biases in parent-reports of both constructs.

The documented relationship between temperament and sleep is posited to reflect both direct and indirect mechanisms. Dahl (2005) hypothesized that individual differences in both sleep-wake behavior and temperamental characteristics share biological underpinnings, specifically in regard to central nervous system arousal regulatory processes. For example, children high in reactivity/negativity and low in effortful control are characterized by having low sensory thresholds, which may make it more likely that they will easily awaken to external or internal stimulation during sleep, which would thus result in fragmented and poor quality sleep (Sadeh et al., 1994). Indirectly, individual differences in temperament characteristics may influence parent-child interactions, especially in the domain of sleep, which requires much parental intervention during early childhood (Gartstein, Potapova, & Hsu, 2013). For example, if a child with a difficult temperament has an insensitive parent, a lack of goodness-to-fit may result in less effective parental responses to problems surrounding sleep, which may intensify such sleep problems (Gartstein, Potapova, & Hsu, 2013).

Though it is likely that temperament influences sleeping patterns or that both share biological underpinnings, it is equally probable that sleep influences temperament. For example, poor sleep quantity and/or quality may negatively affect the restorative power of sleep which may subsequently heighten a child's responsiveness to sensory stimulation and/or increase their 'difficultness' the following day (Sadeh, Lavie, & Scher, 1994). Indeed, research supports this proposition. Novosad and colleagues (1999) found that sleep patterns in the first two days of life predicted temperament at eight months, such that the most reactive infants at eight months of age were those with the most erratic sleep patterns during the first two days of life. Relatedly, Zuckerman and colleagues (1987) demonstrated that sleep problems at eight months of age significantly predicted reactivity and behavioral problems at three years of age. Notably, research indicates that after children with disrupted sleep patterns undergo treatment for their sleep problems, their behavioral reactivity improves, including their feeding interactions with their mothers (Minde, Faucon, & Falkner 1994). In regard to the self-regulatory component of temperament, research indicates that all self-regulatory systems, including regulation of arousal (e.g., sleep-wake states), emotional, attentional, physiological, behavioral, and cognitive states, are interdependent and affect one another (Vohs & Baumeister, 2011). Indeed, research suggests that poor sleep patterns predict eating in the absence of hunger (Hogenkamp et al., 2013), impaired executive functions, such as attentional capacities (Beebe, Fallone, Godiwala, et al., 2008), impulse control (Paavonen et al., 2009), and emotion regulation (Walker & van Der Helm, 2009). Together, therefore, the discussed research suggests that the relationship between temperament and sleep is likely bidirectional.

Given the relationship between temperament and sleep, it is probable that the relationship between temperament and BMI is partly accounted for by sleep, as poor sleep patterns have been associated with a higher BMI in both children (Agras et al., 2012) and adults (see Speigel, Tasali, Leproult, Van Cauter, 2009 for a review). In fact, several studies provide evidence for a dose-response relationship between sleep and obesity risk, with fewer hours asleep associated with increasing odds of obesity (Bell & Zimmeram, 2010; Chaput, Brunet, & Tremblay, 2006; Gupta, Mueller, Chan, & Meininger, 2002; Taheri, 2006). Though research has yet to document the exact mechanisms underlying this relationship, a variety of mechanisms have been proposed. For example, greater time spent awake in an obesogenic environment may result in more time and opportunities to consume additional, excess calories (Sivak, 2006). Moreover, disruptions in sleep patterns alter the levels of appetitive hormones (e.g., leptin and ghrelin), resulting in a hormonal state that may predispose one to overeating (Spiegel, Tasali, Leproult, & Van Cauter, 2009). It is also possible, however, that poor sleep diminishes self-regulatory abilities across various functional domains, such as impairing children's ability to self-regulate their eating behavior and appetite (Anzman & Birch

2009) and/or tolerance for distress (Sadeh, Lavie, & Scher, 1994). Especially in regard to the latter, poorer self-regulation of distress or high reactivity may evoke "feeding-to-soothe" responses from parents. This pathway, however, has yet to be empirically examined.

Examination of Covariates and Shared Risk Factors

When examining the relationships among child temperament and sleep patterns, parental feeding styles, and child BMI over time, it is important to consider and control for other factors that may be related to many or all of these constructs. Potentially important factors include child characteristics (e.g., sex, age), parental characteristics (e.g., BMI, mental health), attitudes or beliefs (e.g., concern for child overweight, perceived feeding problems), and behaviors (e.g., whether or not they breastfed their child), in addition to the family's SES. In regard to child characteristics, parental feeding styles may differ by child sex, with some research indicating that parents engage in more restrictive and controlling feeding practices with their female children (Fisher & Birch, 1999). It has been hypothesized that parents are more restrictive when feeding their female children because the ideal body size for females is thinner than the ideal body size for males (Blisset, Meyer, & Haycraft, 2006). Moreover, it is possible that feeding practices may differ by child age. For example, parents may engage in more controlling feeding practices with younger children, but as their children age and are more capable of feeding themselves, it is possible that parents afford them greater autonomy. Research, however, has yet to definitely examine this.

A number of parental characteristics, attitudes and beliefs, and behaviors may also influence the observed relationships among child temperament, sleep, parental feeding practices, and child BMI. First, parental BMI has been established as one of the strongest predictors of child weight (Wardle et al., 2002) and thus, it is essential to control for when predicting factors influencing children's weight gain over time. Moreover, parental BMI has been associated with their feeding styles, with research demonstrating that obese mothers are less likely to control their child's feeding interactions (Baughcum et al., 2011), and more likely to use to food to soothe (Wardle et al., 2002). Parental mental health (i.e., depression) may also be an important covariate, as research indicates that mothers with depression report using less responsive feeding practices (Hurley, Black, Papes, & Caufield, 2008). Moreover, it is plausible that parents with depression also perceive their child as being more difficult (McMeekin et al., 2013), especially in regard to the feeding relationship. For example, parental depression may be related to parental perceptions of their child's "pickiness" or fussiness during mealtime, which is in turn, associated with greater control of the child's intake (Galloway, Fiorito, Lee, & Birch, 2005). Thus, parental perceptions of their children's eating problems is also an important covariate to consider, as is parental concern of child under or overweight. Parents who rate their children as 'difficult' are more likely to be concerned about their child's weight status (McMeekin et al., 2013), and parents who are concerned about their children's weight are more likely to restrict their children's food intake (Birch & Fisher, 2000; Spruijt-Metz, Lindquist, Birch, Fisher, & Goran, 2002; Webber, Hill, Cooke, Carnell, & Wardle, 2010), thus placing 'difficult' children at even greater risk for problematic feeding practices. Lastly, whether or not the child was breastfed will be controlled for, given that breastfed is a protective factor against obesity (Owen, Martin, Wincup, Smith, & Cook, 2005) and may also encourage feeding styles that are more responsive rather than controlling in nature (Wasser et al., 2011; Farrow & Blisset, 2006; Hendricks, Briefel, Novak, & Ziegler, 2006).

Perhaps the most important covariate for the proposed relationships, however, is SES. In fact, it is possible the relationships among difficult temperament, poor sleep patterns, negative feeding styles, and greater BMI are not casual at all, but simply the result of a shared risk factor, namely, low SES. The association between low SES and higher BMI for both children and adults has been well-established (McLaren, 2007), as has the association between low SES and problematic feeding practices. For example, a study examining factor score differences by family income on the Preschooler Feeding Questionnaire found that parents in the low income group were more likely to be obese, their children were more than twice as likely to be overweight, and the parents pressured their child to eat more frequently, had less structure during meal time, and engaged in more age-inappropriate feeding interactions (e.g., providing complementary foods before a child is ready; Baughcum et al., 2011). Others have also demonstrated the negative relationship between family income and/or maternal education and pressuring child to eat (Francis & Susman, 2001), restricting and monitoring child's intake (Blisset & Haycraft, 2008, McPhie et al., 2011), and using food as a reward (Musher-Eizenman, De Lauzon-Guillain, Holub, Leporc, & Charles, 2009). Moreover, low SES has consistently been associated with behavioral problems and difficult temperament in childhood (e.g., Jansen , et al., 2009), in addition to child sleep problems (Buckhalt, 2011). It is hypothesized that these relationships exist due to the stressful and often chaotic nature of low income households. Thus, it appears as though problems with temperament, sleep, feeding practices, and BMI all tend to congregate in low SES families. Determining, therefore, whether the relationships among temperament, sleep problems, feeding styles, and BMI are simply the result of disadvantaged living is necessary to derive meaningful implications from the proposed study.

CHAPTER 2: PRIMARY PURPOSE AND RESEARCH HYPOTHESES

The overarching goal of this study is to better understand the relationship between child temperament, parental feeding styles, child sleep problems, and child BMI. To do this, rigorous methodology and statistics were employed to capture both the concurrent and longitudinal relationships among these constructs in a population of healthy preschoolers. A greater understanding of the relationships among preschoolers' temperament, sleep patterns, parental feeding styles, and child BMI is important for informing both preventative and treatment interventions for childhood obesity. As summarized, relationships have been demonstrated among temperament, sleep, feeding practices and child BMI, but research has yet to examine the interactive nature of these constructs. Moreover, much of the research in this area has been conducted in infant samples, leaving many unknowns regarding the relationships among these constructs in preschool-aged children. However, research suggests that examining risk factors for obesity during the preschool period is essential, as the risk for obesity may be 'programmed' during this time (Cole, 2004; Taylor, Grant, Goulding, & Williams, 2005). Moreover, the prevalence of obesity (Ogden, Carroll, Kit & Flegal, 2014) and obesogenic behaviors (e.g., high fat diets and sedentary lifestyles; Reilly et al., 2004) in preschool aged children have experienced only minor improvements in recent years. Thus, intervening early, before these obesogenic behaviors become habitual, is essential for preventing weight gain trajectories. Indeed, research suggests that the obesogenic behaviors of preschool age children are more malleable than those of older children and thus, preschool age children are more likely to have successful treatment outcomes (Haemer, Ranade, Barón, & Krebs, 2013).

The findings from this study, therefore, provide important implications for early-life obesity prevention and treatment efforts, such as including strategies to foster children's self-regulatory skills, building parental tolerance for difficult temperamental characteristics, and incorporating sleep and feeding education. For example, research (Israel, Guile, Baker, & Silverman, 1994) indicates that interventions designed to improve children's general self-regulatory abilities (e.g., goal-setting, self-reward, problem solving) have a positive effect on children's weight status (e.g., reduction in percentage overweight), in addition to the children's attitudes regarding food and television. Thus, including self-regulation strategies in intervention efforts may improve both a child's ability to self-regulate food intake, but also to engage in more general regulatory behaviors such as self-control and delay of gratification. The results from this study also demonstrate the importance of building parent's distress tolerance skills for their children's difficult temperament characteristics, such as developing strategies to manage temper tantrums and fostering acceptance and mindfulness skills. Lastly, findings shed further light on the importance of including sleep hygiene and feeding education in early childhood obesity interventions. Findings from this study also have important implications for understanding the role of SES in the relationships between child temperament, sleep patterns, parental feeding styles, and child BMI.

The central hypothesis of the present study was that greater reactivity and poorer effortful control would have direct effect on child BMI, as well as an indirect effect through problematic feeding styles and greater sleep problems, both concurrently and longitudinally. Moreover, it was expected that child sleep problems and obesogenic parental feeding styles (e.g., emotional feeding, instrumental feeding, and control over eating) would increase negative affectivity and self-regulation problems over time, further strengthening the relationship between child temperament and BMI. Before testing substantive hypotheses related to the interactive relationships among temperament, sleep, feeding practices, and BMI, however, confirmatory factor analysis (CFA) was conducted. CFA is used to reduce the number of observed variables (i.e., items) into latent factors (i.e., subscales) based on commonalities in the data (McArdle, 1996). Unlike other commonly used methods of data reduction (e.g., exploratory factor analysis), CFA allows for a statistical comparison between alternative a priori hypothesized models (McArdle, 1996) in order to find the best fitting model.

Specific Aims and Hypotheses

Specific Aim 1: Determine the factor structure of the Parental Feeding Style Questionnaire (PFSQ) and Children's Sleep Habits Questionnaire-Preschool/Toddler Version (CSHQ-PV) using confirmatory factor analysis:

Hypothesis 1a: Consistent with the intended factor structure (Wardle, Sanderson, Guthrie, Rapoport, & Plomin, 2002), the best fitting model for the PFSQ's factor structure was hypothesized to consist of four factors: Control over Eating; Prompting and Encouragement; Instrumental Feeding; and Emotional Feeding.

Hypothesis 1b: Given previous literature demonstrating variance in the magnitude of loadings on feeding constructs between low and high SES parents (Baughcum et al., 2011), it was hypothesized that only configural invariance would hold for the PFSQ across SES groups.

Hypothesis 1c: Consistent with the intended factor structure (Goodlin-Jones, Sitnick, Tang, Liu, & Anders, 2008), the best fitting model for the CSHQ-PV was hypothesized to consist of 8 factors: Bedtime Resistance, Sleep Onset Delay, Sleep Duration, Sleep Anxiety, Night Wakings, Parasomnias, Daytime Sleepiness and Sleep Disordered Breathing.

Hypothesis 1d: Given the higher prevalence of childhood sleep problems in low SES populations (Buckhalt, 2011), it was hypothesized that only configural invariance would hold for the CSHQ-PV across SES groups.

Specific Aim 2: Explicate the concurrent associations among child temperament (i.e., reactivity/negativity and effortful control), sleep problems, parental feeding practices, and BMI, after controlling for key covariates.

Hypothesis 2: Given that specific child temperament characteristics are associated with sleep problems (e.g., Bruni et al., 2006) and problematic feeding practices (e.g., Blissett & Farrow, 2007), both of which are associated with greater BMI (Agras et al., 2012; Clark et al., 2007), it was hypothesized that child temperament characteristics (i.e., high reactivity/negativity and low effortful control) would have an indirect effect on child BMI via sleep problems and problematic feeding practices (emotional feeding, instrumental feeding and control over feeding).

Specific Aim 3: Determine the role of child sleep and parental feeding practices in longitudinal associations between child temperament and BMI, after controlling for key covariates.

Hypothesis 3a: Consistent with prior literature that suggests that child temperament characteristics influence parental feeding styles (Blisset & Farrow, 2007) and that specific parental feeding styles can disrupt a child's ability to self-regulate (Anzman & Birch 2009), it was hypothesized that that greater reactivity/negativity and poorer effortful control Time 1 (T1) would predict parental control over eating, instrumental feeding, emotional feeding at Time 2 (T2) (direct effect) and parental control over eating and emotional feeding at T2 would predict poorer effortful control, but not reactivity/negativity, at T2 (direct effect).

Hypothesis 3b: Consistent with prior literature demonstrating that child temperament predicts sleep problems (Bruni et al., 2006), and sleep problems predict temperamental characteristics (Novosad et al., 1999), it was hypothesized that greater reactivity/negativity and poorer effortful control at T1 would predict poorer sleep indicators at T2 (direct effect) and poorer sleep indicators at T1 would predict greater reactivity/negativity and poorer effortful control at T2 (direct effect).

Hypothesis 3c: Given that specific child temperament characteristics are associated with sleep problems (Bruni et al., 2006) and problematic feeding practices (Blisset & Farrow, 2007), both of which have been associated with an increase in BMI over time (e.g., Bell & Zimmeram, 2010; Rollins et al., 2014a), it was hypothesized that child temperament (i.e., higher reactivity/negativity and poorer effortful control) at T1 would have an indirect effect on T2 child BMI via poorer sleep indicators at T2 and more problematic T2 parental feeding styles (i.e., emotional feeding, instrumental feeding, and control over feeding).

Specific Aim 4: Determine the interactive role of SES in the relationships among child temperament, sleep problems, parental feeding styles, and child BMI.

Hypothesis 4: Given that temperamental difficulties (Jansen et al., 2009), sleep problems (Buckhalt, 2011), problematic parental feeding styles (Blisset & Haycraft, 2008), and greater BMI (McLaren, 2007) are more prevalent in low SES populations, it was hypothesized that SES would interact with the hypothesized relationships among child temperament, sleep problems, parental feeding practices and child BMI (as outlined above), such that these relationships would be stronger for children in low SES families compared to those in high SES families.

CHAPTER 3: METHOD

Participants

Participants at T1 included 297 preschoolers and their accompanying consenting caregivers who presented to Lincoln Pediatric Dentistry in Lincoln, Nebraska for a dental visit. To be eligible to participate, children must have been between the ages of 3 and 5, accompanied by a parent/legal guardian, and the parent must have been able to speak and read English. Children ranged in age from 3 to 5 years (M = 4.48; SD = 0.88) and roughly half of the sample was female (N = 147; 49.5%). The youth were predominantly white (N = 224; 75.7%), with the remaining identifying as Hispanic American (5.4%), African American (4.4%), Asian American (3.4%), Biracial (9.1%) or Multiracial (2.0%). Child zBMI ranged from -4.87 to 4.08 (M = 0.35, SD = 1.16). T1 child demographics are summarized in Table 1.

Parents at T1 ranged in age from 21 to 60 years (M = 33.47; SD = 6.24), with the majority of respondents mothers (N = 253; 85.2%). Parent BMI ranged from 16.93 to 50.86 (M = 27.30, SD = 6.09). Annual household income ranged from $474.00 to $600,000.00 ($M$ = $77,478.15, SD = $63.714.49), with an average income-to-needs ratio of 3.18 (SD = 2.68; ranging from 0.03 to 9.29). Parents were predominately White (N = 242; 81.8%), with the remaining identifying as Hispanic American (7.1%), African American (2.7%), Asian American (2.4%), Native American (0.7%), Biracial (4.7%), and Multiracial (0.7%). Parents' highest level of education varied, with 30.6% earning their Bachelor's degree, 26.1% high school graduates, 25.1% Associates degree, 12.0% Master's degree, 3.4% less than high school, and 2.7% Doctorate degree. The majority of responding parents were married (70.5%), with the remaining single, never married

(17.2%), single, divorced (6.5%), cohabiting (4.2%), or separated (1.5%). A total of 19.9% of parents reported a current or prior depression diagnosis. The majority of parents reported that their child had been breastfed (75.3%). T1 parent demographics are summarized in Table 2.

At Time 2 (T2), participants included 188 children and their accompanying caregivers who consented to participate in the longitudinal study and arrived to Lincoln Pediatric Dentistry for their 6-month follow-up appointment. At T2, children ranged in age from 3.3 to 6.5 years (M = 5.07; SD = 0.90) and roughly half of the sample was female (N = 98; 51.1%). The children were predominantly white (N = 150; 79.8%), with the remaining identifying as Hispanic American (5.9%), African American (5.3%), Asian American (5.3%), or Biracial (3.7%). Child zBMI ranged from -3.30 to 3.95 (M = 0.37, SD = 1.17). T2 child demographics are also summarized in Table 1.

Parents at T2 ranged in age from 22 to 62 years (M = 34.87; SD = 6.22), with the majority of respondents mothers (N = 142; 76.8%). Parent BMI ranged from 17.58 to 54.25 (M = 28.10, SD = 7.68). Annual household income ranged from $5,000 to $700,000.00 ($M$ = $81,397.13, SD = $74,296.74). Parents were predominately White (N = 157; 84.4%), with the remaining identifying as Hispanic American (3.2%), African American (4.3%), Asian American (2.7%), Native American (2.2%), and Biracial (2.7%), and Multiracial (0.5%). The majority of responding parents were married (72.7%), with the remaining single, never married (12.7%), single, divorced (8.5%), cohabiting (5.5%), or separated (0.6%). A total of 21.8% of parents reported a current or prior depression diagnosis. The majority of parents reported that their child had been breastfed (80.8%), with an average length of breastfeeding of 7.33 months (ranging from 0 to 40 months). T2 parent demographics are summarized in Table 2.

Procedures

All children aged three to five and their accompanying parent/legal guardians were recruited to participate in the study during their regularly scheduled dental visit to Lincoln Pediatric Dentistry. After checking in for their appointment, each child-parent pair was approached by a trained research assistant who provided information about the study. Parent consent was obtained. Parents could opt to participate one time only, or opt to continue participation during their next six-month visit. Of the 297 parents who participated in the study at T1, 271 (91.2%) opted to continue participation during their next 6-month visit. After consent was obtained, the research assistant provided the parents with a battery of written questionnaires to complete while their children saw the dentist. The date and time of the participants who agreed to participate in the follow-up study was provided to the primary investigator by Lincoln Pediatric Dentistry, and research assistants approached the participants at these times and approached those families that had agreed to complete the follow-up study. Of those that opted to continue participation, 58 (21.4%) did not show for their scheduled appointments and 25 (9.25%) decided to no longer participate, resulting in a total sample of 188 for T2.

At both T1 and T2, parents completed several measures about their child's health and behavior (summarized below). All measures were administered by the research assistant, who was available to answer any questions, if necessary. After completing their questionnaires, parents placed their completed forms directly into an envelope for completed measures that was collected by the researchers. Questionnaires were administered in the waiting room of the Lincoln Pediatric Dentistry, though quiet rooms were available upon request. Child weight and height were objectively measured using a high-quality digital scale and stadiometer by a dental hygienist before the child's dental appointment at each of the data collection occasions in order to calculate the child's BMI (weight [kg] / [height [m]]^2).

Measures

Demographics. Information regarding both parent and child demographics were collected as part of the assessment packet. This information included parental age, sex, ethnicity, and education and marital status. In addition, parents provided self-report estimates of their height and weight, as well as reported their annual household income and the number of individuals living in the home. Annual household income and number of individuals in the home was the used to calculate income-to-poverty ratio, which represents the ratio of family income to the appropriate poverty threshold based on the number of individuals/children in the home (United States Census Bureau, 2015a, 2015b). An income-to-poverty ratio of 1.00 or greater indicates income above the poverty level, where as a ratio of less than one indicates income below the poverty level. Parents were also asked the following yes-no questions: (1) Are you concerned about your child's current weight status? (2) Is your child a picky eater? (3) Have you ever been diagnosed with depression? and (4) Did you breastfeed your child? At T2, parents were asked to indicate how many months their child was breastfed. Child demographics included age, sex, and ethnicity.

Parental Feeding Style Questionnaire (PFSQ; Wardle et al., 2002). The PFSQ is a 27-item parent-report measure assessing the feeding styles of parents who have children three years and older. The questionnaire was originally developed using literature on parental feeding styles, established questionnaires on feeding, and semi-structured interviews with parents and was subsequently shortened, using only the most "internally coherent" scales (as assessed by Cohen's alpha coefficient). These scales consist of Instrumental Feeding (e.g., *If my child misbehaves I withhold his/her favorite food*), Emotional Feeding (e.g., *I give my child something to eat to make him/her feel better when s/he has been hurt*), Prompting and Encouragement, (e.g., *I encourage my child to try foods that s/he hasn't tasted before),* and Control Over Eating (e.g., *I decide when it is time for my child to have a snack*). Within each scale, items are answered on a 5-point Likert-type scale, ranging from 0 = *I Never Do* to 4 = *I Always Do.* Total scores for each scale are calculated as the mean of the item scores for that scale. Though internal and test-retest reliability coefficients have been calculated and are classically adequate (Wardle et al., 2002), a confirmatory factor analysis has not yet been conducted on the PFSQ.

Children's Behavior Questionnaire- Very Short Form (CBQ-VSF; Putnam & Rothbart, 2006). The CBQ-VSF is a 36-item parent-report measure assessing temperament for children aged three to eight years of age. The very short form was developed in multiple stages using the original CBQ by: (1) excluding rarely endorsed items; (2) including the six items per scale with the highest mean item-total correlations; (3) including only scales for which a minimum alpha of .65 was obtained; (4) conducting principal components analysis and including as many multi-dimensional items per factor as possible; (5) performing content analysis to ensure breadth of content and adequate internal consistency; and (6) creating three subscales consisting of two or three items from each factor. The three subscales include Negative Affectivity (e.g., *Is quite upset by a little cut or bruise)*, Self-Regulation/Effortful Control (e.g., *When drawing or coloring in a book, shows strong concentration*), and Surgency/Extraversion (e.g., *Likes going down high slides or other adventurous activities*). Within each scale, items are answered on a 7-point Likert-type sale, ranging from 1 = *extremely untrue of your child* to 7 = *extremely true of your child*. Total scores for each scale are calculated as the mean of the item scores for that scale. Putnam and Rothbart (2006) demonstrated adequate internal consistency and factor structure for the CBQ-VSF.

Children's Sleep Habits Questionnaire – Preschool/Toddler Version (CSHQ-PV; Goodlin-Jones et al., 2008). The CSHQ-PV is a 33-item parent-report measure designed to screen three- to five-year old children's problematic sleep patterns as defined by the International Classification of Sleep Disorders, Diagnostic and Classification Model (American Academy of Sleep Medicine, 2005). The measure is multiple-choice and consists of eight different subscales including: Bedtime Resistance, Sleep Onset Delay, Sleep Duration, Sleep Anxiety, Night Wakings, Parasomnias, Daytime Sleepiness, and Sleep Disordered Breathing. Most items are answered using a three-point Likert-type scale (*Never*/*Rarely* = 0-1 night per week; *Sometimes* = 2-4 nights per week; *Often/Always*= 5-7 nights per week). The clinical cut-off score for the CSHQ-PV is 41 and is useful in identifying probable sleep problems (Owens, Spirito, & McGuinn, 2000). Adequate validity (as compared to actigraphy) and reliability (based on Cronbach's alpha) for the CHSQ-PV has been demonstrated by Goodlin-Jones and colleagues (2008). Though Sneddon and colleagues (2013) conducted an exploratory factor analysis on the CSHQ-PV, a confirmatory factor analysis has not yet been conducted on this measure.

CHAPTER 4: ANALYTIC RATIONALE

Confirmatory Factor Analyses

The reliability and dimensionality of items assessing (1) parental feeding styles and (2) child sleep problems were examined. First, the internal consistency of the proposed subscales was examined to gather information regarding the overall coherency of the scales (i.e., alpha coefficients), in addition to the discriminatory properties of each item (i.e., corrected item-total correlation). Alpha coefficients are a test of the internal consistency of a scale and range between 0 and 1, with higher estimates indicating that the items in the scale are more likely to be measuring the same concept or construct (though the number of items also influence the estimate of alpha; Tavakol & Dennick, 2011). Acceptable alpha values range from 0.70-0.95 (Bland & Altman, 1997; DeVellis, 2012; Nunnally & Bernstein, 1994). If alpha is low, this could be due to (a) a low number of questions; (b) limited interrelatedness between items; or (c) heterogeneous constructs being assesses (Tavakol & Dennick, 2011). One method of assessing whether items should be removed from a scale to improve alpha is to compute the corrected item-total correlation and remove items with low correlations (≤0.30; Ferketcih, 1991). Thus, for each PFSQ and CSHQ-PV subscale, the alpha coefficient and corrected item-total correlations were computed and examined.

Next, confirmatory factor analysis using robust maximum likelihood estimation with Mplus v6 (Muthén & Muthén, 1998-2012) was conducted to further examine the reliability and dimensionality of the subscales for each measure. All models were identified by setting any latent factor means to 0 and latent factor variances to 1, such that all item intercepts, item factor loadings, and item residual variances were estimated. To evaluate goodness of fit, several indices were used. First, the obtained model χ^2, its scaling factor (in which values different than 1.000 indicate deviations from normality), its degrees of freedom, and its *p*-value (in which non-significance is desirable for good fit) were examined. However, this statistic has some limitations (such as sensitivity to sample size and to violations of the assumption of multivariate normality). Given these limitations, a variety of other indices were also employed. The Root Mean Square Error of Approximation (or RMSEA) is a fit statistic that is parsimony-adjusted that takes into account model complexity (Kline, 2011), and represents the discrepancy between the hypothesized model covariance matrix and the population covariance matrix. Values >0.10 represent poor, <.08 but >.05 represent adequate fit, and values <.05 indicate good fit (Browne & Cudeck, 1993). The 90% confidence interval is provided with the RMSEA to provide information regarding the sampling error, with lower bounds less than .05 and upper bounds less than .08 indicates good fit (Browne & Cudeck, 1993). Also estimated was the standardized root mean square residual (SRMR), in which values equal to or less than 0.08 indicate good fit (Hu & Bentler, 1999). The Comparative Fit Index (CFI) was also estimated, for which values greater than or equal to 0.95 indicate a good fit, values less than 0.95 but greater than 0.90 indicate an adequate fit, and values less than 0.90 indicate a poor fit (Whitley & Kite, 2013).

In addition to examining model fit indices, item factor loadings were examined to identify poorly fitting items. Given that many item loadings fell above the 0.30 cutoff, a conservative cutoff of 0.40 was used for item inclusion (Hair, Anderson, Tatham, & Black, 1998). Moreover, local fit was assessed using the residual correlation matrix in Mplus, which provides the “left-over” item correlations in the correlation metric. Larger residual correlations (in absolute value) indicate areas of potential local misfit. When possible, nested model comparisons were conducted using the rescaled $-2\Delta LL$ with degrees of freedom equal to the rescaled difference in the number of parameters between models (i.e., a rescaled likelihood ratio test).

Path Analyses

Bivariate correlations between the predictors and potential covariates and T1 and T2 outcomes were examined first. Then, a series of path models were estimated via robust information maximum likelihood (MLR) with Monte Carlo integration to examine direct and indirect effects using Mplus v.6. Using MLR, parameter standard errors and significance tests are robust to deviations of normality. Moreover, Monto Carlo integration is a resampling method that draws repeatedly from *a (*independent variable to mediator path*)* and *b* (mediator to dependent variable path) parameter distributions (instead of the data) and then computes point estimates, standard errors, and confidence intervals from these distributions (thus, allowing for non-normal data). Given that there is no observed covariance matrix to compare the model predictions to, there are no standard absolute fit statistics. Convergence was obtained with no issues on all models. Standardized coefficients and standard errors are reported in all tables. The amount of explained variability in the final models is represented by the R^2 for each endogenous variable.

CHAPTER 5: RESULTS

Specific Aim 1: Confirmatory Factor Analyses of Key Measures

Hypothesis 1a: Consistent with the intended factor structure (Wardle, Sanderson, Guthrie, Rapoport, & Plomin, 2002), the best fitting model for the PFSQ's factor structure was hypothesized to consist of four factors: Control over Eating; Prompting and Encouragement; Instrumental Feeding; and Emotional Feeding.

Descriptive Statistics. Item level statistics are reported in Table 3, including minimum, maximum, mean, standard deviation, skewness, and kurtosis estimates. Notably, a number of the variables are highly skewed/kurtotic, indicating non-normal distributions. As such, all proceeding analyses will be conducted using estimators robust to deviations in non-normality.

Internal Consistency of PFSQ. The Control over Feeding subscale (10 items) had an alpha coefficient of 0.789. Corrected item-total correlations are reported in Table 4. Item 1 had a low corrected item-total correlation, suggesting that this item may need to be removed. The Emotional Feeding subscale (5 items) had an alpha coefficient of 0.812 (corrected item-total correlations in Table 4). No items had an item-total correlation ≤ 0.30. The alpha coefficient for the Encouragement and Prompting subscale (8 items) was 0.741. Again, item-total correlations are reported in Table 4. The Instrumental Feeding subscale (4 items) had an alpha coefficient of 0.600 and corrected-item total correlations (Table 4) indicate that Item 3 should be considered for removal.

Confirmatory Factor Analysis of PFSQ. Confirmatory factor analysis was then used to test the goodness of fit of competing models of the structure of the PFSQ. A total of 5 models were tested. Model 1 tested the original four-factor solution as proposed by the original study authors (see Table 5 for item loading estimates). Model 2 also tested a four factor-solution, but with the items that had item-total correlations ≤0.30 and factor loadings <0.40 removed. A summary of fit indices for these models is shown in Table 6. Fit for Model 1 was poor according to all fit indices except for the SRMR. After removing poorly fitting items, fit indices CFI indicated improvement in fit for Model 2, but still fit poorly overall.

Three items within the Encouragement and Prompting Subscale also had loadings <0.40. Rather than removing these preemptively (given that they did not also have item-total correlations ≤0.30), inspection of the wordings of these items indicates potential heterogeneity in the subscale, as some items (items 3, 5, 6, 8) pertained to encouragement of variety, while other items (items 1, 2, 4, 7) related to prompting eating, in general. Thus, Model 3 tested a five factor model: Control Over Feeding, Emotional Feeding, Encouragement of Variety, Prompting of Eating and Instrumental Eating. Nested model comparison with Model 2 indicated that the five-factor model fit significantly better than the four-factor model (*rescaled -2ΔLL* = 69.507, $df = 4$, $p < 0.001$), suggesting that the two encouragement subscales represent two different constructs (correlation between factors was 0.604). All indices aside from SRMR, however, still indicated less than adequate fit (see Table 6).

Inspection of factor loadings and modification indices indicated further potential misfit within the Encouragement subscales, as the two "praise" items in both subscales were more related with each other than the model was allowing them to be. Rather than adding residual covariances which capitalize on the error within a sample, these items were simply removed as praising a child for eating is theoretically different than encouraging a child to eat. Thus, Model 4 was the same as Model 3, but with the praise items removed. Fit indices indicated improvement in model fit, though still not acceptable according to all indices (Table 6).

Lastly, another source of misfit identified was within the Control Over Feeding subscale, as the type of control assessed (i.e., control over when, what, or where the child eats) added heterogeneity to the scale. While control over when and what were assessed using overlapping questions (e.g., "*I decide what my child eats between meals*" reflects both what the parent allows the child to eat between meals and whether the child is allowed to eat between meals), the remaining "where" items (i.e., "*I insist that my child eats at the table*" and "*I allow my child to wander during meals*") reflect neither what nor when the child eats. As such, these items were removed (Model 5). Model fit again indicated an improvement in model fit and was acceptable according to all indices (see Table 6). Examination of normalized residuals and modification indices suggested no further modifications. Moreover, there did not appear to be any further theoretically justifiable modifications to be made to the model. Item-total correlations and alphas were calculated again. No item-total correlations were ≤0.30 for any subscale. Estimated item factor loadings for the final model are reported in Table 7. The Emotional Feeding subscale was covaried significantly with the Control over Feeding ($\beta = -0.224$, $p = 0.003$), Encouragement of Variety ($\beta = -0.325$, $p < 0.001$), and Instrumental Feeding subscales ($\beta = 0.764$, $p < 0.001$). Control over Feeding also covaried significantly with the Prompting of Eating ($\beta = 0.298$, $p = 0.002$) and Encouragement of Variety subscales ($\beta = 0.466$, $p < 0.001$). Lastly, the Prompting of Eating and Encouragement of Variety subscales significantly covaried ($\beta = 0.608$, $p < 0.001$). Cronbach alpha and omega coefficients for the final are reported in Table 8.

Overall, results were inconsistent with the proposed research hypothesis, as the best-fitting model consisted of five, rather than four factors in this sample of three- to five-year olds. Given that the core structure of the PFSQ was not strong, invariance testing was not conducted as items and scales would be unlikely to survive the rigorous analyses. Thus, Hypothesis 1b could not be tested.

Hypothesis 1c: Consistent with the intended factor structure (Goodlin-Jones, Sitnick, Tang, Liu, & Anders, 2008), the best fitting model for the CSHQ-PV was hypothesized to consist of 8 factors: Bedtime Resistance, Sleep Onset Delay, Sleep Duration, Sleep Anxiety, Night Wakings, Parasomnias, Daytime Sleepiness and Sleep Disordered Breathing.

Descriptive statistics. Due to a clerical error in which the response scale was inadvertently changed on the sleep measure at T1, the CFA for the CSHQ-PV was conducted at T2 rather than T1. Item-level descriptive statistics are reported in Table 9, including minimum, maximum, mean, standard deviation, skewness, and kurtosis estimates. Notably, a number of the variables are highly skewed/kurtotic, indicating non-normal distributions. As such, all proceeding analyses were conducted using estimators robust to deviations in non-normality. However, a number of the variables were so highly skewed (>90% of respondents indicated that the behavior “rarely/never” occurred) that the 3-point scale either became dichotomous or the items were simply so skewed that they become non-discriminatory within this sample of three- to five-year olds and thus, are likely not useful as part of the scale.

Internal Consistency of CSHQ-PV. The Bedtime Resistance subscale (6 items) had an alpha coefficient of 0.756. Corrected item-total correlations are reported in Table 10. Item 6 had a low corrected item-total correlation, suggesting that this item may need to be removed. The Sleep Onset Delay subscale consists of only one-item and thus, an alpha coefficient was not possible to calculate. The alpha coefficient of the Sleep Duration subscale (3 items) was 0.755. No items had an item-total correlation ≤0.30. The Sleep Anxiety subscale (4 items) had an alpha coefficient of 0.628, with one item (Item 21) having an item-total correlation ≤ 0.30, suggesting that this item may also need removed. The Night Wakings subscale had an alpha of 0.600, with no item-total correlations below minimally acceptable levels. The Parasomnias subscale had an alpha of 0.375, and all but one item had an item-total correlation below acceptable levels. Further examination of response patterns on these items indicated that many were highly skewed and non-discriminatory, with over 90% of responses indicating that the behaviors "rarely/never" occur. Given the infrequent report of occurrence of these behaviors among three- to five-year olds, these results suggest that these items are not discriminatory among this population and thus, may need to be removed. Similarly, the alpha coefficient for the Sleep Disordered Breathing subscale was 0.171, with all item-total correlations ≤0.30. Again, these items were highly skewed (>90% response rate on "rarely/never"), suggesting that these items are not discriminatory in a sample of three- to five-year olds and may need removed. Lastly, the Daytime Sleepiness subscale had an alpha coefficient of 0.755. Items 32 and 33 had item-total correlations ≤0.30 and may need to be removed. The overall scale had an alpha of 0.756.

Confirmatory Factor Analysis of CSHQ-PV. Confirmatory factor analysis was then used to test the goodness of fit of competing models of the structure of the CSHQ-PV. A total of 6 models were tested. Model 1 tested the original 8-factor solution as proposed by the original study authors. However, the 8 factor model as proposed by the study authors would not converge in a CFA framework given: (1) the presence of unintended dichotomous variables; (2) one-item factors; and (3) factors with cross-loading items. Next, the four-factor model proposed by Sneddon and colleagues' (2013) exploratory factor analysis was tested (Model 2), but model fit was poor. As such, the best-fitting model was found by making adjustments to the original 8 factor model. First, all dichotomous items were removed (items 9, 15, 19, 20, 23 and 25). According to Goodlin-Jones and colleagues (2008), item 12 ("*Wets bed at night"*) is likely not related to sleep in preschool children given that bed wetting is common and most likely unrelated to sleep at this young age. As such, this item was also removed from the model.

The remaining items were restructured into different factors in order to preserve item 2 ("*Falls asleep within 20 minutes*"; originally part of a one-item factor) and item 18 ("*Snores loudly*"; became a one-item factor after the removal of items 19 and 20) and to avoid the use of cross-loading items. These factors included: (1) Difficulty at Bedtime (items 1, 2, 6); (2) Sleep Duration (items 10 and 11); (3) Sleep Anxiety (items, 3, 4, 5, 7, 8, and 21), (4) Night Wakings (items 16, 24), Restless Sleep (items 13, 14, 17, 18, 22), and Difficulty at Waking (items 26, 27, 28, 29, 30, 31, 32, 33). The model fit indices for this model (Model 3) are reported in Table 11. The SRMR and RMSEA estimates indicated adequate fit, but the CFI estimate indicated poor fit.

To improve upon model fit, those items that were still part of the original subscales and had *both* a corrected item-total correlation ≤0.30 and a factor loading <0.40 were removed (items 32, 33). The fit statistics for Model 4 are reported in Table 11. Again, the SRMR and RMSEA estimates indicated adequate fit, but the CFI estimate indicated poor fit.

Model 5 included only those items with significant factor loadings. As such, the "Restless Sleep" factor was removed, in addition to items 7 ("*Afraid of sleeping in dark*") and 21 ("*Trouble sleeping away from home*"). Model fit is reported in Table 11. RMSEA and SRMR still indicated adequate, but not good fit. The CFI estimate still indicated poor fit. Examination of modification indices indicated that item 28 ("*Adults wake the child*") and 26 ("*Child wakes him/herself*") were more related than the model allowed. Rather than adding a residual covariance to the model, item 28 was removed in Model 6 given its redundancy with item 26 and the model was re-estimated. Table 11 summarizes fit statistics for Model 6. SRMR and RMSEA both indicated good fit. Examination of normalized residuals and modification indices suggested no further modifications. Moreover, there did not appear to be any further theoretically justifiable modifications to be made to the model. Item-total correlations and alphas were calculated again. No item-total correlations were ≤0.30 for any subscale. Estimated factor loadings for the final model are reported in Table 12. Sleep Duration significantly covaried with Difficulty at Bedtime (β = 0.418, p = 0.001), Sleep Anxiety (β = 0.274, p = 0.020), and Difficulty at Waketime (β = 0.455, p < 0.001). Sleep Anxiety also significantly covaried with Difficulty at Bedtime (β = 0.385, p = 0.034), Night Wakings (β = 0.365, p = 0.001), and Difficulty at Waketime (β = 0.260, p = 0.009). Lastly, Difficulty at Bedtime significantly covaried with Night Wakings significantly covaried ($\beta = 0.319$, $p = 0.038$) and Difficulty at Waketime ($\beta = 0.471$, $p < 0.001$). Cronbach alpha coefficients and omega reliability estimates for the final model are reported in Table 13.

Overall, results are contrary with the proposed research hypothesis, as the best-fitting model consisted of five, rather than eight factors in this sample of three- to five-year olds. Given that the core structure of the CSHQ-PV was not strong, invariance testing was not conducted as items and scales would unlikely survive the rigorous analyses and thus, Hypothesis 1d could not be tested.

Specific Aim 2. Concurrent Analyses

Hypothesis 2: Child temperament characteristics (i.e., high reactivity/negativity and low effortful control) would have an indirect effect on child BMI via sleep problems and problematic feeding practices (emotional feeding, instrumental feeding, and control over feeding).

Preliminary analyses. All concurrent analyses were conducted at T2 due to a clerical error in which the response scale to the CSHQ-PV was inadvertently changed at T1. First, correlations were conducted to examine bivariate relationships among main analysis variables and demographics (see Table 14). In regard to effortful control, results indicate that poorer effortful control is related to more difficulty at bedtime [r (185) = −0.204, $p = 0.005$)], shorter sleep duration [r (184) = −0.198, $p = 0.007$], and greater overall sleep disturbance [$r(178) = -0.211$, $p = 0.005$] at the bivariate level. Demographics related to effortful control at the bivariate level included child sex, parent sex, and number of months breastfed. Specifically, parents reported greater effortful control abilities in daughters as opposed to sons [$r(187) = 0.294$, $p < 0.001$]. Mothers were more likely to report greater effortful control abilities [r (180) = 0.158, p = 0.034]. Lastly, more months breastfed was related to greater effortful control abilities [r (167) = 0.182, p = 0.018].

In regard to reactivity/negativity, results indicate that greater reactivity/negativity is associated with more instrumental feeding [r (186)= 0.240, p = 0.001], emotional feeding [r(185) = 0.236, p = 0.001], difficulty at bedtime [r (185) = 0.235, p = 0.001], sleep anxiety [$r(182)$ = 0.186, p = 0.012], night wakings [r (185) = 0.290, $p < 0.001$], poorer sleep duration [r (184) = 0.221, p = 0.003], and overall greater total sleep disturbances [r (178) = 0.378, $p < 0.001$] at the bivariate level. Demographics related significantly to reactivity/negativity at the bivariate level included parental depression, length of breastfeeding, and perceiving one's child as a picky eater. Specifically, parents with a current or prior history of a depression diagnosis reported greater reactivity/negativity [r (183) = 0.184, p = 0.012]. More months breastfed was related to less reactivity/negativity [r (167) = −0.158, p = 0.041]. Lastly, children perceived as picky eaters were also rated as more reactive/negative [r(187) = 0.161, p = 0.028].

Instrumental feeding was related to emotional feeding [r(187) = 0.629, $p < 0.001$], shorter sleep duration [r(184) = 0.244, p = 0.001] and greater total sleep disturbance [r(178) = 0.157, p = 0.036]. No demographics significantly correlated with instrumental feeding at the bivariate level.

Greater control over feeding was related to fewer emotional feeding strategies [r(181) = −0.217, p = 0.003], less sleep anxiety [r(178) = −0.161, p = 0.031], less difficulty at wake time (r(179) = −0.151, p = 0.043) and less total sleep disturbance

[r(174) = −0.174, p = 0.022] at the bivariate level. No demographics significantly correlated with control over feeding at the bivariate level.

Greater emotional feeding was related to greater reactivity/negativity [r(185) = 0.236, p = 0.001], more instrumental feeding strategies [r(187) = 0.629, p < 0.01], poorer sleep duration [r(183) = 0.254, p = 0.001], greater sleep anxiety [r(181) = 0.219, p = 0.003] and greater total sleep disturbance [r(177) = 0.235, p = 0.002] at the bivariate level. Significant demographics at the bivariate level included length of breastfeeding and concern over child's weight. Specifically, more number of months breastfed was related to greater use of emotional feeding strategies [r(166) = 0.154, p = 0.046]. Moreover, parents who reported greater concern of child weight also reported using more emotional feeding strategies [r(188)= 0.147, p = 0.044].

Greater total sleep disturbance was related to poorer effortful control [r(178) = −0.211, p = 0.005], greater reactivity [r(178) = 0.378, p < 0.001], greater instrumental feeding [r (178) = 0.157, p = 0.036], less control over feeding [r(174) = −0.174, p = 0.022], and greater emotional feeding [r(176) = 0.235, p = 0.002] at the bivariate level. Significant demographics at the bivariate level included parent depression and perception of a picky eater. Specifically, parents with a current or past diagnosis of depression reported their children having greater sleep disturbances [r(175) = 0.221, p = 0.003]. Moreover, parents who perceived their child as a picky eater also reported greater sleep problems [r(179) = 0.278, p < 0.001].

The only significant predictors of child zBMI at the bivariate level included length of breastfeeding and income-to-needs ratio. Specifically, more months breastfed was related to a lower zBMI [$r(165) = -0.173$, $p = 0.026$]. Moreover, a greater income-to-needs ratio was related to a lower zBMI [$r(156) = -0.175$, $p = 0.028$].

In relation to the main analysis variables, income-to-needs ratio was related only to zBMI at the bivariate level. Income-to-needs ratio was also related to demographic variables, including parent age, parent BMI, parent depression, and length of breastfeeding. Specifically, a lower income-to-needs ratio was related to younger parent age [$r(146) = 0.172$, $p = 0.037$], greater parent BMI [$r(147) = -0.209$, $p = 0.011$)], a past or current depression diagnosis, [$r(155) = -0.225$, $p = 0.005$], and fewer months breastfed [$r(144) = 0.188$, $p = 0.023$].

Next, a series of path analyses were conducted to explicate the direct and indirect concurrent effects among child temperament (i.e., reactivity/negativity and effortful control), sleep problems, parental feeding practices, and zBMI , after controlling for all theoretically-relevant covariates, even if not significant at the bivariate level in order to detect any potential suppressor effects. The models were also conducted using the original PFSQ and CSHQ-PV scales, but the pattern of results did not differ.

Model 1. T2 Temperament → T2 Emotional Feeding → T2 zBMI. First, a model examining the direct and indirect relationships among child reactivity/negativity, effortful control, emotional feeding, and zBMI was conducted, controlling for theoretically-relevant covariates (see Table 15). The full model indicated that child reactivity/negativity was significantly related to emotional feeding, such that more reactive/negative preschoolers were more likely to have parents engage in emotional feeding strategies ($\beta = 0.254$, $p = 0.003$). Effortful control was also significantly related to emotional feeding strategies, such that preschoolers with poorer self-regulatory abilities were more likely to have parents who engaged in emotional feeding strategies (β = −0.162, p = 0.048). Reactivity/negativity was also directly related to child zBMI, such that more reactive/negative children had significantly greater zBMI scores (β = 0.185, p = 0.037). However, effortful control and emotional feeding were not significantly related to zBMI and no significant indirect effects emerged. See Table 15 for a summary of the full model.

Model 2. T2 Temperament → T2 Control over Feeding → T2 zBMI. Next, a model examining the direct and indirect relationships among child reactivity/negativity, effortful control, control over feeding, and zBMI was conducted, again controlling for key covariates (see Table 16). Aside from parent BMI (β = 0.221, p = 0.011) and length of breastfeeding (β = −0.216, p = 0.002) relating to child zBMI, no other direct or indirect effects were observed.

Model 3. T2 Temperament → T2 Instrumental Feeding →T2 zBMI. The direct and indirect relationships among child reactivity/negativity, effortful control, instrumental feeding, and zBMI were examined next, controlling for key covariates (see Table 17). Child reactivity/negativity was significantly related to instrumental feeding, such that more negative/reactive children were more likely to have parents who engaged in instrumental feeding strategies (β = 0.235, p = 0.017). Aside from parent BMI and length of breastfeeding predicting child zBMI (see Table 17), no other significant direct or indirect effects emerged.

Model 4. T2 Temperament → T2 Total Sleep Disturbance → T2 zBMI. Finally, the direct and indirect effects among children reactivity/negativity, effortful control, sleep problems, and zBMI were examined, controlling for key covariates (see Table 18). Child reactivity/negativity significantly predicted total sleep disturbance, such that more negative/reactive preschoolers had greater total sleep problems ($\beta = 0.268$, $p < 0.001$). Aside from covariates predicting total sleep disturbance and child zBMI (see Table 18), no other significant direct or indirect effects emerged.

Model 5. Final Model. The final concurrent model included child T2 reactivity/negativity T2 emotional and instrumental feeding, T2 total sleep disturbance, and T2 zBMI, controlling for all theoretically-relevant covariates (see Table 19 and Figure 1). Child reactivity/negativity significantly predicted emotional feeding ($\beta = 0.244$, $p = 0.005$), instrumental feeding ($\beta = 0.248$, $p = 0.011$) and total sleep disturbance ($\beta = 0.269$, $p < 0.001$), such that more negative/reactive preschoolers were significantly more likely to have parents who engaged in emotional and instrumental feeding strategies and to have sleep problems. No other significant direct or indirect effects emerged among main study variables. See Table 19 for a summary of significant covariates. The final model accounted for 9.7% of the variance in emotional feeding, 10.6% of the variance in instrumental feeding, 25.7% of the variance in sleep problems, and 17.5% of the variance in zBMI.

In partial support of the research hypothesis, child reactivity/negativity at T2 was positively associated with T2 emotional and instrumental feeding strategies, as well as T2 sleep problems. Moreover, better effortful control at T2 was related to fewer T2 emotional feeding strategies. However, when added in the full model, effortful control no longer emerged as a significant predictor and was thus, dropped. Contrary to the research hypothesis, none of the study constructs significantly predicted zBMI in the final model and thus, no indirect effects between temperament and zBMI emerged.

Specific Aim 3: Longitudinal Analyses

First, a dropout analysis was performed between the children and parents at T1 who did and did not complete the six-month follow up (see Table 20 for difference tests). Child and parent ethnicity differed significantly between study dropouts and completers, such that a greater proportion of study dropouts were Hispanic-American compared to study completers (10.5% vs. 2.2% of children and 12.3% vs. 3.8% of parents). Parents who dropped out of the study were also significantly younger than those who completed (M = 32.37 years vs. M = 34.17 years) and significantly less educated (37.8% high school graduates or less vs. 24.5% high school graduates or less). Moreover, children of study dropouts were rated as having significantly poorer effortful control abilities (M = 5.10 vs. M = 5.27). No significant differences emerged regarding child age, sex, or zBMI, or parent sex, BMI, marital status, depression diagnosis, breastfeeding history, and income-to-need ratio.

Next, correlations were conducted to examine bivariate relationships among T1 and T2 variables (see Table 21) and T2 variables and covariates (see Table 22). Bivariate results indicate that T1 reactivity/negativity was associated with greater reactivity/negativity at T2 [$r(187) = 0.695$, $p < 0.001$], as well as greater total sleep disturbance at T2 [$r(187) = 0.316$, $p < 0.001$]. Moreover, T1 reactivity/negativity was also related to greater T1 and T2 instrumental feeding [$r(291) = 0.216$, $p < 0.001$ and $r(188) = 0.176$, $p = 0.015$, respectively] and T1 and T2 emotional feeding [$r(292) = 0.176$, $p = 0.003$ and $r(187) = 0.284$, $p < 0.001$, respectively]. Demographics related to T1 reactivity/negativity at the bivariate level included parent's past or current diagnosis of depression, as well as parent's perception that their child is a picky eater. Specifically, parents with a past of current diagnosis depression rated their child as more negative/reactive [$r(186) = 0.212$, $p = 0.004$], while those who perceive their child as a picky eater also perceive their child as more negative/reactive [$r(190) = 0.203$, $p = 0.005$].

In regard to T1 effortful control, bivariate results indicate that greater effortful control at T1 was related to greater T2 effortful control [$r(187) = 0.531$, $p < 0.001$]. Greater T1 effortful control was also related to less T2 instrumental feeding [$r(188) = -0.178$, $p = 0.014$] and T2 emotional feeding at [$r(187) = -0.146$, $p = 0.046$]. Demographics significantly related to effortful control at the bivariate level included child age, child sex, and length of breastfeeding. Specifically, girls were rated as higher in effortful control than boys [$r(296) = 0.148$, $p = 0.011$] older children were rated lower in effortful control than younger children [$r(296) = -0.156$, $p = 0.010$]. Lastly, more months breastfed was related to greater effortful control [$r(171) = 0.161$, $p = 0.035$].

In regard to T1 instrumental feeding, bivariate results indicated that greater instrumental feeding at T1 was related to greater T1and T2 emotional feeding [$r(289) = 0.575$, $p < 0.001$ and $r(186) = 0.504$, $p < 0.001$, respectively], as well as greater instrumental feeding at T2 [$r(187) = 0.607$, $p < 0.001$]. T1 instrumental feeding was also related to greater T1 and T2 reactivity/negativity [$r(291) = 0.216$, $p < 0.001$ and $r(186) = 0.243$, $p = 0.001$, respectively], as well as greater T2 total sleep disturbance [$r(177) = 0.185$, $p = 0.014$]. Demographics significantly related to T1 instrumental feeding at the bivariate level included parental concern over their child's weight, such that those more concerned about their child's weight were more likely to engage in instrumental feeding [$r(189) = 0.232$, $p = 0.001$].

Bivariate results indicate that T1 control over feeding was related to less T1 and T2 emotional feeding [$r(286) = -0.197$, $p = 0.001$ and $r(183) = -0.146$, $p = 0.048$, respectively] and greater T2 control over feeding [$r(179) = 0.553$, $p < 0.001$]. Demographics significantly related to T1 control over feeding at the bivariate level included length of breastfeeding, such that more months breastfed was related to less control over feeding ($r(166) = -0.160$, $p = 0.039$)

Emotional feeding at T1 was related to less T1 control over feeding [$r(286) = -0.197$, $p = 0.001$], more T1 and T2 instrumental feeding [$r(289) = 0.575$, $p < 0.001$ and $r(188) = 0.476$, $p < 0.001$, respectively] and greater T2 emotional feeding [$r(187) = 0.584$, $p < 0.001$]. T1 emotional feeding was also related to greater reactivity/negativity at both T1 and T2 [$r(292) = 0.176$, $p = 0.003$ and $r(186) = 0.206$, $p = 0.005$, respectively], as well also greater T2 total sleep disturbance [$r(178) = .0231$, $p = 0.002$]. Demographics related to T1 emotional feeding included parent BMI, such that parents with a greater BMI were more likely to engage in emotional feeding strategies [$r(174) = 0.175$, $p = 0.021$].

Due to a clerical error at T1 in which the scale of the CSHQ-PV was inadvertently changed to a 5-point rather than 3-point scale, no relationships emerged as significant between the CSHQ-PV T1 total sleep disturbance score. However, the CHSQ-PV also includes a column on the measure that asks parents to indicate whether each sleep behavior is a problem for them and their children. As such, the frequency of sleep problems was used in place of the total sleep disturbance score at T1 for an alternative measure of sleep. T1 sleep problem frequency was significantly related to greater T1 reactivity/negativity [$r(222) = 0.189$, $p = 0.001$] and greater T2 total sleep disturbance

[$r(146) = 0.359$, $p < 0.001$]. No demographics emerged as significant predictors of T1 sleep problem frequency at the bivariate level.

T1 zBMI was significantly related only to T2 zBMI [$r(184) = 0.664$, $p < 0.001$] in regard to main study variables. However, demographics significantly related to T1 zBMI included child age and parental depression. Specifically, older children had a greater T1 zBMI [$r(292) = 0.215$, $p = 0.004$], and a current or prior diagnosis of depression of the parent was related to a greater T1 child zBMI [$r(184) = 0.156$, $p = 0.035$].

Next, a series of path analyses were conducted to explicate the direct and indirect longitudinal effects among T1 child temperament (i.e., negative reactivity and self-regulation), T2 sleep problems, T2 parental feeding practices, and T2 zBMI , after controlling for all theoretically-relevant covariates, even if not significant at the bivariate level in order to detect any suppressor effects. The model was also conducted using the PFSQ and CSHQ-PV original scales, but the pattern of results did not differ.

Hypothesis 3a: Greater reactivity/negativity and poorer effortful control at T1 would predict parental control over eating, emotional feeding, and instrumental feeding at T2 (direct effects) and parental control over eating, emotional feeding, and instrumental feeding at T1 would predict poorer effortful control, but not reactivity/negativity, at T2 (direct effects).

To examine this hypothesis, a series of path models with child reactivity/negativity and effortful control at T1 predicting feeding strategies at T2 were examined, controlling feeding strategies for key covariates. Model 1 examined the effect of T1 effortful control and T1 reactivity/negativity on T2 emotional feeding (Table 23). Results indicated that T1 reactivity/negativity significantly predicted T2 emotional feeding (β = 0.257, p = 0.002), such that greater reactivity/negativity at T1 predicted greater use of emotional feeding strategies at T2. T1 effortful control emerged as a marginally significant predictor of T2 emotional feeding (β = −0.165, p = 0.077), such that poorer effortful control at T1 predicted greater use of T2 emotional feeding strategies. Model 2 examined the effect of T1 effortful control and reactivity/negativity on T2 control over feeding (Table 24). Neither T1 reactivity/negativity nor effortful control emerged as significant predictors of T2 control over feeding strategies. Finally, Model 3 examined the predictive power of T1 effortful control and T1 reactivity/negativity on T2 instrumental feeding (Table 25). Again, results indicated that neither T1 reactivity/negativity nor T1 effortful predicted instrumental feeding.

Next, a series of models with T1 feeding strategies predicting T2 temperament were examined next, again controlling for key covariates. Model 4 examined the predictive power of T1 feeding strategies on T2 reactivity/negativity (see Table 26). Results indicated that T1 instrumental feeding predicted greater T2 negativity/reactivity (β = 0.197, p = 0.022). Model 5 examined the effect of T1 feeding strategies on T2 effortful control (Table 27). Results indicated that instrumental feeding at T1 predicted greater effortful control at T2 (β = 0.204, p = 0.039). T1 emotional feeding emerged as a marginally significant predictor of T2 effortful control (β = −0.163, p = 0.075), such that greater emotional feeding at T2 was related to poorer T2 effortful control.

Thus, in partial support of the research hypothesis, T1 reactivity/negativity significantly predicted greater T2 emotional feeding strategies and T1 effortful control marginally predicted greater T2 emotional feeding strategies. However, contrary to the research hypothesis, no temperament measurements at T1 significantly predicted T2 instrumental or control over feeding strategies. Supporting the research hypothesis, T1 emotional feeding marginally predicted poorer T2 effortful control. Contrary to the research hypothesis, however, T1 control over feeding did not predict any T2 temperament measurements, and T1 instrumental feeding predicted both greater effortful control and reactivity/negativity.

Hypothesis 3b: Greater reactivity/negativity and poorer effortful control at T1 would predict poorer sleep at T2 (direct effect) and poorer sleep at T1 would predict greater reactivity/negativity and poorer effortful control at T2 (direct effect).

To examine this hypothesis, a path model with T1 reactivity/negativity and T1 effortful control predicting T2 total sleep disturbance was examined, controlling for key covariates (see Table 28). Model 1 indicated that T1 reactivity/negativity significantly predicted T2 total sleep problems ($\beta = 0.193$, $p = 0.004$). Next, a series of path models with T1 child sleep problems predicting T2 child reactivity/negativity and T2 effortful control were examined, controlling for key covariates. Model 2 examined the effect of T1 total sleep disturbance on T2 effortful control, but sleep did not emerge as a significant predictor (Table 29). T1 sleep problem frequency was substituted in Model 3 as an alternative measure of sleep at T1 and the relationship between sleep problems and T2 effortful control was reexamined. Again, however, sleep problems at T1 did not emerge as a significant predictor of T2 effortful control (Table 30). Model 3 examined the effect of T1 total sleep disturbance on T2 reactivity/negativity, but T1 total sleep disturbance did not emerge as a significant predictor (see Table 31). Again, therefore, T1 sleep problem frequency was substituted in Model 4 as an alternative measure of sleep at T1.

However, T1 sleep problem frequency also did not emerge as a significant predictor of T2 reactivity/negativity, after controlling for key covariates (Table 32).

Partially supporting the research hypothesis, T1 reactivity/negativity predicted greater T2 total sleep disturbance. However, T1 effortful control was not related to T2 sleep problems. Moreover, T1 sleep problems did not significantly predict T2 temperament characteristics.

Hypothesis 3c: Child temperament (i.e., higher reactivity/negativity and poorer effortful control) at T1 would have an indirect effect on T2 child zBMI via poorer sleep T2 and more problematic T2 parental feeding styles.

Given that control over feeding and instrumental feeding were not adequately predicted by temperament, the final model examined the effect of T1 reactivity/negativity on T2 zBMI via T2 total sleep disturbance and T2 emotional feeding strategies (see Table 33 and Figure 2). Results indicated that T1 reactivity/negativity predicted T2 emotional feeding strategies ($\beta = 0.269$, $p < 0.001$) and T2 total sleep disturbance ($\beta = 0.197$, $p = 0.003$). T1 reactivity/negativity, T2 emotional feeding, and T2 total sleep disturbance, however, were not related to zBMI and thus, no indirect effects emerged. The final model accounted for 11.6% of the variability in emotional feeding, 22.0% in total sleep problems, and 45.00% in child zBMI.

Consistent with the research hypothesis, therefore, T1 reactivity/negativity did significantly predict greater sleep problems and emotional feeding strategies at T2. Contrary to the research hypothesis, however, T1 reactivity/negativity, T2 sleep problems, and T2 emotional feeding did not relate to T2 zBMI and thus, no indirect effects emerged.

Specific Aim 4: SES Moderator Analyses

Hypothesis 4: SES will interact with the hypothesized relationships among child temperament, sleep problems, parental feeding practices and child BMI (as outlined above), such that these relationships will be stronger for children in low SES families compared to those in high SES families.

The moderating role of SES was examined in the two final models from Aims 2 and 3. To examine the moderating role of SES, all variables were mean centered. To create the interaction terms, the mean-centered income-to-needs ratio variable was multiplied with each of the endogenous variables in the models. Only covariates significant in the final models were included in the moderation models.

Model 1 examines the moderating role of SES on the concurrent relationships between temperament, emotional feeding, sleep disturbances, and zBMI (see Table 34). Results indicate that the effect of T2 total sleep disturbance on T2 zBMI is marginally moderated by SES ($\beta = 0.227$, $p = 0.070$), such that the non-significant positive effect of total sleep disturbance on T2 zBMI becomes marginally more positive by 0.227 for every 1-unit increase in the income-to-needs ratio. Thus, for higher SES families, the positive relationship between T2 sleep problems and T2 zBMI is stronger (marginally) than for lower SES families. Model 2 examines the moderating role of SES on the longitudinal relationships between temperament, emotional feeding, sleep disturbances, and zBMI (see Table 35). SES did not emerge as a significant moderator of any of the longitudinal relationships.

To better understand this pattern of results, all covariates were removed from the model and only the main effect and interaction terms were included. For Model 3, the reduced concurrent model (see Table 36), reactivity/negativity ($\beta = 0.271$, $p = 0.001$), income-to-needs ratio ($\beta = 0.204$, $p = 0.014$) and the negativity by income-to-needs ratio interaction term ($\beta = -0.185$, $p = 0.035$) were significantly related to instrumental feeding. Thus, for every 1-unit increase in the income-to-needs ratio, the effect of reactivity/negativity on instrumental feeding becomes weaker (or less positive) by 0.185. Interestingly, the interaction term became significant when all covariates were removed from the model, even though no covariates specifically were used to predict instrumental feeding. Moreover, income-to-needs ratio was significantly related to zBMI in this reduced model ($\beta = -0.220$, $p = 0.015$). Thus, these results suggest that the SES relates to zBMI only when parent BMI and length of breastfeeding are not accounted for. Thus, the effect of SES on zBMI appears to be driven largely by these two factors.

In Model 4, all covariates were removed from the longitudinal model (see Table 37). The T1 reactivity/negativity by income-to-needs ratio interaction term emerged as a significant predictor of T2 total sleep disturbance ($\beta = -0.117$, $p = 0.015$), indicating that for every 1-unit increase in income-to-needs ratio, the effect of reactivity/negativity ($\beta = 0.319$, $p < 0.001$), becomes weaker (less positive) by 0.117. Thus, the effect of reactivity/negativity on total sleep disturbance is stronger for low-income families, when not accounting for child age, sex, parent depression, or perception of child as a picky eater. Moreover, in this reduced model, income-to-needs ratio was also a significant predictor of zBMI ($\beta = -0.150$, $p = 0.030$), such that greater income-to-needs ratio was related to lower zBMI. Thus, only when not accounting for parental BMI, parent depression and length of breastfeeding does SES emerge as a significant predictor of child zBMI. No significant interaction terms emerged in the reduced model. A series of models with only one interaction term added at a time were also conducted (not shown) in order to reduce collinearity amount interaction terms and examine each individually, but still, none emerged significant.

Thus, contrary to the research hypothesis, SES did not interact with the relationships among child temperament, sleep problems, feeding practices, and child zBMI. It appears as though other factors likely related to SES, such as parental BMI, parental depression, and length of breastfeeding, are more related to feeding practices, sleep, and BMI than SES.

Exploratory Analyses.

Given the significant bivariate relationships between reactivity/negativity, emotional feeding strategies, and total sleep disturbances, a series of exploratory path models were conducted to examine the direct and indirect effects among these constructs.

Model 1 examined the direct and indirect relationship among T2 reactivity/negativity, T2 total sleep disturbance, and T2 emotional feeding, controlling for covariates significant in the preceding models (see Table 38 and Figure 3). Results indicate that T2 reactivity/negativity had a direct effect on both T2 total sleep disturbance ($\beta = 0.361$, $p < 0.001$) and T2 emotional feeding ($\beta = 0.158$, $p = 0.033$). However, T2 total sleep disturbance was not related to T2 emotional feeding and thus, no significant indirect effect emerged. To explore the longitudinal relationships among these same constructs, T1 reactivity/negativity was substituted for T2 reactivity/negativity in Model 2 (see Table 39 and Figure 4). Results indicate that T1 reactivity/negativity has a significant direct effect on T2 total sleep disturbance ($\beta = 0.226$, $p < 0.001$) and T2 emotional feeding ($B = 0.206$, $p < 0.001$). Again, however, T2 total sleep disturbance did not emerge as a significant predictor of T2 emotional feeding and thus, no significant indirect effect emerged.

Next, an alternative model (Model 3) with T2 total sleep disturbance predicting T2 reactivity and T2 emotional feeding was examined (see Table 40 and Figure 5). Results indicate that T2 total sleep disturbance had a significant direct effect on T2 reactivity/negativity (β = 0.381, p < 0.001) and T2 emotional feeding (β = 0.187, p = 0.006). T2 reactivity/negativity had a marginally significant direct effect on T2 emotional feeding (β = 0.167, p = 0.076). T2 total sleep disturbance had a significant indirect effect on T2 emotional feeding (unstandardized coefficient = 0.007, p = 0.010).

Lastly, the longitudinal relationships among these relationships were examined in Model 4, with T1 sleep problems frequency predicting T2 reactivity/negativity and T2 emotional feeding (see Table 41 and Figure 6). Results indicate that T1 sleep problem frequency had a marginally significant direct effect on T2 reactivity/negativity (β = 0.052, p = 0.052) and a significant direct effect on T2 emotional feeding (β = 0.112, p = 0.042). T2 reactivity/negativity also had a significant direct effect on T2 emotional feeding (β = 0.294, p < 0.001), and a significant indirect effect emerged between T1 sleep problems and T2 emotional feeding (unstandardized coefficient = 0.010, p = 0.012).

CHAPTER 6. DISCUSSION

The primary aim of the present study was to examine the concurrent and longitudinal relationships among temperament characteristics (i.e., reactivity/negativity and effortful control), sleep problems, parental feeding styles, and zBMI in children three- to five-years of age. Prior research suggests that greater reactivity/negativity and poorer effortful control in childhood is related to later obesity risk in both childhood and adulthood (e.g., Anzman-Frasca et al., 2012; Darlington & Wright, 2006; Evans, Fuller-Rowell, & Doan, 2012; Niegel, Ystrom, & Vollrath, 2007;). However, less research has examined the mechanisms underlying this relationship. It is likely that temperament exerts an influence on a number of important factors that increase one's risk for obesity, including both parental feeding practices and child sleep patterns. Some research suggests that temperamental characteristics may influence the feeding strategies that parents use, some of which may be obesogenic in nature (e.g., emotional feeding; McMeekin et al., 2013) and thus, cause weight gain over time. Alternatively, certain temperamental characteristics (e.g., reactivity/negativity) may be related to disruptive sleeping patterns, which subsequently increase one's risk for obesity (Agras et al., 2012). Thus, the present study's aim was to provide a thorough and rigorous examination of temperament, feeding practices, sleep problems and child zBMI in a sample of healthy preschool children.

Specifically, this study attempted to overcome several existing limitations to research examining temperament and its relationship to feeding practices, sleep, and zBMI. Much of the research examining the link between temperament and parental feeding practices has been cross-sectional, thus providing no casual evidence for the relationship between temperament and feeding practices. This study overcomes this limitation by measuring temperament, sleeping, feeding, and zBMI at two different measurement points conducted six months apart, thus allowing for a longitudinal examination between these constructs. Second, many of the studies examining the links between these constructs failed to control for many important potential confounders, including parental BMI, breastfeeding history, and SES. To overcome this limitation, the current study controlled for a variety of potential confounders in each analysis in an attempt to isolate the unique effects among temperament, sleep, feeding, and zBMI. Third, prior research has been limited by using primarily female samples, thus limiting our understanding of the relationships among both male and female preschoolers. This research addresses this limitation by including a sample with equal numbers of males and females. The current research also extends beyond prior research by conducting validation research on key study constructs, as well as examining the moderating role of SES.

Thus, the primary goal of the present study was to better understand the relationship between temperament, feeding practices, sleep, and zBMI using rigorous and innovative methods that allow for the examination of complex, longitudinal relationships. The first aim of the study focused on validating the measures used in this study to assess child's sleep problems and parental feeding practices. The second aim of the study was to describe the concurrent relationships among temperament, feeding practices, sleep, and BMI, while the third aim examined these relationships longitudinally. Finally, the fourth aim of the study focused on explicating how SES moderated the relationships among temperament, feeding practices, sleep, and zBMI in preschoolers. In addition, a number of exploratory analyses were conducted to better understand how sleep and feeding practices influence each other both concurrently and longitudinally.

Overview of Results

Confirmatory Factor Analysis of PFSQ

The PFSQ was developed by Wardle and colleagues (2002) to assess parental feeding styles that potentially contribute to the development of obesity, including emotional and instrumental feeding, as well as more controlling feeding styles. Importantly, this is one of only two measures for preschoolers that assesses emotional feeding. The other measure (i.e., the Comprehensive Feeding Practices Questionnaire; Musher-Eizenman & Holub, 2007), only assesses feeding in response to upset/fussiness and boredom. The PFSQ expands upon this by examining feeding in response to being hurt, angry, and worried. As such, validation of this measure is essential to ensure a more complete and reliable measurement of emotional feeding, a construct that is gaining much research attention (e.g., Braden, Rhee, Peterson, Rydell, Zucker & Boutelle, 2014; Rodgers et al., 2013; Sleddens, Kremers, Stafleu, Dagnelie, De Vries, & Thijs, 2014). Thus, the first aim of this study was to conduct the first confirmatory factor analysis on the PFSQ to establish preliminary evidence of its factor structure.

Though Wardle and colleagues (2002) developed the PFSQ to have four subscales (i.e., Control over Feeding, Emotional Feeding, Encouragement and Prompting, and Instrumental Feeding), confirmatory factor analysis in this sample supported a five-factor model. These factors included: Control over Feeding, Instrumental Feeding, Emotional Feeding, Encouragement of Variety, and Prompting of Eating. In addition to splitting the Encouragement and Prompting subscale into two separate subscales given the heterogonous nature of the items making up this subscale, a number of other modifications had to be made to the factor structure as intended by Wardle and colleagues (2002) in order to achieve good fit. Two items were removed as they did not discriminate among preschoolers in this sample. These items include "*I allow my child to choose which foods to have for meals*" and "*I use puddings to as a bribe to get my child to eat his/her main course*." The former item had a low corrected item-total correlation and did not load on the factor as expected, indicating that it is not a useful assessment of Control over Feeding. In regard to the latter item, the highly specific nature of using puddings as a bribe resulted in very few parents endorsing it, thus, making it an unhelpful scale item. Additional items were also removed due to the heterogeneity, and thus measurement error, they added to the factor structure. Within the Control over Feeding subscale, the items pertaining to "where" the child eats ("*I allow my child to wander around during a meal*" and "*I insist my child eats meals at the table*") were removed. Many of the Control over Feeding items assess both when and what the child eats within one item (e.g., "*I decide what my child eats between meals*" reflects both what the parent allows the child to eat between meals and whether the child is allowed to eat between meals). However, the items pertaining to "where" the child eats reflect neither what nor when the child eats and thus, are assessing something different. Lastly, two items within the original Encouragement and Prompting subscale were removed (i.e., "*I praise my child if s/he eats a new food*" and "*I praise my child if s/he eats what I give him/her*") as praising children for eating something after they have already ate it is different than encouraging children to eat something they have not yet ate. After making these modifications, CFA model fit indices indicated adequate fit.

The results of this CFA indicate a number of potential revisions to the PFSQ that would improve upon the measure. First, attention should be paid to ensuring that heterogeneous constructs are not combined within one factor. This is especially pertinent in regard to the Control over Feeding subscale, which assessed control over when, what, and where a child eats, as well as the Encouragement and Prompting subscale, which assessed prompting to eat in general, encouragement of eating a variety of foods, and praising of eating behavior. Additional items could be added to the measure to create separate subscales for Control over Consumption Type (e.g., "*I decide how many snacks my child should eat.*" "I *decide the types of foods my child eats for snacks*" and "*I decide what my child eats for meals*."), Control over Consumption Frequency (e.g., "*I decide when it is time for my child to have a snack*," "*I decide the times when my child eats his/her meals*") and Control over Consumption Environment (e.g., "*I insist my child eats meals at the table*," "*I insist that my child eats while sitting*," and *"I decide the appropriate locations for my child to eat.*"). Similarly, additional items could be added to the measure to create separate subscale for Prompting to Eat, Encouragement of Variety, and Praising Eating Behavior. This is especially important as these heterogeneous behaviors likely have different relationships to child's obesity risk.

Second, scale items should be worded so that unintended measurement effects do not arise. For example, within the Control over Feeding subscale, the reverse-coded items were more related to each other than the model allowed, given that they were worded differently than the non-reverse coded items. It is recommended that the items be reworded so that no items need to be reverse coded. Lastly, items that are too specific (i.e., "*I use puddings as a bribe to get my child to eat his/her main course*") should be revised to be more encompassing, such as "*I use the promise of dessert to get my child to eat his/her main course*."

Correlations between factors indicate that emotional feeding practices were inversely related to controlling feeding practices, as assessed by the PFSQ. Moreover, controlling feeding practices were positively correlated with encouragement of variety (while emotional and instrumental feeding practices were inversely correlated with encouragement of variety). Thus, the controlling feeding practices assessed by the PFSQ appear to be desirable practices. Indeed, the items that make up this subscale include behaviors that reflect stability in feeding routines and authoritative feeding practices (e.g., "*I decide the times when my child eats his/her meals*"). These practices are different from more restrictive feeding practices, such as placing snacks out of reach of the child, placing limits on second helpings, and limiting a child's intake of favorite foods, which are posited to prevent children from learning how to regulate their own food intake and thus, are related to increasing BMI trajectories (Anzman & Birch, 2014; Fisher & Birch, 1999). Thus, the Control over Feeding subscale of the PFSQ may be more aptly named Monitoring of Feeding. Indeed, studies who have used the Control over Feeding subscale of the PFSQ have found it to relate to lower, not greater, BMI (Wardle et al., 2002).

Though none of the feeding styles as assessed by the PFSQ in the current study significantly correlated with child zBMI, it is plausible that parental monitoring and encouragement of healthy eating behaviors (e.g., added variety), would be associated with healthy weight trajectories over time, while emotional and instrumental feeding would be associated with increasing weight trajectories. This would be consistent with prior literature which suggests that emotional and instrumental feeding strategies override children's natural signals of hunger and satiety and teach children that food can be used as a tool to alleviate negative feelings, thus, leading to unhealthy eating behaviors (e.g., Blisset, Haycraft, & Farrow, 2010; Braden et al., 2014; Farrow, Haycraft, & Blisset, 2015) and greater weight gain (e.g., Rodgers et al., 2013). Alternatively, research indicates that monitoring and the encouragement of healthy eating behaviors have no negative consequences on food intake or future obesity risk (Carnell et al., 2014). If the revised factor structure is replicated in additional studies, including those with more ethnically and racially-diverse samples, future research should examine how the revised PFSQ subscales related to child eating behaviors and zBMI over longer follow-up periods.

Confirmatory Factor Analysis of CSHQ-PV

The CSHQ is a widely used parent-report measure to assess for sleep problems in children (Owens et al., 2000). Originally developed to be used with parents of four to 10-year olds (Owens et al., 2000), Goodlin-Jones and colleagues (2008) were the first to provide preliminary data that the CSHQ is a useful and valid tool for screening sleep problems in toddlers and preschoolers, as well. However, a confirmatory factor analysis has never been conducted on the CSHQ in preschoolers. Given that the scale was created with the intention to be used for screening purposes in clinical settings, Owens and colleagues (2000) indicated that items were intentionally grouped into subscales conceptually rather than relying on factor analysis in order to create subscales that correspond to diagnosis categories. However, the CSHQ is widely used in research (e.g., Garrison & Christakis, 2012; Hodge, Hoffman, Sweeney, & Riggs, 2013; van Geijlswijk, Mol, Egberts, & Smits, 2011). As such, conducting a CFA on the scale is important to ensure that the version of the scale used in research studies is psychometrically sound.

Waumans and colleagues (2010) conducted a CFA on the CHSQ within a sample of Dutch school-age children and found internal consistency reliabilities were poor for several of the original 8-factor CSHQ scales and that the 8-factor solution fit poorly. However, this study was limited by the fact that the authors reduced the 3-point Likert scale into a binary scale and failed to report the final solution for the best-fitting model. Instead, the authors simply noted that they deleted items and allowed three items to cross-load. Sneddon and colleagues (2013) then conducted an exploratory factor analysis on CHSQ within a sample of preschool-aged children and found that the best solution consisted of four factors. However, a limitation of exploratory factor analysis is that it is data-driven, rather than theory driven and thus, the resulting factors are often not interpretable (Brown, 2006). Indeed, Sneddon and colleagues (2013) settled on a four-factor solution: Sleep Initiation, Sleep Distress, Sleep Transition, and Sleep Duration. However, the Sleep Initiation factor contained items pertaining to sleep anxiety, night wakings, and sleep initiation. The Sleep Distress factor included items related to sleep anxiety and difficulty waking. Confirmatory factor analysis, therefore, overcomes this limitation by allowing the researcher to specify the number of factors, pattern of factor loadings, and the relationships among factors in advance, in order to empirically test the fit of competition models using fit statistics (Brown, 2006).

As such, confirmatory factor analysis was conducted on the CHSQ-PV in the current study. Consistent with prior psychometric findings (Snedden et al., 2013; Waumans et al, 2010), the eight-factor structure did not fit the data and, in fact, the model would not converge. Moreover, the four factor model as proposed by Sneddon and colleagues (2013) was tested, but model fit was poor. The results of the current study's CFA of the CSHQ supported a five-factor model, instead: Difficulty at Bedtime, Sleep Anxiety, Sleep Duration, Night Wakings, and Difficulty at Waketime. This five-factor model emerged as a better fit than the eight-factor model due to cross-loading items on the original eight-factor, as well as one-item factors and infrequently endorsed items.

As with the PFSQ, a number of modifications were made to the CSHQ-PV factor structure in order to achieve acceptable fit. Consistent with Sneddon and colleagues (2013), a number of items (including items pertaining to sleepwalking, stops breathing, and snorts/gasps) were identified as occurring "rarely" by over 90% of parents and thus, these items were removed as they did not sufficiently discriminate between children. In both the current study and the study conducted by Sneddon and colleagues (2013), the items pertaining to bedwetting and appearing sleepy or falling asleep in the car or while watching TV were removed, as overall sleep is less likely to be related to these behaviors in a sample of preschool-aged. Corrected-item total correlations for these items were less than 0.30, supporting this argument. After making these adjustments, a number of items still did not load on to any factors and thus, were removed. Consistent with Sneddon and colleagues (2013), the item pertaining to snoring did not load on any factor and was thus, removed. However, a number of additional items did not load on any factors that Sneddon and colleagues (2013) did not remove. These included items related to fear of the dark, sleeping too little, talking during sleep, restlessness, trouble sleeping away from home, awakens screaming, alarmed by scary dreams, wakes up more than once at night, and awakened by others. Importantly, in Sneddon and colleagues (2013) principle components factor analysis, these items were allowed to load on all factors, and many of them had loadings greater than 0.30 on more than one factor. Thus, it is not surprising that in a CFA framework, these items reduced model fit.

The results of this CFA indicate a number of potential revisions to the CSHQ-PV that would improve upon the measure. First, the items on the CSHQ-PV are currently answered using a 3-point scale of rarely (0-1 nights per week), sometimes (2-4 nights per week), and usually (5-7 nights per week). This response scale, however, resulted in highly skewed items, especially for items assessing infrequent behaviors such as sleepwalking, snorting/gasping, and awakening alarmed by frightening dreams. It is recommended, therefore, that a larger scale be used to ensure greater variability. A 5-point scale of never (0 nights per week), rarely (1-2 nights per week), sometimes (3-4 nights per week), often (5-6 nights per week), and always (7 nights per week) could be piloted, as could a 7-point scale in which parent simply indicate how many nights per week, on average, a behavior occurs. The utility of both scales could be assessed empirically to determine which scale best discriminates among children.

Second, a number of items did not appear to be related to sleep in three- to five-year old children. As suggested by others (Goodlin-Jones et al., 2008; Sneddon et al., 2013) items pertaining to bed wetting and appearing sleepy while watching TV or riding in the car are not appropriate to use to assess sleep in preschool-aged children. However, a number of other items also emerged as unrelated to sleep in the current sample (fear of the dark, sleeping too little, talking during sleep, restlessness, trouble sleeping away from home, awakens screaming, alarmed by scary dreams, wakes up more than once at night, and awakened by others) . It is possible that some of these behaviors are either so common (e.g., fear of the dark, trouble sleeping away from home, being awakened by others in the morning) or so uncommon (e.g., grinding teeth, snoring, awakens screaming) that these items are not related to sleep quality in preschool-aged children. As such, when using the CSHQ-PV for research purposes, these items should be considered for removal.

Overall, it is recommended that the revised factor structure as reported in this study is used in research as a more psychometrically sound measurement of sleep than the original eight-factor structure, if future research finds this revised structure to work well in more racially and ethnically diverse samples. However, the original factor structure and items may still be used in clinical practice to obtain more nuanced information regarding highly atypical behaviors (e.g., those related to sleep apnea) which would be important to know when planning appropriate treatment interventions. Nevertheless, future research should examine the revised factor structure in a clinical population and examine how useful it is in classifying preschoolers with sleep problems. It may be particularly useful for future research to determine a cut-off score to use for the revised factor structure to best classify non-clinical and clinical sleep problems.

Concurrent and Longitudinal Analyses

Prior research indicates significant associations between child temperament and BMI in children (e.g., Agras, Hammer, McNicholas, & Kraemer, 2004; Carey, 1985; Darlington & Wright, 2006; Pulkki-Råback et al., 2005). Less research, however, has examined the mechanisms underlying this relationship. However, it is likely that child temperament relates to key health behaviors, such as parental feeding practices and child sleep problems, which increase one's risk for obesity. Though research has begun to elucidate links between temperament and parental feeding practices and temperament and sleep problems, little research has examined all of these constructs together. Indeed, Bergmeier and colleagues (2013) noted the paucity of rigorous research investigating the relationships among child temperament, health behaviors (e.g., maternal feeding practices, sleep) and weight status in preschoolers, and called for research to examine the relationships among these constructs longitudinally. The second and third aims of this study, therefore, were to examine relationships among the child temperament, sleep, feeding, and BMI both concurrently and longitudinally.

Results of both the concurrent and longitudinal analyses indicate that child reactivity/negativity is significantly related to parental feeding strategies (both emotional and instrumental, concurrently, and emotional feeding longitudinally) and to child sleep problems. That is, parents who indicated that their children were more reactive/negative indicated engaging in more emotional and instrumental feeding strategies concurrently. Moreover, reactivity/negativity at T1 predicted the use of more emotional feeding strategies six months later. Children rated as more reactive/negative were also rated by parents as having more sleep problems, and greater T1 reactivity/negativity predicted greater sleep problems at T2. Though reactivity/negativity, feeding strategies, and sleep problems did not significantly relate to zBMI in either the final concurrent or longitudinal model, results provide preliminary evidence of two possible mechanisms by which reactivity/negativity may be related to greater zBMI.

First, reactivity/negativity appears to be related to the use of more "non-nutritive" feeding strategies (i.e., using food to manage emotions or behavior, rather than using food to provide nutrition). That is, for preschoolers who are characterized as high in negativity (e.g., sadness, anger/frustration, low levels of soothability), parents are more likely to use food to help their children feel better when they are feeling upset, hurt, worried, or angry. Moreover, parents of highly reactive/negative preschoolers also reported engaging in more instrumental feeding strategies, such as using food as a reward for good behavior. The second possible mechanism underlying the relationship between reactivity/negativity and greater BMI is increased sleep problems. In the current study, greater negativity/reactivity was related to greater sleep problems both concurrently and longitudinally. These results are consistent with recent cross-sectional research that indicates that more difficult temperament traits are related to greater sleep problems (Molfese et al., 2015; Wilson et al., 2014).

Though the reactivity/negativity component of temperament related to parental feeding strategies and child sleep problems as expected, effortful control did not relate significantly to either parental feeding strategies or sleep problems. Few studies have actually examined the relationship between effortful control and parental feeding styles. Among those that have, Tan and Holub (2011) found that parents were more likely to use highly restrictive feeding practices with children who had lower self-regulatory abilities, such as inhibitory control. Moreover, Horn and colleagues (2011) conducted a sibling study and found that parents used more restrictive feeding styles for the sibling who was rated as less persistent (i.e., more distractible).Thus, these studies suggest that effortful control may be related to greater restrictive feeding practices. However, as aforementioned, the control subscale of the PFSQ seems to be a “healthier” form of control (i.e. monitoring) than the restrictive feeding styles examined in prior studies (i.e., Horn et al., 2011; Tan & Holub, 2011). Whether a parent monitors their child’s feeding may be more related to parent characteristics (e.g., general parenting styles) than child temperament. In regard to the more non-nutritive feeding practices, poorer effortful control was related to greater instrumental and emotional feeding in longitudinal bivariate analyses. However, after controlling for numerous covariates, including child reactivity, these relationships no longer emerged. In fact, when child reactivity/negativity was removed from the model in which T1 temperament predicted T2 emotional feeding strategies, poorer T1 effortful control remained a significant predictor of T2 emotional feeding (p = 0.043). Thus, these results suggest that the temperamental characteristics shared between effortful control and reactivity/negativity relate to emotional feeding, but that the temperament characteristics unique to effortful control do not.

In regard to sleep, prior research has demonstrated a relationship between effortful control and sleep problems (Aviezer & Scher, 2013; Kushnir et al., 2014; El-Sheikh & Buckhalt, 2005). In the current study, poorer effortful control was significantly related to greater difficulty at bedtime, poorer sleep duration, and greater total sleep disturbances in concurrent bivariate analyses. However, after controlling for reactivity/negativity, as well as numerous covariates (including child age, sex, length of breastfeeding), the relationship between effortful control and sleep disturbances became non-significant. After removing reactivity/negativity (and perception of child as a picky eater) from this model child sex and parental depression remained the only significant predictors of T2 total sleep problem. Thus, these results reflect a possible common-rater bias, such that depressed parents are more likely to rate their child as being more reactive/negative, a pickier eater, and more problematic in regard to sleep. It appears as though this effect may be overpowering the true effect between effortful control and sleep problems. As such, it will be important for future research to use multi-method/reporters when examining how effortful control relates to sleep problems and risk for obesity.

Interestingly, feeding practices and sleep problems did not predict zBMI either concurrently or longitudinally in the current study. Though some research does suggest direct effects between non-nutritive feeding strategies and greater BMI (Rodgers et al., 2013) and sleep problems and greater BMI (see Cappucio et al., 2008 and Hart et al., 2011 for reviews), it is possible that a six-month follow-up was not enough time for these feeding strategies and sleep problems to influence zBMI. However, it is also possible that non-nutritive feeding strategies and sleep problems actually have an indirect effect on BMI through the development of unhealthy eating behaviors. For example, research suggests that emotional feeding teaches children to use food as a tool to distract from or alleviate adverse emotions (Blisset, Haycraft, & Farrow, 2010; Farrow, Haycraft, & Blissett, 2015), while instrumental feeding strengthens children's preference for the foods used to reward, typically highly palatable and energy-dense foods (Benton, 2004; Evans, Seth, Smith et al., 2011; Raaijmakers, Gever, Teuscher, Kremers, & van Assema, 2014; Saxton, Carnell, van Jaarsveld, & Wardle., 2009). Indeed, these "non-nutritive" feeding practices predict children's unhealthy eating practices over time, including emotional eating (Braden et al., 2015; Farrow, Haycraft, & Blisset, 2015) and greater snacking (Sleddens, Kremers, De Vries, & Thijs, 2010; Vereecken, Keukelier, & Maes, 2004), as well as increased food responsiveness (Ainuki & Akamatsu, 2011). Emotional feeding, greater snacking, and increased food responsiveness are all linked with greater BMI (e.g., Braet, 2008; Carper, Fisher & Birch, 2000; Sleddens et al., 2010). In regard to sleep, poor sleep impairs executive functions (Beebe et al., 2008; Dahl, 1996), alters reward processing (e.g., Chaput, 2013; Gujar, Yoo, Hu, & Walker, 2011), increases negative emotionality (e.g., Yoo, Gujar, Hu, Jolesz, & Walker, 2007), and impairs impulse control (e.g., Paavonen et al., 2009), all of which make it difficult to resist overeating highly palatable foods (see Lundahl & Nelson, 2015 for a review). Together, therefore, this research suggests that temperament may influence parental feeding strategies and children's sleep patterns, both of which influence the development of unhealthy eating patterns over time and ultimately increase one's risk for obesity. It is unlikely that six months was enough time, however, for these patterns to emerge.

Moderator Analyses

The final aim of the study was to examine the moderating role of SES in relationships among temperament, sleep, feeding practices, and child zBMI. It was expected that the relationships among these constructs would be stronger in low SES as compared to high SES families, given that more difficult temperament characteristics (e.g., Jansen et al., 2009), sleep problems (Buckhalt, 2011), problematic feeding practices (e.g., Baughcum et al., 2011; Blisset & Haycraft, 2008; Musher-Eizenman et al., 2009), and greater BMI (McLaren, 2007) are all higher among low SES individuals. However, in this study, income-to-needs ratio (which was used to represent SES) did not emerge as a significant predictor or moderator of any these relationships when factors such as parental BMI, parental depression, and length of breastfeeding were controlled for.

When covariates were removed from both the concurrent and longitudinal models, different patterns of results did emerge. For example, in the concurrent model, the reactivity/negativity by income-to-needs ratio interaction term significantly predicted instrumental feeding, suggesting that the effect of reactivity/negativity on instrumental feeding becomes weaker (less positive) as income-to-needs ratio increases, suggesting that the effect of reactivity/negativity on instrumental feeding is greater for lower-income families than higher-income families. Moreover, greater income-to-needs ratio related significantly to lower zBMI. Compared to the model that included covariates, these results would suggest that the part of SES that is related to zBMI is accounted for by parental BMI and length of breastfeeding. In the longitudinal model, the income-to-needs ratio by T1 reactivity/negativity interaction term also emerged as a significant predictor of T2 total sleep disturbance, such that the effect of reactivity/negativity on total sleep problems became weaker (less positive) as income-to-needs ratio increases, suggesting that the effect of reactivity/negativity on sleep problems six months later is greater for low-income families. A greater income-to-needs ratio also significantly related to lower zBMI. Again, comparing these results to the model that included covariates, these results suggest that the effect of income-to-needs ratio is largely accounted for by parental depression, parental BMI, and length of breastfeeding.

As such, SES, as assessed in the present study, did not relate to nor interact with the relationships between temperament, feeding, sleep, and BMI after accounting for important covariates. It is possible that other indicators of SES, such as parental occupation or education, may relate to and interact differently with these constructs. Though each indicator of SES has strengths and imitations in regard to assessing the relationship between SES and health outcomes (Wang, 2001; Zhang & Wang, 2004), the income-to-needs ratio was chosen as it is the most continuous and quantitative indicator of SES, thus allowing for more variation among individuals (Wang & Zhang, 2006).

However, it is possible that parental occupation or education may relate different to temperament, feeding, sleep, and BMI. As such, future research should examine how different indicators of SES relate differently to these constructs.

Though the lack of significant interactions with SES in the current study may be due to methodological limitations, it is also possible that the relationships among temperament, sleep, feeding practices, and BMI are either universal across SES levels or depend on other sociodemographics, such as ethnicity. Indeed, not all research examining the effect of SES on health indicators such as sleep, feeding, and BMI indicates significant relationships between SES and these constructs. Indeed, others have also not found significant effects of SES on sleep using either objective or subjective measurements of sleep, including the CSHQ (e.g., Werner et al., 2008; Olds et al., 2010; Owens et al., 2000), feeding (Carnell & Wardle, 2012; Spruijt-Metz, Lindquist, Birch, Fisher, & Goran, 2002), or BMI (Ball, Kylie, & Brawford, 2005 for review; Wang & Zang, 2006; Zhang & Wang, 2004). Indeed, research indicates that the relationship between SES indicators and BMI in both children and adults has weakened over time given the increasingly prevalent nature of sedentary lifestyles in high-SES groups (Wang & Zhang, 2006). Moreover, El-sheikh and colleagues (2013) demonstrated that different SES indicators relate to subjectively and objectively measured sleep outcomes differently, and that ethnicity often moderated the effect of SES on sleep such that effects were stronger for African-American versus White children. Specifically, income-to-needs ratio was related to child-reported sleep/wake problems, but this was moderated by ethnicity (El-Sheikh et al., 2013). Similar findings have also been found in regard to the relationship between SES and BMI (Wang & Zang, 2006). It is also possible, therefore, that the effects of SES on the relationships examined in this study differ by ethnicity. However, given the limited variability of ethnicity in this study, meaningful comparisons across ethnicities could not be made. Future research should recruit more ethnically-diverse samples to examine how these relationships differ across groups.

Exploratory Analyses.

Lastly, a series of exploratory path analyses were conducted to examine, preliminarily, the relationships between temperament, sleep, and feeding. Results of these exploratory analyses, for which there were no a priori hypotheses, indicate that total sleep problems have a significant direct and indirect relationship with emotional feeding via increased reactivity/negativity, both concurrently and longitudinally. That is, as sleep problems increase, both reactivity/negativity and emotional feeding strategies increase, and one mechanism by which sleep problems relates to increased emotional feeding strategies is via increased reactivity/negativity. Though no research has examined the relationship between child sleep problems and parental feeding styles, these results suggest that sleep problems may increase reactivity/negativity, which subsequently increases the risk for emotional feeding. This is consistent with research that suggests that child sleep problems relate to emotional dysregulation (e.g., Yoo, Gujar, Hu, Jolesz, & Walker, 2007). These results suggest that parents may respond to this emotional dysregulation associated with poor sleep by using emotional feeding strategies. Future research should examine these relationships more systematically.

Implications of Findings

The results of this study have important implications for obesity prevention and treatment efforts. Overall, results suggest that more reactive/negative preschoolers are more likely to be emotionally and instrumentally fed. Emotional and instrumental feeding styles can teach children to eat in response to external cues, such as negative emotions, rather than relying on cues of hunger and satiety (Blissett, Haycraft, & Farrow, 2010; Braden et al., 2014). Moreover, the foods provided to children in emotional and instrumental feeding situations are typically highly palatable and energy-dense (Evans et al., 2011; Saxton, Carnell, van Jaarsveld, & Wardle, 2009). In fact, Raaijmakers and colleagues (2014) found that the foods most frequently used to comfort children or be used as a reward were candy, cookies, chocolate, and ice cream. Thus, not only are children receiving unhealthy foods in these contexts, but the contexts in which these foods are given increases the preferences for these foods over time (Carnell & Wardle, 2007). Emotional and instrumental feeding styles, therefore, set children up to prefer energy-dense foods and rely on cues other than hunger and satiety to guide their eating behavior, behaviors strongly associated with unhealthy weight trajectories (Braet, 2008; Carper, Fisher & Birch, 2000; Sleddens et al., 2010). This is especially problematic for children with more difficult temperamental traits, given that they experience emotions more reactively than less difficult children. Moreover, results suggest that reactive/negative preschoolers are more likely to have sleep problems and that greater sleep problems are related to the use of more emotional feeding strategies. Thus, sleep problems appear to further increase the likelihood of being emotionally fed, suggesting that reactive/negative preschoolers with sleep problems are at the greatest risk of being fed in a non-nutritive manner. Importantly, the relationships that emerged in this study appear to be universal in regard to socioeconomic status, indicating the pervasiveness of these effects across all socioeconomic levels.

These results indicate the importance of obesity prevention and treatment efforts to include a focus on child temperament, sleep, and parental feeding practices. Specifically, such efforts should include a strong behavioral focus. That is, parents should be provided education on and strategies for behavioral management techniques that do not involve the use of food to comfort, reward, or punish. For example, parents could be encouraged to think of healthier rewards for good behavior (e.g., going for a walk with parents instead of going for ice cream), and learn how to more effectively manage difficult behavior, especially around challenging daily activities such as meal times and bedtime. Moreover, parents could be provided with information about how to help their children cope with difficult emotions without using food (e.g., modeling appropriate behavior, using emotion words, discussing the fleeting nature of emotions, teaching alternatives).

These results also highlight the increasing need to consider sleep in efforts to reduce childhood obesity. Screening for sleep problems should be a standard component of obesity prevention and treatment programs and more specific sleep interventions should be pursued, if necessary. In fact, treatment of sleep problems may improve emotional reactivity and difficult behaviors (Meltzer & Mindell, 2014), which may indirectly reduce the use of emotional and instrumental feeding practices. However, even if significant sleep problems are not identified, basic sleep hygiene education should be provided to all parents, and should include discussions of the consequences of poor sleep (e.g., more obesogenic feeding and eating practices).

Lastly, findings from this study suggest that prevention and treatment efforts for childhood obesity may be improved upon by including a focus on improving parents coping resources. The results of this study imply that parents with highly reactive/negative preschoolers respond to their children's difficult behavior and emotional experiences by feeding. It is possible that by including information regarding coping strategies, such as acceptance and mindfulness-based skills, parents may be better able to manage their own emotional responses to their children's behavior and thus, respond in a manner that does not rely on food to soothe or reward.

Future Directions

In addition to having important implications for health promotion and intervention programs, the results from the present study also indicate the need for future research in a number of areas. First, results indicate the need for future research to refine the measurement of parental feeding styles and children's sleep problems using the PFSQ and CSHQ-PV, respectively. Results suggested the need for both measures to undergo revision to ensure that questions are worded in a manner that does not result in unintended measurement effects (e.g., reverse-coding) and for appropriateness to preschool populations. Moreover, future research should conduct invariance testing of final models in the current study across groups (e.g., mothers/fathers; SES), as well as time in order to further establish reliability. Concurrent and criterion validity should also be examined by associated the measures with well-validated measures of feeding and sleep (e.g., actigraphy). Lastly, future research should examine the proposed factor structures in more racially and ethnically diverse samples, as well as clinical populations, especially in regard to the CSHQ-PV. The utility of the revised factor structure of the CSHQ-PV in correctly classifying preschoolers with sleep problems will be especially important for maximizing the usefulness of the revised CSHQ-PV factor structure in both research and clinical settings.

This study also provides one of the first investigations of the mechanisms by which temperament relates to zBMI both concurrently and longitudinally. As expected, results indicate that more reactive/negative preschoolers are more likely to be fed in non-nutritive manners (e.g., emotionally or instrumentally) and to have sleep problems both concurrently and longitudinally. However, because this is one of the first studies examining these relationships, further systematic evaluation is needed to replicate and build upon these findings. First, future research should examine these longitudinal relationships using follow-up periods greater than six-months to better capture the long-term effects of sleep problems and obesogenic feeding practices on BMI in preschoolers. Moreover, future research should consider using objective measurements of sleep (e.g., actigraphy) and more accurate objective measurements of adiposity (e.g., skin-fold thickness) to assess even more rigorously the relationships among these constructs.

Although this study provides a useful first look at the relationship between temperament, feeding styles, sleep, and BMI in a healthy sample of preschoolers, the present study did not assess how temperament, feeding styles, and sleep impact preschooler's eating behaviors. However, both feeding practices and sleep problems are known risk-factors for the development of unhealthy child eating behaviors (Anzman et al., 2010; McDermott, Mamun, Najman, Williams, O'Callaghan, & Bor, 2008; Rodgers et al., 2013). Future research should examine the direct and indirect effects of child temperament on child eating behaviors, via both parental feeding practices and sleep problems. It is likely that child temperament (e.g., greater reactivity/negativity) would relate to greater sleep problems and more non-nutritive feeding strategies, which would interact to produce more obesogenic eating styles. Longer term follow-up studies, then, could examine the implications this pathway has for BMI trajectories.

Lastly, the exploratory analyses suggest that sleep may influence feeding styles. Future research should examine how sleep relates to parental feeding styles using objective measurements (e.g., actigraphy) and rigorous methodology and design. For example, the effect of inadequate sleep on parental feeding styles could be measured at the daily-level by using actigraphy and assessing temperament and feeding styles with daily reports. Such research would provide an in-depth look at the sequential relationships between sleep, temperament, and feeding and provide important implications for obesity and treatment efforts.

Limitations

Although the present study has made significant contributions to the literature by describing how temperament relates to sleep and feeding practices in a sample of healthy preschoolers, limitations do exist. First, a number of limitations in regard to measurement exist. All of the measures, aside from BMI, were parent-report. As such, common-rater bias may exist and thus, future research should use multi-method, multi-rater measures. In addition, CFA results using the PFSQ and CSHQ-PV indicate that the core structures of these measures were not strong and that future research is needed to further establish their reliability and validity. This is especially true in regard to invariance testing, which was not conducted in the current study due to the weak structure of these scales. Moreover, at T1, there was a clerical error in the sleep measurement, in which the scale on the CSHQ-PV was inadvertently changed to a 5-point, rather than 3-point, scale. As such, sleep was not measured using the same scale across the two time points, which limited the analyses in which sleep at T1 predicted T2 behaviors. This error also necessitated the CFA analyses to be conducted at T2 instead of T1, which resulted in a smaller sample size for these analyses.

Limitations also exist in the measurement of BMI. Despite being the most commonly used measurement of adiposity in both children and adults (Brambilla, Badogni, Hao, & Pietrobelli, 2013), BMI is plagued by a number of limitations. For example, BMI is not an accurate measure of percent body fat (Mel, Grummer-Strawn, Pietrobelli, Goulding, Goran, & Dietz, 2002), as it is not able to differentiate adipose-tissue from adipose-free tissue. Moreover, BMI does not provide information regarding body fat distribution. Research suggests that where body fat is distributed on the body may be a more accurate measurement than total adiposity of one's obesity risk (McCarthy & Ashwell, 2006). Lastly, it is likely that six months was not enough time for sleep problems and feeding strategies to exert a measureable effect on zBMI. Indeed, a comparison between T1 and T2 zBMI scores indicate no change ($t(184) = 0.399$, $p = 0.690$). These limitations may explain why reactivity/negativity, sleep problems, or feeding strategies did not emerge as significant predictors of zBMI in either the final concurrent or longitudinal models. It is possible, however, that these effects did not emerge as a number of very strong predictors of child zBMI were included in the model, such as parental BMI (Keane, Layte, Harrington, Kearney & Perry, 2012; Magarey, Daniels, Boulton, & Cockington, 2003; Whitaker, Jarvis, Becken, Boniface, & Wardle, 2010) and length of breastfeeding (Dietz, 2001; Grummer-Strawn & Mei, 2004).

Lastly, drop-out analyses indicated that differences did exist among those who remained in the study and those who dropped out. Specifically, the parents of preschoolers who dropped out were more likely to be ethnically-diverse, younger, and less educated. As such, representativeness of the sample at T2 may be reduced in comparison to the broader practice.

Conclusions

The purpose of the present study was to examine potential mechanisms underlying the relationship between temperament and BMI in a sample of healthy preschoolers. Results have made a significant contribution to the literature by supporting the hypothesis that child temperament is related to and predicts sleep problems and obesogenic parental feeding practices. These findings have a number of important implications. First, reactivity/negativity predicts the use of non-nutritive feeding practices. Second, reactivity/negativity also predicts greater sleep problems. Third, the effect of reactivity/negativity on non-nutritive feeding practices and sleep problems appears to be universal across socioeconomic classes. Finally, by including an emphasis on temperament, feeding practices, and sleep in health promotion and intervention efforts, health outcomes may be improved.

CHAPTER 7: REFERENCES

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Table 1. *T1 and T2 descriptive statistics for child demographics*

	Time 1				Time 2			
Variable	**N**	**%**	**Mean**	**SD**	**N**	**%**	**Mean**	**SD**
Child age (months)	297		53.87	10.66	188		60.82	10.88
Child zBMI	291		0.35	1.16	188		0.37	1.17
Child Gender	297				188			
Male	150	50.5			90	47.9		
Female	147	49.5			98	51.1		
Child Ethnicity	296				186			
White	224	75.7			148	79.8		
African-American	13	4.4			11	5.9		
Hispanic-American	16	5.4			10	5.3		
Asian-American	10	3.4			10	5.3		
Native-American	0	0.0			0	0.0		
Other	33	11.1			7	3.7		

Table 2. *T1 and T2 descriptive statistics on parent demographics*

	Time 1				Time 2			
Variable	**N**	**%**	**Mean**	**SD**	**N**	**%**	**Mean**	**SD**
Parent Age	295		33.47	6.24	175		34.87	6.22
Parent BMI	290		27.30	6.09	177		28.10	7.68
Annual Income	252		77,478.15	63,714.49	169		81,397.13	74,296.74
Parent Gender	297				185			
Male	44	14.8			43	23.2		
Female	253	85.2			142	76.8		
Parent Ethnicity	296				186			
White	242	81.8			157	84.4		
African-American	8	2.7			6	3.2		
Hispanic-American	21	7.1			8	4.3		
Asian-American	7	2.4			5	2.7		
Native-American	2	0.7			4	2.2		
Other	16	5.4			6	3.2		
Parent Education	291				187			
Less than High School	10	3.4			4	2.1		
High School Graduate	76	26.1			48	25.7		
Associates Degree	73	25.1			37	19.8		
Bachelor's Degree	89	30.6			64	34.2		
Master's Degree	35	12.0			26	13.9		
Doctorate Degree	8	2.7			8	4.3		
Marital Status	261				165			
Single, Never Married	45	17.2			21	12.7		
Single, Divorced	17	6.5			14	8.5		
Separated	4	1.5			1	0.6		
Cohabiting	11	4.2			9	5.5		
Married	184	70.5			120	72.7		
Depression Diagnosis	296				188			
No	237	80.1			147	78.2		
Yes	59	19.9			41	21.8		
Breastfed	295				172		7.33	6.99
No	73	24.7			33	19.2		
Yes	222	75.3			139	80.8		

Table 3. *Parental Feeding Style Questionnaire (PFSQ) item-level descriptive statistics*

	Min	Max	Mean	SD	Skewness	Kurtosis
I allow my child to choose which foods to have for meals	1.00	5.00	3.22	0.63	0.44	1.59
I decide how many snacks my child should have	1.00	5.00	4.35	0.79	-1.25	1.78
I allow my child to wander around during a meal	1.00	5.00	4.37	0.75	-1.07	1.02
I let my child decide when s/he would like to have her meal	1.00	5.00	4.01	0.89	-0.77	0.55
I allow my child to decide when s/he has had enough snacks to eat	1.00	5.00	3.94	1.07	-0.96	0.38
I decide when it is time for my child to have a snack	1.00	5.00	3.89	0.94	-0.88	0.85
I decide the times when my child eats his/her meals	1.00	5.00	4.25	0.83	-1.57	3.59
I let my child eat between meals whenever s/he wants	1.00	5.00	3.99	0.84	-0.60	0.17
I insist my child eats meals at the table	2.00	5.00	4.53	0.62	-1.05	0.48
I decide what my child eats between meals	1.00	5.00	3.99	0.79	-0.80	1.46
I give my child something to eat to make him/her feel better when s/he is feeling upset	1.00	4.00	1.96	0.74	0.32	-0.41
I give my child something to eat to make him/her feel better when s/he has been hurt	1.00	5.00	1.81	0.82	0.85	0.63
I give my child something to eat if s/he is feeling bored	1.00	4.00	1.34	0.52	1.33	1.65
I give my child something to eat to make him/her feel better when s/he is worried	1.00	4.00	1.34	0.57	1.56	2.01
I give my child something to eat to make him/her feel better when s/he is feeling angry	1.00	4.00	1.32	0.55	1.78	3.51
I encourage my child to look forward to the meal	1.00	5.00	3.61	0.94	-0.68	0.24
I praise my child if s/he eats what I give him/her	1.00	5.00	3.91	0.92	-0.81	0.55
I encourage my child to eat a wide variety of foods	2.00	5.00	4.54	0.64	-1.30	1.54
I present food in an attractive way to my child	1.00	5.00	3.48	0.85	-0.49	0.45
I encourage my child to taste all the foods I serve at mealtime	1.00	5.00	4.61	0.66	-2.08	6.00
I encourage my child to try foods that s/he hasn’t tasted before	1.00	5.00	4.45	0.70	-1.43	3.24
I encourage my child to enjoy his/her food	1.00	5.00	4.16	0.78	-0.92	1.28
I praise my child if s/he eats a new food	1.00	5.00	4.42	0.88	-1.98	4.29
To get my child to behave, I promise him/her something to eat	1.00	5.00	1.92	0.82	0.74	0.56
If my child misbehaves, I withhold his/her favorite food	1.00	5.00	1.61	0.84	1.29	1.19
I use puddings as a bribe to get my child to eat his/her main course	1.00	5.00	1.35	0.74	2.25	4.77
I give my child something to eat when s/he is well behaved	1.00	5.00	2.27	0.85	-0.01	-0.67

Table 4. *Corrected item-total correlations for PFSQ items*

Description of Subscale Items	**Corrected Item-Total Correlation**
CONTROL OVER FEEDING	
Item 1. I allow my child to choose which foods to have for meals – **Reverse Coded**	0.30*
Item 2. I decide how many snacks my child should have	0.56
Item 3. I allow my child to wander around during a meal – **Reverse Coded**	0.41
Item 4. I let my child decide when s/he would like to have her meal – **Reverse Coded**	0.42
Item 5. I allow my child to decide when s/he has had enough snacks to eat – **Reverse Coded**	0.43
Item 6. I decide when it is time for my child to have a snack	0.55
Item 7. I decide the times when my child eats his/her meals	0.52
Item 8. I let my child eat between meals whenever s/he wants – **Reverse Coded**	0.50
Item 9. I insist my child eats meals at the table	0.42
Item 10. I decide what my child eats between meals	0.46
EMOTIONAL FEEDING	
Item 1. I give my child something to eat to make him/her feel better when s/he is feeling upset	0.59
Item 2. I give my child something to eat to make him/her feel better when s/he has been hurt	0.67
Item 3. I give my child something to eat if s/he is feeling bored	0.52
Item 4. I give my child something to eat to make him/her feel better when s/he is worried	0.67
Item 5. I give my child something to eat to make him/her feel better when s/he is feeling angry	0.64
ENCOURAGEMENT AND PROMPTING	
Item 1. I encourage my child to look forward to the meal	0.38
Item 2. I praise my child if s/he eats what I give him/her	0.38
Item 3. I encourage my child to eat a wide variety of foods	0.46
Item 4. I present food in an attractive way to my child	0.43
Item 5. I encourage my child to taste all the foods I serve at mealtime	0.47
Item 6. I encourage my child to try foods that s/he hasn't tasted before	0.52
Item 7. I encourage my child to enjoy his/her food	0.46
Item 8. I praise my child if s/he eats a new food	0.44
INSTRUMENTAL FEEDING	
Item 1. To get my child to behave, I promise him/her something to eat	0.51
Item 2. If my child misbehaves, I withhold his/her favorite food	0.36
Item 3. I use puddings as a bribe to get my child to eat his/her main course	0.25*
Item 4. I give my child something to eat when s/he is well behaved	0.41

**Indicates item with corrected item-total correlation* $\leq$ *0.30*

Table 5. *Standardized factor loadings for original 4-factor PFSQ model*

	Std. Factor Loading	S.E.	p
CONTROL OVER FEEDING			
Item 1. I allow my child to choose which foods to have for meals – **Reverse Coded**	0.293	0.069	<0.001
Item 2. I decide how many snacks my child should have	0.646	0.046	<0.001
Item 3. I allow my child to wander around during a meal – **Reverse Coded**	0.459	0.082	<0.001
Item 4. I let my child decide when s/he would like to have her meal – **Reverse Coded**	0.425	0.077	<0.001
Item 5. I allow my child to decide when s/he has had enough snacks to eat – **Reverse Coded**	0.427	0.064	<0.001
Item 6. I decide when it is time for my child to have a snack	0.621	0.064	<0.001
Item 7. I decide the times when my child eats his/her meals	0.645	0.053	<0.001
Item 8. I let my child eat between meals whenever s/he wants – **Reverse Coded**	0.559	0.061	<0.001
Item 9. I insist my child eats meals at the table	0.501	0.064	<0.001
Item 10. I decide what my child eats between meals	0.534	0.076	<0.001
EMOTIONAL FEEDING			
Item 1. I give my child something to eat to make him/her feel better when s/he is feeling upset	0.673	0.052	<0.001
Item 2. I give my child something to eat to make him/her feel better when s/he has been hurt	0.760	0.046	<0.001
Item 3. I give my child something to eat if s/he is feeling bored	0.612	0.056	<0.001
Item 4. I give my child something to eat to make him/her feel better when s/he is worried	0.759	0.061	<0.001
Item 5. I give my child something to eat to make him/her feel better when s/he is feeling angry	0.692	0.063	<0.001
ENCOURAGEMENT AND PROMPTING			
Item 1. I encourage my child to look forward to the meal	0.307	0.106	0.004
Item 2. I praise my child if s/he eats what I give him/her	0.285	0.102	0.005
Item 3. I encourage my child to eat a wide variety of foods	0.577	0.066	<0.001
Item 4. I present food in an attractive way to my child	0.449	0.068	<0.001
Item 5. I encourage my child to taste all the foods I serve at mealtime	0.723	0.073	<0.001
Item 6. I encourage my child to try foods that s/he hasn't tasted before	0.756	0.069	<0.001
Item 7. I encourage my child to enjoy his/her food	0.435	0.079	<0.001
Item 8. I praise my child if s/he eats a new food	0.394	0.079	<0.001
INSTRUMENTAL FEEDING			
Item 1. To get my child to behave, I promise him/her something to eat	0.722	0.047	<0.001
Item 2. If my child misbehaves, I withhold his/her favorite food	0.425	0.068	<0.001
Item 3. I use puddings as a bribe to get my child to eat his/her main course	0.349	0.089	<0.001
Item 4. I give my child something to eat when s/he is well behaved	0.643	0.059	<0.001

Table 6. *PFSQ confirmatory factor analysis model comparisons*

Model	**# Items**	**# Est. Par.**	**X^2 Value**	**X^2 Scale Factor**	**X^2 DF**	**X^2 p**	**CFI**	**SRMR**	**RMSEA**	**RMSEA Lower CI**	**RMSEA Higher CI**	**RMSEA p**
Model 1. Four Factor	27	87	748.39	1.11	318	<0.001	0.753	0.077	0.067	0.061	0.073	<0.001
Model 2. Four Factor, items with CITC ≤ 0.30 removed	25	81	618.61	1.12	269	<0.001	0.783	0.076	0.066	0.059	0.073	<0.001
Model 3. Five Factor Encouragement subscale divided)	25	85	562.44	1.13	265	<0.001	0.815	0.069	0.061	0.054	0.068	0.005
Model 4. Five Factor (praise items removed)	23	79	421.71	1.13	220	<0.001	0.862	0.055	0.055	0.047	0.063	0.135
Model 5. Five Factor ("where" items removed)	21	73	298.39	1.15	179	<0.001	0.906	0.056	0.047	0.038	0.056	0.683

Table 7. *Standardized item factor loadings for final five factor PSFQ model*

	Std. Factor Loading	S.E.	p	Residual variance
CONTROL OVER FEEDING				
Item 2. I decide how many snacks my child should have	0.690	0.047	<0.001	0.524
Item 4. I let my child decide when s/he would like to have her meal – **Reverse Coded**	0.400	0.074	<0.001	0.840
Item 5. I allow my child to decide when s/he has had enough snacks to eat – **Reverse Coded**	0.426	0.071	<0.001	0.819
Item 6. I decide when it is time for my child to have a snack	0.673	0.062	<0.001	0.547
Item 7. I decide the times when my child eats his/her meals	0.664	0.054	<0.001	0.559
Item 8. I let my child eat between meals whenever s/he wants – **Reverse Coded**	0.531	0.065	<0.001	0.718
Item 10. I decide what my child eats between meals	0.513	0.081	<0.001	0.737
EMOTIONAL FEEDING				
Item 1. I give my child something to eat to make him/her feel better when s/he is feeling upset	0.685	0.051	<0.001	0.531
Item 2. I give my child something to eat to make him/her feel better when s/he has been hurt	0.771	0.045	<0.001	0.406
Item 3. I give my child something to eat if s/he is feeling bored	0.600	0.057	<0.001	0.640
Item 4. I give my child something to eat to make him/her feel better when s/he is worried	0.747	0.065	<0.001	0.442
Item 5. I give my child something to eat to make him/her feel better when s/he is feeling angry	0.682	0.064	<0.001	0.535
PROMPTING TO EAT				
Item 1. I encourage my child to look forward to the meal	0.457	0.102	<0.001	0.791
Item 4. I present food in an attractive way to my child	0.572	0.078	<0.001	0.673
Item 7. I encourage my child to enjoy his/her food	0.610	0.074	<0.001	0.627
ENCOURAGEMENT OF VARIETY				
Item 3. I encourage my child to eat a wide variety of foods	0.551	0.079	<0.001	0.696
Item 5. I encourage my child to taste all the foods I serve at mealtime	0.758	0.054	<0.001	0.426
Item 6. I encourage my child to try foods that s/he hasn't tasted before	0.801	0.051	<0.001	0.358
INSTRUMENTAL FEEDING				
Item 1. To get my child to behave, I promise him/her something to eat	0.737	0.048	<0.001	0.457
Item 2. If my child misbehaves, I withhold his/her favorite food	0.409	0.073	<0.001	0.832
Item 4. I give my child something to eat when s/he is well behaved	0.681	0.054	<0.001	0.537

Table 8. *Alpha and Omega reliability coefficients for final five-factor PSFQ model*

	Alpha	**Omega**
Control Over Feeding	0.786	0.754
Emotional Feeding	0.811	0.830
Prompting to Eat	0.550	0.553
Encouragement of Variety	0.741	0.755
Instrumental Feeding	0.613	0.645

Table 9. *Children's Sleep Habits Questionnaire – Preschool Version (CSHQ-PV) item-level descriptive statistics*

	Min	Max	Mean	Std. Dev.	Skewness	Kurtosis	% "rarely/ never"
1. Child goes to bed at the same time at night.	1.00	3.00	1.16	0.38	2.17	3.65	84.70
2. Child falls asleep within 20 minutes after going to bed.	1.00	3.00	1.34	0.59	1.59	1.47	72.90
3. Child falls asleep alone in own bed.	1.00	3.00	1.35	0.68	1.67	1.28	76.20
4. Child falls asleep in parent's or sibling's bed.	1.00	3.00	1.27	0.61	2.07	2.91	81.10
5. Child needs parent in the room to fall asleep.	1.00	3.00	1.32	0.66	1.82	1.81	78.40
6. Child struggles at bedtime	1.00	3.00	1.27	0.55	1.96	2.87	78.40
7. Child is afraid of sleeping in the dark.	1.00	3.00	1.40	0.67	1.41	0.66	70.00
8. Child is afraid of sleep alone.	1.00	3.00	1.24	0.54	2.17	3.73	81.10
9. Child sleeps too little.	1.00	2.00	1.13	0.33	2.27	3.18	87.40
10. Child sleeps the right amount.	1.00	3.00	1.15	0.39	2.53	5.91	86.10
11. Child sleeps about the same amount each day.	1.00	3.00	1.11	0.35	3.23	10.59	89.90
12. Child wets the bed at night.	1.00	3.00	1.25	0.60	2.27	3.67	83.90
13. Child talks during sleep.	1.00	3.00	1.24	0.44	1.44	0.60	76.80
14. Child is restless and moves a lot during sleep.	1.00	3.00	1.42	0.62	1.21	0.39	65.30
15. Child sleepwalks during the night.	1.00	2.00	1.03	0.16	5.97	33.95	97.40
16. Child moves to someone else's bed during the night	1.00	3.00	1.25	0.52	2.03	3.27	79.40
17. Child grinds teeth during sleep	1.00	3.00	1.21	0.50	2.43	5.12	83.70
18. Child snores loudly.	1.00	3.00	1.15	0.40	2.73	7.18	86.80
19. Child seems to stop breathing during sleep.	1.00	2.00	1.01	0.07	13.71	188.00	99.50
20. Child snorts and/or gasps during sleep.	1.00	2.00	1.02	0.14	6.71	43.44	97.90
21. Child has trouble sleeping away from home	1.00	3.00	1.17	0.43	2.50	5.78	84.70
22. Child awakens sweating, screaming, and inconsolable.	1.00	3.00	1.07	0.28	3.97	16.53	93.10
23. Child awakens alarmed by a frightening dream.	1.00	2.00	1.13	0.33	2.27	3.18	87.40

24. Child wakes up once during the night.	1.00	3.00	1.37	0.56	1.25	0.59	67.40
25. Child wakes up more than once during the night.	1.00	2.00	1.08	0.27	3.15	7.99	92.10
26. Child wakes up by him/herself in the morning.	1.00	3.00	1.49	0.67	1.05	-0.11	61.40
27. Child wakes up in a negative mood.	1.00	3.00	1.22	0.43	1.60	1.17	78.90
28. Adults or siblings wake the child	1.00	3.00	1.67	0.70	0.56	-0.84	46.30
29. Child has difficulty getting out of bed in the morning.	1.00	3.00	1.31	0.53	1.50	1.33	72.60
30. Child takes a long time to become alert in the morning	1.00	3.00	1.19	0.43	2.18	4.11	82.60
31. Child seems tired in the morning.	1.00	3.00	1.24	0.45	1.55	1.25	76.70
32. Child appears very sleepy while watching TV.	1.00	3.00	1.16	0.41	2.57	6.22	85.70
33. Child appears very sleepy while riding in the car.	1.00	3.00	1.35	0.52	1.10	0.11	67.40

Table 10. *Corrected item-total correlations for CSHQ-PV items*

BEDTIME RESISTANCE (6 items)	**Corrected Item-Total Correlation**
1. Goes to bed at same time	0.397
3. Falls asleep in own bed	0.652
4. Falls asleep in other's bed	0.573
5. Needs parent in room to sleep	0.652
6. Struggles at bedtime	0.179*
8. Afraid of sleeping alone	0.568
SLEEP ONSET DELAY	
2. Falls asleep in 20 minutes	---
SLEEP DURATION	
9. Sleeps too little	0.460
10. Sleeps the right amount	0.673
11. Sleeps same amount each day	0.639
SLEEP ANXIETY	
5. Needs parent in room to sleep	0.474
7. Afraid of sleeping in the dark	0.346
8. Afraid of sleeping alone	0.659
21. Trouble sleeping away	0.204*
NIGHT WAKINGS	
16. Moves to other's bed in night	0.391
24. Awakes once during night	0.541
25. Awakes more than once	0.404
PARASOMNIAS	
12. Wets the bed at night	0.018*
13. Talks during sleep	0.164*
14. Restless and moves a lot	0.261*
15. Sleepwalks	0.225*
17. Grinds teeth during sleep	0.167*
22. Awakens screaming, sweating	0.319
23. Alarmed by scary dream	0.215*
SLEEP DISORDERED BREATHING	
18. Snores loudly	0.087*
19. Stops breathing	0.138*
20. Snorts/gasps	0.218*
DAYTIME SLEEPINESS	
26. Wakes up himself	0.573
27. Wakes up in negative mood	0.496
28. Others wake child	0.526
29. Hard time getting out of bed	0.668
30. Takes long time be alert	0.455
31. Seems tired	0.580
32. Watching TV	0.298*
33. Riding in car	0.107*

**Indicates item with corrected item-total correlation ≤ 0.30*

Table 11. *CSHQ-PV confirmatory factor analysis model comparisons*

Model	**# Items**	**# Est. Par.**	**X^2 Value**	**X^2 Scale Factor**	**X^2 DF**	**X^2 p**	**CFI**	**SRMR**	**RMSEA**	**RMSEA Lower CI**	**RMSEA Higher CI**	**RMSEA p**
Model 1. 8 Factor	33	--	--	--	--	--	--	--	--	--	--	--
Model 2. 4 Factor proposed by Sneddon et al., (2013)	24	78	518.152	1.164	246	<0.001	0.695	0.096	0.076	0.067	0.085	<0.001
Model 3. 6 Factor – dichotomous items removed	26	93	519.622	1.150	284	<0.001	0.753	0.079	0.066	0.057	0.075	0.002
Model 4. 6 Factor – CITC ≤ 0.30 removed	24	87	448.577	1.140	237	<0.001	0.769	0.077	0.069	0.059	0.078	0.001
Model 5. 5 Factor – Nonsignificant item factor loadings removed	17	61	217.497	1.206	109	<0.001	0.845	0.067	0.072	0.058	0.086	0.006
Model 6. 5 Factor – Redundant item removed	16	58	162.686	1.238	94	<0.001	0.885	0.064	0.062	0.046	0.078	0.108

Table 12. *Standardized item factor loadings for final five-factor CSHQ-PV model*

	Std. Factor Loading	**S.E.**	**p**	**Residual variance**
DIFFICULTY AT BEDTIME				
2. Falls asleep in 20 minutes	0.457	0.131	0.001	0.791
6. Struggles at bedtime	0.531	0.135	<0.001	0.718
1. Goes to bed at same time	0.662	0.126	<0.001	0.562
SLEEP DURATION				
10. Sleeps the right amount	0.806	0.119	<0.001	0.350
11. Sleeps same amount each day	0.834	0.094	<0.001	0.304
SLEEP ANXIETY				
3. Falls asleep in own bed	0.750	0.081	<0.001	0.437
4. Falls asleep in other's bed	0.628	0.093	<0.001	0.606
5. Needs parent in room to sleep	0.834	0.051	<0.001	0.304
8. Afraid of sleeping alone	0.710	0.087	<0.001	0.495
NIGHT WAKINGS				
16. Moves to other's bed in night	0.656	0.161	<0.001	0.570
24. Awakes once during night	0.628	0.157	<0.001	0.605
DIFFICULTY WAKING				
26. Wakes up himself	0.603	0.071	<0.001	0.637
27. Wakes up in negative mood	0.604	0.079	<0.001	0.636
29. Hard time getting out of bed	0.843	0.047	<0.001	0.290
30. Takes long time be alert	0.544	0.083	<0.001	0.704
31. Seems tired	0.729	0.063	<0.001	0.468

Table 13. *Alpha and omega reliability coefficients for final CSHQ-PV model*

	Alpha	**Omega**
Difficulty at Bedtime	0.557	0.531
Sleep Duration	0.801	0.801
Sleep Anxiety	0.818	0.829
Night Wakings	0.583	0.582
Difficulty Waking	0.782	0.625
Total Sleep Disturbance	0.766	0.784

Table 14. *Correlation matrix of T2 variables*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1. T2 Effortful Control	1.00																					
2. T2 Reactivity/Negativity	-.090	1.00																				
3. T2 Instrumental Feeding	-.108	**.240****	1.00																			
4. T2 Control Over Feeding	-.072	-.103	-.025	1.00																		
5. T2 Emotional Feeding	-.116	**.236****	**.629****	**-.217****	1.00																	
6. T2 Difficulty at Bedtime	**-.204****	**.235****	.122	-.068	.058	1.00																
7. T2 Sleep Duration	**-.198****	**.221****	**.244****	-.015	**.254****	**.290****	1.00															
8. T2 Sleep Anxiety	-.133	**.186***	.067	**-.161***	**.219****	**.167***	**.218****	1.00														
9. T2 Difficulty at Waketime	-.128	**.339****	.115	**-.151***	.136	**.305****	**.383****	**.193****	1.00													
10. T2 Night Wakings	-.083	**.290****	.083	-.107	.093	**.242****	**.337****	**.153***	**.889****	1.00												
11. T2 Total Sleep Disturbance	**-.211****	**.378****	**.157***	**-.174***	**.235****	**.555****	**.553****	**.635****	**.821****	**.761****	1.00											
12. T2 Child zBMI	-.039	.068	-.057	-.065	-.060	.066	-.109	-.019	.127	.136	.058	1.00										
13. Child age	-.076	.142	-.034	-.023	-.010	-.068	.101	-.023	.082	.137	.045	.095	1.00									
14. Child sex	**.294****	-.040	-.005	-.052	.006	-.009	.020	-.006	.142	.117	.093	-.039	-.137	1.00								
15. Parent age	-.146	-.027	-.043	.018	.018	-.036	**.175***	.058	.034	.040	.076	-.034	.150	.051	1.00							
16. Parent sex	**.158***	.021	-.049	-.131	-.046	-.079	.019	.063	**.150***	.143	.103	.092	-.016	.076	-.064	1.00						
17. Parent BMI	.013	.067	.015	.025	.043	.075	.076	-.002	-.016	-.116	-.007	.126	-.057	.024	.058	-.127	1.00					
18. Parent depression	-.058	**.184***	.000	-.018	-.013	.042	.128	.121	**.258****	.126	**.221****	.018	.125	.038	.065	.104	**.202****	1.00				
19. Length of breastfeeding	**.182***	**-.158***	.038	-.093	**.154***	-.113	.029	**.159***	**-.160***	-.099	-.044	**-.173***	-.095	-.059	.056	-.094	-.127	**-.174***	1.00			
20. Picky eater	-.035	**.161***	.105	-.091	.069	.072	.115	**.152***	**.283****	**.265****	**.278****	-.143	.093	-.026	.029	.091	.018	.117	-.147	1.00		
21. Concern of child weight	.025	.117	.120	.051	**.147***	-.003	-.004	.059	.009	.010	.031	-.098	.140	-.125	.110	.055	-.074	.079	-.101	**.199****	1.00	
22. Income-to-need ratio	.061	-.038	.098	-.106	-.041	-.113	-.122	-.128	-.099	-.059	-.155	**-.175***	.018	-.021	**.172***	-.134	**-.209***	**-.225****	**.188***	-.044	-.037	1.00

Table 15. *Parameter estimates for Hypothesis 2 Model 1. T2 Temperament → T2 Emotional Feeding → T2 zBMI.*

	Standardized estimate	S.E.	p-value
T2 Emotional Feeding			
T2 Effortful Control	-0.162	0.082	**0.048***
T2 Reactivity/Negativity	0.254	0.086	**0.003****
Child age	-0.093	0.090	0.300
Child sex	0.102	0.090	0.256
Parent age	-0.075	0.091	0.410
Parent sex	-0.015	0.080	0.856
Parent BMI	-0.057	0.091	0.530
Parent depression	-0.018	0.091	0.844
Length of breastfeeding	0.167	0.107	0.120
Picky eater	-0.011	0.087	0.903
Concern over weight	0.059	0.066	0.373
Income-to-need ratio	-0.018	0.123	0.881
T2 Child zBMI			
T2 Effortful Control	0.069	0.097	0.478
T2 Reactivity/Negativity	0.185	0.089	**0.037***
T2 Emotional Feeding	-0.111	0.085	0.194
Parent age	-0.001	0.116	0.991
Parent BMI	0.209	0.089	**0.019***
Parent depression	0.004	0.078	0.962
Length of breastfeeding	-0.192	0.07	**0.006****
Picky eater	-0.081	0.08	0.311
Concern over weight	-0.057	0.241	0.811
Income-to-need ratio	-0.074	0.055	0.177
Indirect Effects			
T2 Effortful Control → T2 Emotional Feeding → T2 zBMI	0.032	0.031	0.290
T2 Reactivity/Negativity → T2 Emotional Feeding → T2 zBMI	-0.043	0.041	0.291

Note: **p* < 0.05; ***p* < 0.01

Table 16. *Parameter estimates for Hypothesis 2 Model 2. T2 Temperament → T2 Control Over Feeding → T2 zBMI.*

	Standardized estimate	S.E.	p-value
T2 Control Over Feeding			
T2 Effortful Control	-0.048	0.090	0.592
T2 Reactivity/Negativity	-0.137	0.124	0.266
Child age	-0.020	0.093	0.832
Child sex	-0.072	0.088	0.412
Parent age	0.023	0.078	0.773
Parent sex	-0.091	0.098	0.357
Parent BMI	0.029	0.083	0.724
Parent depression	0.002	0.082	0.984
Length of breastfeeding	-0.116	0.099	0.241
Picky eater	-0.038	0.088	0.668
Concern over weight	-0.006	0.054	0.916
Income-to-need ratio	-0.130	0.107	0.224
T2 Child zBMI			
T2 Effortful Control	0.079	0.098	0.418
T2 Reactivity/Negativity	0.147	0.084	**0.079**†
T2 Control Over Feeding	-0.069	0.087	0.431
Parent age	0.009	0.115	0.938
Parent BMI	0.221	0.087	**0.011***
Parent depression	0.008	0.076	0.915
Length of breastfeeding	-0.216	0.070	**0.002****
Picky eater	-0.081	0.079	0.305
Concern over weight	-0.065	0.239	0.785
Income-to-need ratio	-0.079	0.061	0.195
Indirect Effects			
T2 Effortful Control → T2 Control Over Feeding → T2 zBMI	0.001	0.008	0.913
T2 Reactivity/Negativity → T2 Control Over Feeding → T2 zBMI	0.007	0.013	0.608

Note: $^{\dagger}p < 0.10$; $*p < 0.05$; $**p < 0.01$

Table 17. *Parameter estimates for Hypothesis 2 Model 3. T2 Temperament → T2 Instrumental Feeding → T2 zBMI.*

	Standardized estimate	**S.E.**	**p-value**
T2 Instrumental Feeding			
T2 Effortful Control	-0.049	0.082	0.549
T2 Reactivity/Negativity	0.235	0.098	**0.017***
Child age	-0.154	0.091	**0.090**†
Child sex	0.093	0.091	0.305
Parent age	-0.071	0.086	0.409
Parent sex	-0.111	0.095	0.243
Parent BMI	-0.022	0.081	0.782
Parent depression	0.058	0.086	0.501
Length of breastfeeding	0.004	0.082	0.957
Picky eater	0.066	0.088	0.450
Concern over weight	0.040	0.065	0.543
Income-to-need ratio	0.131	0.084	0.120
T2 Child zBMI			
T2 Effortful Control	0.086	0.096	0.373
T2 Reactivity/Negativity	0.155	0.088	**0.077**†
T2 Instrumental Feeding	0.008	0.079	0.915
Parent age	0.010	0.115	0.933
Parent BMI	0.218	0.088	**0.013***
Parent depression	0.009	0.077	0.906
Length of breastfeeding	-0.209	0.071	**0.003****
Picky eater	-0.077	0.079	0.330
Concern over weight	-0.070	0.237	0.767
Income-to-need ratio	-0.072	0.057	0.209
Indirect Effects			
T2 Effortful Control → T2 Instrumental Feeding → T2 zBMI	0.000	0.004	0.906
T2 Reactivity/Negativity → T2 Instrumental Feeding → T2 zBMI	0.004	0.030	0.904

Note:† $p < 0.10$; *$p < 0.05$; **$p < 0.01$

Table 18. *Parameter estimates for Hypothesis 2 Model 4. T2 Temperament → T2 Total Sleep Disturbance → T2 zBMI.*

	Standardized estimate	S.E.	p-value
T2 Total Sleep Disturbance			
T2 Effortful Control	-0.081	0.081	0.316
T2 Negativity	0.268	0.056	**<0.001*** **
Child age	-0.181	0.077	**0.019***
Child sex	0.198	0.077	**0.010***
Parent age	0.068	0.064	0.284
Parent sex	0.083	0.067	0.214
Parent depression	0.156	0.084	**0.062**†
Length of breastfeeding	0.132	0.074	**0.075**†
Picky eater	0.239	0.082	**0.004***
Income-to-need ratio	-0.078	0.070	0.268
T2 Child zBMI			
T2 Effortful Control	0.086	0.096	0.371
T2 Negativity	0.154	0.087	**0.078**†
T2 Total Sleep Disturbance	0.012	0.115	0.917
Parent age	0.008	0.116	0.947
Parent BMI	0.218	0.087	**0.012***
Parent depression	0.008	0.075	0.919
Length of breastfeeding	-0.211	0.072	**0.004****
Picky eater	-0.080	0.086	0.356
Concern over weight	-0.068	0.237	0.774
Income-to-need ratio	-0.069	0.058	0.230
Indirect Effects			
T2 Effortful Control → T2 Total Sleep Disturbance → T2 zBMI	-0.002	0.015	0.914
T2 Reactivity/Negativity → T2 Total Sleep Disturbance → T2 zBMI	0.005	0.048	0.915

Note:† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 19. *Parameter estimates for Hypothesis 2 Model 5. T2 Reactivity/Negativity→ T2 Emotional Feeding, T2 Instrumental Feeding, T2 Total Sleep Disturbance → T2 zBMI.*

	Std. Estimate	S.E.	p-value
T2 Emotional Feeding			
T2 Reactivity/Negativity	0.244	0.086	**0.005****
Child age	-0.140	0.087	0.107
Child sex	0.048	0.087	0.576
Parent age	-0.069	0.087	0.426
Parent sex	-0.031	0.081	0.703
Parent BMI	-0.054	0.087	0.536
Parent depression	0.019	0.090	0.834
Length of breastfeeding	0.087	0.101	0.389
Picky eater	0.018	0.086	0.835
Concern over weight	0.049	0.063	0.438
Income-to-need ratio	0.041	0.112	0.713
T2 Instrumental Feeding			
T2 Reactivity/Negativity	0.248	0.097	**0.011***
Child age	-0.137	0.093	0.142
Child sex	0.080	0.088	0.359
Parent age	-0.043	0.086	0.621
Parent sex	-0.107	0.094	0.254
Parent BMI	-0.039	0.082	0.636
Parent depression	0.014	0.065	0.834
Length of breastfeeding	0.063	0.073	0.388
Picky eater	0.013	0.063	0.835
Concern over weight	0.035	0.045	0.436
Income-to-need ratio	0.030	0.081	0.714
T2 Total Sleep Disturbance			
T2 Reactivity/Negativity	0.269	0.056	**<0.001*****
Child age	-0.194	0.074	**0.009****
Child sex	0.175	0.072	**0.015***
Parent age	0.076	0.062	0.224
Parent sex	0.077	0.064	0.232
Parent depression	0.159	0.085	**0.061**†
Length of breastfeeding	0.118	0.077	0.126
Picky eater	0.237	0.082	**0.004****
Income-to-need ratio	-0.082	0.068	0.228
T2 zBMI			
T2 Reactivity/Negativity	0.172	0.091	**0.058**†

T2 Emotional Feeding	-0.177	0.098	**0.072**†
T2 Instrumental Feeding	0.094	0.090	0.293
T2 Total Sleep Disturbance	0.030	0.110	0.787
Parent age	-0.012	0.116	0.920
Parent BMI	0.207	0.091	**0.023***
Parent Depression	-0.003	0.075	0.964
Length of breastfeeding	-0.176	0.068	**0.010***
Picky eater	-0.090	0.087	0.297
Concern over weight	-0.044	0.245	0.858
Income-to-need ratio	-0.077	0.053	0.141
Indirect Effects			
T2 Reactivity/Negativity → T2 Emotional Feeding → T2 zBMI	-0.066	0.050	0.188
T2 Reactivity/Negativity → T2 Instrumental Feeding → T2 zBMI	0.039	0.043	0.365
T2 Reactivity/Negativity → T2 Total Sleep Disturbance → T2 zBMI	0.013	0.047	0.773

Note:† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 20. *T1 and T2 sample mean differences on main analysis variables*

	Study completers	Study dropouts	Difference test
Child age	$M = 53.97$; $SD = 11.04$	$M = 53.69$; $SD = 10.06$	$F(1,295) = 0.051$, $p = 0.882$
Child sex			$X^2(1) = 1.12$, $p = 0.340$
Male	48.1% ($N = 88$)	54.4% ($N = 62$)	
Female	51.9% ($N = 95$)	45.6% ($N = 52$)	
Child race/ethnicity			$X^2(4) = 11.41$, $p = \mathbf{0.022}$*****
White	79.1% ($N = 144$)	70.2% ($N = 80$)	
African-American	3.3% ($N = 6$)	6.1% ($N = 7$)	
Hispanic-American	2.2% ($N = 4$)	10.5% ($N = 12$)	
Asian-American	3.3% ($N = 6$)	3.5% ($N = 4$)	
Native-American	0% ($N = 0$)	0% ($N = 0$)	
Other	12.1% ($N = 22$)	9.6% ($N = 11$)	
Child zBMI	$M = 0.35$; $SD = 1.15$	$M = 0.35$; $SD = 1.18$	$F(1,289) = 0.00$, $p = 0.98$
Parent age	$M = 34.17$; $SD = 6.03$	$M = 32.37$; $SD = 6.44$	$F(1,293) = 5.93$, $p = \mathbf{0.015}$*****
Parent sex			$X^2(1) = .941$, $p = 0.402$
Male	16.4% ($N = 30$)	12.3% ($N = 14$)	
Female	83.6% ($N = 153$)	87.7% ($N = 100$)	
Parent race/ethnicity			$X^2(5) = 17.918$, $p = \mathbf{0.003}$******
White	87.4% ($N = 159$)	72.8% ($N = 183$)	
African-American	1.1% ($N = 2$)	5.3% ($N = 6$)	
Hispanic-American	3.8% ($N = 7$)	12.3% ($N = 14$)	
Asian-American	1.6% ($N = 3$)	3.5% ($N = 4$)	
Native-American	0.0% ($N = 0$)	1.8% ($N = 2$)	
Other	6.0% ($N = 11$)	4.4% ($N = 5$)	
Parent BMI	$M = 27.32$; $SD = 6.13$	$M = 27.26$; $SD = 6.04$	$F(1,288) = 0.007$, $p = 0.934$
Parent education			$X^2(5) = 22.115$, $\mathbf{p < 0.001}$*******
Less than High School	1.7% ($N = 3$)	6.3% ($N = 7$)	
High School Graduate	22.8% ($N = 41$)	31.5% ($N = 35$)	
Associates Degree	20.6% ($N = 37$)	32.4% ($N = 36$)	
Bachelor's Degree	36.1% ($N = 65$)	21.6% ($N = 24$)	
Master's Degree	14.4% ($N = 26$)	8.1% ($N = 9$)	
Doctorate Degree	4.4% ($N = 8$)	0.0% ($N = 0$)	
Marital Status			$X^2(4) = 6.365$, $p = 0.173$
Single, Never Married	13.8% ($N = 23$)	23.4% ($N = 22$)	
Single, Divorced	7.8% ($N = 13$)	4.3% ($N = 4$)	
Separated	1.2% ($N = 2$)	2.1% ($N = 2$)	
Cohabiting	5.4% ($N = 9$)	2.1% ($N = 2$)	
Married	71.9% ($N = 120$)	68.1% ($N = 64$)	
Parent Depression			$X^2(1) = 0.195$, $p = 0.656$
Yes	80.9% ($N = 148$)	78.8% ($N = 89$)	
No	19.1% ($N = 35$)	21.2% ($N = 24$)	
Breastfeeding History			$X^2(1) = 0.003$, $p = 0.954$

Yes	24.9% (N = 45)	24.6% (N = 28)	
No	75.1% (N = 136)	75.4% (N = 86)	
Income-to-need Ratio	M = 3.33; SD = 2.90	M = 2.88; SD = 2.11	F(1, 221) = 1.32, p = 0.251
Effortful Control	M = 5.27; SD = 0.72	M = 5.10; SD = 0.73	F(1, 296) = 4.055, p = **0.045***
Reactivity/Negativity	M = 3.82; SD = 0.87	M = 3.89 SD = 0.85	F(1, 296) = 0.359, p = 0.549
Emotional Feeding	M = 1.53; SD = 0.48	M = 1.57; SD = 0.49	F(1, 292) = 0.302, p = 0.583
Control over Feeding	M = 4.06; SD = 0.53	M = 4.09; SD = 0.61	F(1,287) = 0.224, p = 0.636
Instrumental Feeding	M = 1.90; SD = 0.59	M = 1.96; SD = 0.67	F(1, 292) = 0.675, p = 0.412
Total Sleep Problems	M = 57.00; SD = 25.54	M = 58.97; SD = 23.42	F(1,264) = 0.391, p = 0.532

Note: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 21. *Correlation matrix of T1 and T2 variables*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. T1 Reactivity/Negativity	1.00														
2. T1 Effortful Control	-.098	1.00													
3. T1 Instrumental Feeding	.216**	-.113	1.00												
4. T1 Control Over Feeding	-.088	.077	-.063	1.00											
5. T1 Emotional Feeding	.176**	-.081	.575**	-.197**	1.00										
6. T1 Total Sleep Disturbance	.046	-.023	.053	.007	-.001	1.00									
7. T1 Frequency Sleep Problems	.189**	-.066	.021	-.065	-.018	-.031	1								
8. T1 Child zBMI	-.107	-.011	-.046	.016	-.025	-.054	.000	1.00							
9. T2 Reactivity/Negativity	.695**	-.090	.243**	-.026	.206**	.069	.140	.015	1.00						
10. T2 Effortful Control	-.069	.531**	.025	-.107	-.035	-.025	.015	-.059	-.090	1.00					
11. T2 Instrumental Feeding	.176*	-.178*	.607**	-.058	.476**	-.067	.086	-.005	.240**	-.108	1.00				
12. T2 Control Over Feeding	-.109	-.083	-.047	.553**	-.073	.024	-.020	-.011	-.103	-.072	-.025	1.00			
13. T2 Emotional Feeding	.284**	-.146*	.504**	-.146*	.584**	.063	.146	-.085	.236**	-.116	.629**	-.217**	1.00		
14. T2 Total Sleep Disturbance	.316**	-.024	.185*	-.099	.231**	.054	.359**	.057	.378**	-.211**	.157*	-.174*	.235**	1.00	
15. T2 zBMI	.026	-.089	.023	-.045	-.065	-.075	-.044	.664**	.068	-.039	-.057	-.065	-.060	.058	1.00

Table 22. *Correlation matrix of T1 variables and covariates*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. T1 Reactivity	1.00																	
2. T1 Effortful Control	-0.098	1.00																
3. T1 Instrumental Feeding	**.216****	-0.113	1.00															
4. T1 Control Over Feeding	-0.088	0.077	-0.063	1.00														
5. T1 Emotional Feeding	**.176****	-0.081	**.575****	**-.197****	1.00													
6. T1 Total Sleep Disturbance	0.046	-0.023	0.053	0.007	-0.001	1.00												
7. T1 Frequency Sleep Problems	**.189****	-.066	.021	-.065	-.018	-.031	1											
8. T1 Child zBMI	-0.107	-0.011	-0.046	0.016	-0.025	-0.054	-.090	1.00										
9. Child age	0.086	-.156*	-0.009	-0.082	-0.032	0.139	-.155	**.215****	1.00									
10. Child sex	-0.02	**.148***	-0.013	-0.017	0.022	-0.059	.052	-0.008	-0.137	1.00								
11. Parent age	-0.067	-0.092	-0.024	-0.049	0.036	0.085	-.075	0.096	0.15	0.051	1.00							
12. Parent sex	0.03	0.082	-0.048	-0.083	-0.017	0.013	.042	0.001	-0.016	0.076	-0.064	1.00						
13. Parent BMI	0.028	-0.053	0.012	-0.111	**.175***	-0.028	.074	0.118	-0.057	0.024	0.058	-0.127	1.00					
14. Parent depression	**.212****	-0.01	0.007	-0.018	0.085	-0.001	.122	**.156***	0.125	0.038	0.065	0.104	**.202****	1.00				
15. Length of breastfeeding	-0.072	**.161***	0.095	**-.160***	-0.011	-0.015	.025	-0.14	-0.095	-0.059	0.056	-0.094	-0.127	**-.174***	1.00			
16. Picky eater	**.203****	0.048	0.069	-0.102	0.118	-0.011	.017	-0.038	0.093	-0.026	0.029	0.091	0.018	0.117	-0.147	1.00		
17. Concern over child's weight	0.113	-0.024	**.232****	0.066	0.117	-0.038	-.017	-0.025	0.14	-0.125	0.11	0.055	-0.074	0.079	-0.101	**.199****	1.00	
18. Income-to-needs ratio	-0.084	0.04	0.034	-0.085	-0.048	0.02	-.053	-0.085	0.018	-0.021	**.172***	-0.134	**-.209***	**-.225****	**.188***	-0.044	-0.037	1.00

Table 23. *Parameter estimates for Hypothesis 3a Model 1. T1 Temperament → T2 Emotional Feeding*

	Std. estimate	**S.E.**	**p-value**
T2 Emotional Feeding			
T1 Effortful Control	-0.165	0.093	**0.077**†
T1 Reactivity/Negativity	0.257	0.082	**0.002****
Child age	-0.082	0.086	0.342
Child sex	0.090	0.090	0.320
Parent age	-0.079	0.098	0.422
Parent sex	0.000	0.082	0.997
Parent BMI	-0.041	0.099	0.674
Parent depression	0.028	0.104	0.790
Length of breastfeeding	0.123	0.106	0.245
Picky eater	-0.066	0.090	0.463
Concern over feeding	0.046	0.058	0.433
Income-to-need ratio	-0.009	0.143	0.948
T1 child zBMI	-0.081	0.079	0.304

Note:† *$p < 0.10$*; ; ***p* < 0.01

Table 24. *Parameter estimates for Hypothesis 3a Model 2. T1 Temperament → T2 Control over Feeding*

	Std. estimate	**S.E.**	**p-value**
T2 Control over Feeding			
T1 Effortful Control	-0.085	0.106	0.419
T1 Reactivity/Negativity	-0.023	0.093	0.807
Child age	-0.005	0.094	0.959
Child sex	-0.065	0.090	0.469
Parent age	0.004	0.082	0.960
Parent sex	-0.064	0.107	0.549
Parent BMI	0.046	0.083	0.580
Parent depression	-0.051	0.095	0.590
Length of breastfeeding	-0.079	0.115	0.490
Picky eater	0.023	0.091	0.801
Concern over feeding	-0.042	0.048	0.385
Income-to-needs ratio	-0.187	0.116	0.107
T1 child zBMI	0.047	0.088	0.592

Table 25. *Parameter estimates for Hypothesis 3a Model 3. T1 Temperament → T2 Instrumental Feeding*

	Standardized estimate	S.E.	p-value
T2 Instrumental Feeding			
T1 Effortful Control	-0.076	0.101	0.456
T1 Reactivity/Negativity	0.095	0.097	0.324
Child age	-0.173	0.095	**0.069**†
Child sex	0.081	0.093	0.380
Parent age	-0.088	0.089	0.323
Parent sex	-0.119	0.101	0.238
Parent BMI	0.008	0.086	0.929
Parent depression	0.068	0.083	0.413
Length of breastfeeding	0.042	0.089	0.639
Picky eater	0.026	0.090	0.768
Concern over feeding	0.076	0.071	0.284
Income-to-need ratio	0.149	0.115	0.194
T1 child BMIz	0.044	0.101	0.663

Note:† $p < 0.10$

Table 26. *Parameter estimates for Hypothesis 3a Model 4. T1 Feeding Strategies→ T2 Reactivity/negativity*

	Std. estimate	**S.E.**	**p-value**
T2 Reactivity/negativity			
T1 Control Over Feeding	0.042	0.094	0.656
T1 Emotional Feeding	0.066	0.099	0.504
T1 Instrumental Feeding	0.197	0.086	**0.022***
Child age	0.112	0.091	0.218
Child sex	0.007	0.094	0.938
Parent age	-0.018	0.095	0.847
Parent sex	0.116	0.091	0.202
Parent depression	0.096	0.108	0.375
Length of breastfeeding	-0.089	0.077	0.247
Picky eater	-0.027	0.090	0.761
Income-to-needs ratio	0.032	0.098	0.745
T1 child zBMI	-0.022	0.090	0.810

*Note:*p* < 0.05

Table 27. *Parameter estimates for Hypothesis 3a Model 5. T1 Feeding Strategies→T2 Effortful Control*

	Std. estimate	**S.E.**	**p-value**
T2 Effortful Control			
T1 Control Over Feeding	-0.046	0.097	0.636
T1 Emotional Feeding	-0.163	0.091	**0.075**†
T1 Instrumental Feeding	0.204	0.099	**0.039***
Child age	0.134	0.082	0.101
Child sex	0.247	0.080	0.002
Parent age	-0.135	0.114	0.235
Parent sex	0.088	0.077	0.250
Parent depression	-0.032	0.095	0.738
Length of breastfeeding	0.222	0.094	**0.019***
Picky eater	0.044	0.084	0.598
Income-to-needs ratio	0.033	0.063	0.594
T1 child zBMI	0.030	0.086	0.727

Note:† $p < 0.10$; *$p < 0.05$

Table 28. *Parameter estimates for Hypothesis 3b Model 1. T1 Temperament → T2 Total Sleep Disturbance*

	Std. estimate	**S.E.**	**p-value**
T2 Total Sleep Disturbance			
T1 Effortful Control	0.097	0.100	0.336
T1 Negativity	0.193	0.066	**0.004****
Child age	-0.171	0.075	**0.022***
Child sex	0.153	0.072	**0.034***
Parent age	0.086	0.075	0.247
Parent sex	0.066	0.067	0.326
Parent depression	0.184	0.100	**0.064**†
Length of breastfeeding	0.049	0.076	0.519
Picky eater	0.207	0.081	**0.011***
Income-to-needs ratio	-0.067	0.069	0.328
T1 child zBMI	-0.051	0.080	0.523

Note: $^{\dagger}p < 0.10$; $*p < 0.05$; $**p < 0.01$

Table 29. *Parameter estimates for Hypothesis 3b Model 2a. T1 Total Sleep Disturbance→ T2 Effortful Control*

	Std. estimate	**S.E.**	**p-value**
T2 Effortful Control			
T1 Total Sleep	0.029	0.096	0.762
Child age	0.094	0.084	0.265
Child sex	0.259	0.084	**0.002****
Parent age	-0.043	0.127	0.734
Parent sex	0.108	0.083	0.196
Parent depression	-0.005	0.100	0.961
Breastfeeding length	0.281	0.085	**0.001****
Picky eater	-0.003	0.092	0.970
Income-to-needs ratio	0.078	0.083	0.342
T1 child zBMI	0.007	0.093	0.939

Note: ***p* < 0.01

Table 30. *Parameter estimates for Hypothesis 3b Model 2b. T1 Sleep Problem Frequency→ T2 Effortful Control*

	Std. estimate	S.E.	p-value
T2 Effortful Control			
T1 Sleep Frequency	0.067	0.102	0.509
Child age	0.175	0.097	**0.070**†
Child sex	0.311	0.090	**0.001****
Parent age	0.023	0.121	0.852
Parent sex	0.073	0.092	0.427
Parent depression	-0.085	0.108	0.433
Breastfeeding length	0.117	0.112	0.296
Picky eater	0.066	0.097	0.493
Income-to-needs ratio	0.060	0.080	0.452
T1 child zBMI	0.050	0.108	0.643

Note:†$p < 0.10$; **$p < 0.01$

Table 31. *Parameter estimates for Hypothesis 3b Model 3a. T1 Total Sleep Disturbance→ T2 Reactivity/Negativity*

	Std. estimate	S.E.	p-value
T2 Reactivity/negativity			
T1 Total Sleep	0.071	0.099	0.473
Child age	0.032	0.104	0.757
Child sex	0.000	0.098	0.997
Parent age	-0.057	0.107	0.598
Parent sex	0.063	0.095	0.509
Parent depression	0.190	0.116	0.102
Breastfeeding length	-0.048	0.071	0.500
Picky eater	0.000	0.091	0.997
Income-to-need ratio	-0.038	0.100	0.706
T1 child zBMI	-0.089	0.096	0.356

Table 32. *Parameter estimates for Hypothesis 3b Model 3b. T1 Sleep Problem Frequency → T2 Reactivity/negativity*

	Std. estimate	**S.E.**	**p-value**
T2 Reactivity/negativity			
T1 Sleep Frequency	0.089	0.088	0.312
Child age	0.170	0.103	0.099
Child sex	0.151	0.104	0.146
Parent age	-0.005	0.108	0.965
Parent sex	-0.095	0.077	0.217
Parent depression	0.035	0.125	0.780
Breastfeeding length	-0.037	0.087	0.672
Picky eater	0.127	0.093	0.173
Income-to-needs ratio	-0.056	0.117	0.631
T1 child zBMI	-0.007	0.116	0.949

Table 33. *Parameter estimates for Hypothesis 3c. Final Model. T1 Reactivity/Negativity → T2 Emotional Feeding and T2 Total Sleep Disturbance → T2 zBMI*

	Std. Estimate	S.E.	p-value
T2 Emotional Feeding			
T1 Reactivity/Negativity	0.269	0.081	**0.001****
Child age	-0.087	0.086	0.314
Child sex	0.054	0.086	0.530
Parent age	-0.054	0.097	0.575
Parent sex	-0.024	0.083	0.771
Parent BMI	-0.042	0.092	0.651
Parent depression	0.018	0.108	0.868
Length of breastfeeding	0.079	0.105	0.455
Picky eater	-0.071	0.091	0.435
Concern over weight	0.058	0.058	0.314
Income-to-need ratio	-0.002	0.138	0.989
T1 child zBMI	-0.091	0.076	0.233
T2 Total Sleep Disturbance			
T1 Reactivity/Negativity	0.197	0.067	**0.003****
Child age	-0.174	0.076	**0.021***
Child sex	0.177	0.070	**0.011***
Parent age	0.075	0.066	0.252
Parent sex	0.087	0.069	0.206
Parent depression	0.167	0.097	0.086
Length of breastfeeding	0.067	0.070	0.340
Picky eater	0.203	0.084	**0.015***
Income-to-need ratio	-0.065	0.074	0.381
T1 child zBMI	-0.048	0.086	0.571
T2 zBMI			
T1 Reactivity/Negativity	0.130	0.081	0.107
T2 Emotional Feeding	-0.048	0.071	0.498
T2 Total Sleep Disturbance	0.075	0.098	0.443
Parent age	-0.053	0.080	0.507
Parent BMI	0.090	0.062	0.149
Parent Depression	-0.138	0.055	**0.012***
Length of breastfeeding	-0.190	0.050	**<0.001*****
Picky eater	-0.103	0.083	0.214
Concern over weight	-0.002	0.104	0.988
Income-to-needs ratio	-0.052	0.043	0.227
T1 child zBMI	0.599	0.111	**<0.001*****
Indirect Effects			
T1 Reactivity/Negativity → T2 Emotional Feeding → T2 zBMI	-0.017	0.027	0.526
T1 Reactivity/Negativity → T2 Total Sleep Disturbance → T2 zBMI	0.019	0.027	0.474

Note: **p* < 0.05; ***p* < 0.01; ****p* < 0.001

Table 34. *Parameter estimates for Hypothesis 4. Model 1. Final concurrent model with SES as moderator*

	Std. Estimate	S.E.	p-value
T2 Emotional Feeding			
T2 Reactivity/Negativity	0.249	0.084	**0.003****
Income-to-needs ratio	-0.020	0.102	0.847
T2 Reactivity*Income-to-needs ratio	0.001	0.094	0.993
T2 Instrumental Feeding			
T2 Reactivity/Negativity	0.227	0.089	**0.011***
Income-to-needs ratio	0.238	0.095	**0.013***
T2 Reactivity*Income-to-needs ratio	-0.161	0.099	0.105
T2 Total Sleep Disturbance			
T2 Reactivity/Negativity	0.278	0.059	**<0.001*****
Child age	-0.163	0.079	**0.040***
Child sex	0.183	0.070	**0.009****
Parent depression	0.153	0.088	**0.080****
Picky eater	0.246	0.081	**0.002****
Income-to-needs ratio	-0.069	0.084	0.410
T2 Reactivity*Income-to-needs ratio	0.017	0.077	0.830
T2 zBMI			
T2 Reactivity/Negativity	0.146	0.088	0.100
T2 Emotional Feeding	-0.124	0.099	0.212
T2 Instrumental Feeding	0.014	0.092	0.883
T2 Total Sleep Disturbance	0.047	0.094	0.615
Parent BMI	0.234	0.088	**0.008****
Length of breastfeeding	-0.152	0.068	**0.026***
Income-to-needs ratio	-0.071	0.097	0.461
T2 Reactivity*Income-to-needs ratio	0.128	0.112	0.252
T2 Emotional Feeding*Income-to-needs ratio	-0.129	0.104	0.215
T2 Instrumental Feeding*Income-to-needs ratio	-0.019	0.096	0.842
T2 Sleep*Income-to-needs ratio	0.227	0.125	**0.070†**
Indirect Effects			
T2 Reactivity/Negativity → T2 Emotional Feeding → T2 zBMI	-0.047	0.044	0.281
T2 Reactivity/Negativity → T2 Instrumental Feeding → T2 zBMI	0.008	0.033	0.801
T2 Reactivity/Negativity → T2 Total Sleep Disturbance → T2 zBMI	0.020	0.039	0.601

Note: †*p* < 0.10; **p* < 0.05; ***p* < 0.01; ****p* < 0.001

Table 35. *Parameter estimates for Hypothesis 4. Model 2. Final longitudinal model with SES as moderator*

	Std. Estimate	S.E.	p-value
T2 Emotional Feeding			
T1 Reactivity/Negativity	0.267	0.083	**0.001****
Income-to-needs ratio	0.036	0.109	0.739
T1 Reactivity*Income-to-needs ratio	-0.094	0.097	0.332
T2 Total Sleep Disturbance			
T1 Reactivity/Negativity	0.222	0.067	**0.001****
Child age	-0.137	0.080	**0.087**†
Child sex	0.185	0.068	**0.007****
Parent depression	0.156	0.089	**0.082**†
Picky eater	0.206	0.084	**0.014***
Income-to-needs ratio	-0.028	0.076	0.718
T2 Reactivity*Income-to-needs ratio	-0.067	0.064	0.296
T2 BMIz			
T1 Reactivity/Negativity	0.112	0.083	0.180
T2 Emotional Feeding	-0.025	0.069	0.723
T2 Total Sleep Disturbance	0.058	0.092	0.529
Parent BMI	0.114	0.059	**0.054**†
Parent depression	-0.137	0.054	**0.011***
Length of breastfeeding	-0.171	0.050	**0.001****
T1 child zBMI	0.572	0.122	**<0.001*****
Income-to-needs ratio	-0.069	0.067	0.296
T1 Reactivity*Income-to-needs ratio	0.086	0.066	0.193
T2 Emotional Feeding*Income-to-needs ratio	0.016	0.079	0.839
T2 Sleep*Income-to-needs ratio	0.072	0.119	0.545
Indirect Effects			
T1 Reactivity/Negativity → T2 Emotional Feeding → T2 zBMI	-0.008	0.024	0.732
T1 Reactivity/Negativity → T2 Total Sleep Disturbance → T2 zBMI	0.016	0.028	0.579

Note:† $p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 36. *Parameter estimates for Hypothesis 4. Model 3. Reduced concurrent model with SES as moderator*

	Std. Estimate	S.E.	p-value
T2 Emotional Feeding			
T2 Reactivity/Negativity	0.296	0.079	**<0.001*****
Income-to-needs ratio	-0.046	0.087	0.595
T2 Reactivity*Income-to-needs ratio	-0.020	0.086	0.819
T2 Instrumental Feeding			
T2 Reactivity/Negativity	0.271	0.082	**0.001****
Income-to-needs ratio	0.204	0.083	**0.014***
T2 Reactivity*Income-to-needs ratio	-0.185	0.087	**0.035***
T2 Total Sleep Disturbance			
T2 Reactivity/Negativity	0.345	0.061	**<0.001*****
Income-to-needs ratio	-0.098	0.071	0.164
T2 Reactivity*Income-to-needs ratio	-0.062	0.064	0.331
T2 zBMI			
T2 Reactivity/Negativity	0.146	0.092	0.113
T2 Emotional Feeding	-0.083	0.104	0.424
T2 Instrumental Feeding	0.020	0.094	0.828
T2 Total Sleep Disturbance	0.034	0.095	0.716
Income-to-needs ratio	-0.220	0.091	**0.015***
T2 Reactivity*Income-to-needs ratio	0.113	0.104	0.278
T2 Emotional Feeding*Income-to-needs ratio	-0.069	0.090	0.445
T2 Instrumental Feeding*Income-to-needs ratio	0.009	0.096	0.922
T2 Sleep*Income-to-needs ratio	0.054	0.100	0.590
Indirect Effects			
T2 Reactivity/Negativity → T2 Emotional Feeding → T2 zBMI	-0.035	0.047	0.456
T2 Reactivity/Negativity → T2 Instrumental Feeding → T2 zBMI	0.008	0.036	0.830
T2 Reactivity/Negativity → T2 Total Sleep Disturbance → T2 zBMI	0.017	0.046	0.719

Note: *p < 0.05; **p < 0.01; ***p < 0.001

Table 37. *Parameter estimates for Hypothesis 4. Model 4. Reduced longitudinal model with SES as moderator*

	Std. Estimate	**S.E.**	**p-value**
T2 Emotional Feeding			
T1 Reactivity/Negativity	0.307	0.077	**<0.001*** **
Income-to-needs ratio	0.001	0.090	0.991
T1 Reactivity*Income-to-needs ratio	-0.097	0.079	0.218
T2 Total Sleep Disturbance			
T1 Reactivity/Negativity	0.319	0.063	**<0.001*** **
Income-to-needs ratio	-0.080	0.063	0.201
T2 Reactivity*Income-to-needs ratio	-0.117	0.048	**0.015***
T2 BMIz			
T1 Reactivity/Negativity	0.127	0.099	0.201
T2 Emotional Feeding	-0.066	0.077	0.396
T2 Total Sleep Disturbance	0.059	0.100	0.556
Income-to-needs ratio	-0.150	0.069	**0.030***
T1 Reactivity*Income-to-needs ratio	0.096	0.095	0.315
T2 Emotional Feeding*Income-to-needs ratio	-0.037	0.071	0.604
T2 Sleep*Income-to-needs ratio	0.081	0.104	0.440
Indirect Effects			
T1 Reactivity/Negativity → T2 Emotional Feeding → T2 zBMI	-0.026	0.033	0.430
T1 Reactivity/Negativity → T2 Total Sleep Disturbance → T2 zBMI	0.024	0.042	0.570

Note: *p < 0.05; ***p < 0.001

Table 38. *Parameter estimates for exploratory analysis. Model 1. Direct and indirect relationship among T2 Reactivity/Negativity, T2 Total Sleep Disturbance, and T2 Emotional Feeding*

	Std. Estimate	**S.E.**	**p-value**
T2 Total Sleep Disturbance			
T2 Reactivity/Negativity	0.361	0.062	**<0.001*** **
Child age	-0.024	0.069	0.729
Child sex	0.181	0.067	**0.007** **
Parent depression	0.164	0.080	**0.040***
Length of breastfeeding	0.071	0.077	0.357
Picky eater	0.189	0.074	**0.011***
T2 Emotional Feeding			
T2 Reactivity/Negativity	0.158	0.075	**0.033***
T2 Total Sleep Disturbance	0.134	0.108	0.211
Indirect Effect			
T2 Reactivity→ T2 Total Sleep Disturbance → T2 Emotional Feeding	0.029	0.024	0.238

Note: *p < 0.05; **p < 0.01; ***p < 0.001

Table 39. *Parameter estimates for exploratory analysis. Model 2. Direct and indirect relationship among T1 Reactivity/Negativity, T2 Total Sleep Disturbance, and T2 Emotional Feeding*

	Std. Estimate	**S.E.**	**p-value**
T2 Total Sleep Disturbance			
T1 Reactivity/Negativity	0.226	0.060	**<0.001*** **
Child age	0.009	0.069	0.891
Child sex	0.093	0.067	0.166
Parent depression	0.144	0.079	**0.070**†
Length of breastfeeding	0.030	0.049	0.542
Picky eater	0.195	0.073	**0.007** **
T2 Emotional Feeding			
T1 Reactivity/Negativity	0.206	0.074	**<0.001*** **
T2 Total Sleep Disturbance	0.160	0.100	0.109
Indirect Effect			
T1 Reactivity→ T2 Sleep Disturbance → T2 Emotional Feeding	0.019	0.014	0.186

Note: †$p < 0.10$; **$p < 0.01$; ***$p < 0.001$

Table 40. *Parameter estimates for exploratory analysis Model 3. Direct and indirect relationship among T2 Total Sleep Disturbance, T2 Reactivity/Negativity, and T2 Emotional Feeding*

	Std. Estimate	**S.E.**	**p-value**
T2 Reactivity			
T2 Total Sleep Disturbance	0.381	.051	**<0.001*** **
T2 Emotional Feeding			
T2 Reactivity/Negativity	0.167	0.094	**0.076**†
T2 Total Sleep Disturbance	0.187	0.067	**0.006** **
Indirect Effect (unstandardized)			
T2 Sleep Disturbance→ T2 Reactivity → T2 Emotional Feeding	0.007	0.003	**0.011***

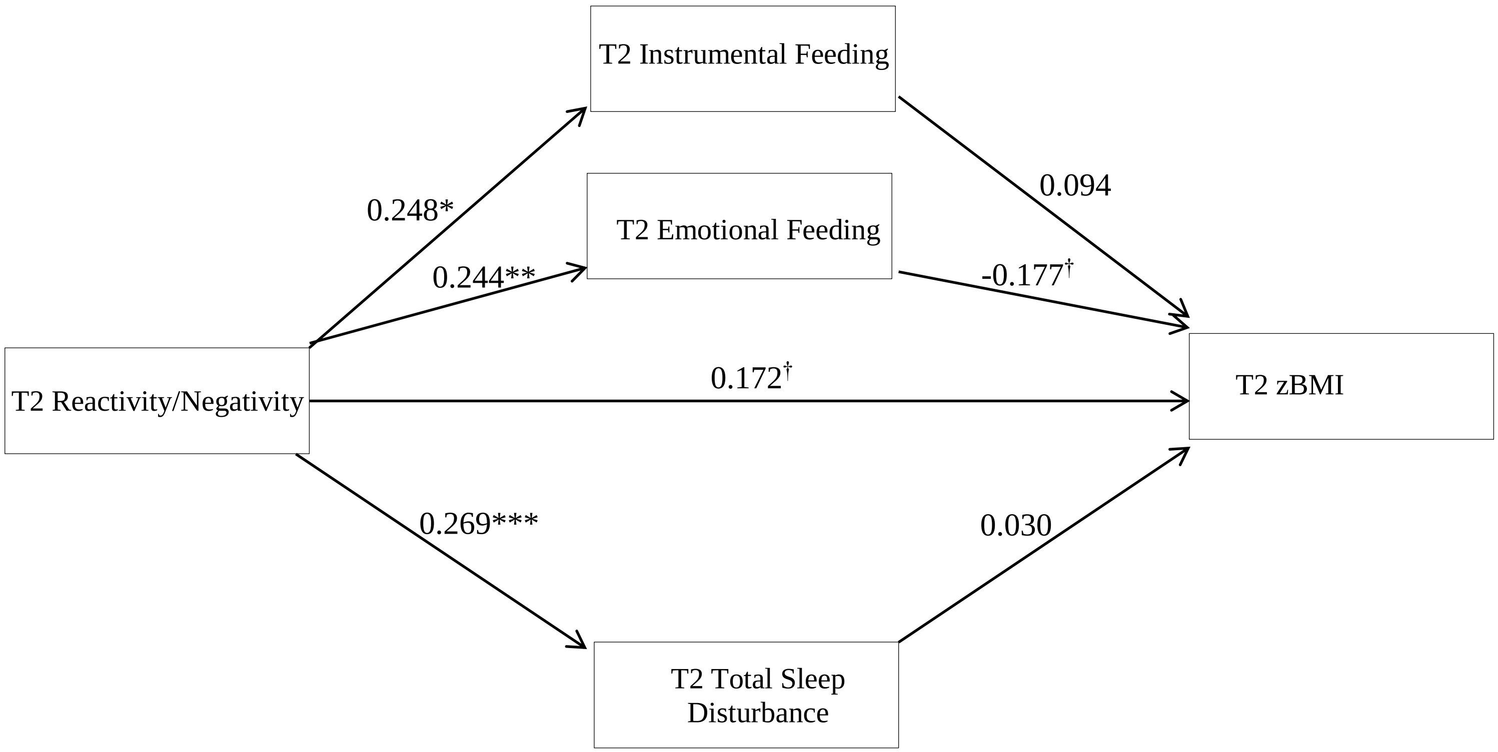
Note: †*p* < 0.10; **p* < 0.05; ***p* < 0.01; ****p* < 0.001

Table 41. *Parameter estimates for exploratory analysis Model 4. Direct and indirect relationship among T1 Sleep Problem Frequency, T2 Reactivity/Negativity, and T2 Emotional Feeding*

	Std. Estimate	**S.E.**	**p-value**
T2 Reactivity			
T1 Sleep Problem Frequency	0.052	0.071	**0.052**†
T2 Emotional Feeding			
T2 Reactivity/Negativity	0.294	0.065	**<0.001*** **
T1 Sleep Problem Frequency	0.112	0.055	**0.042***
Indirect Effect			
T1 Sleep Problem Frequency→ T2 Reactivity → T2 Emotional Feeding	0.010	0.004	**0.012***

Note: $^{\dagger}p < 0.10$; $^{*}p < 0.05$; $^{***}p < 0.001$

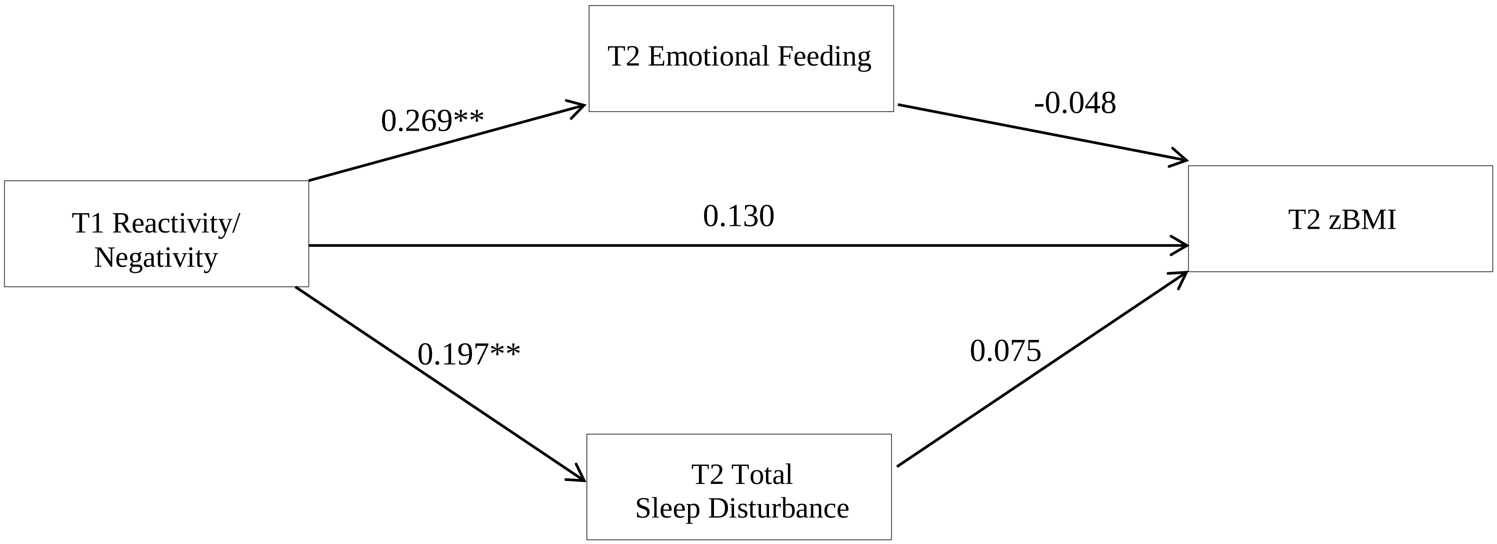
Figure 1. *Final concurrent analysis model*



Note: Covariate paths and covariances between feeding and sleep scales not illustrated

Note: †p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001

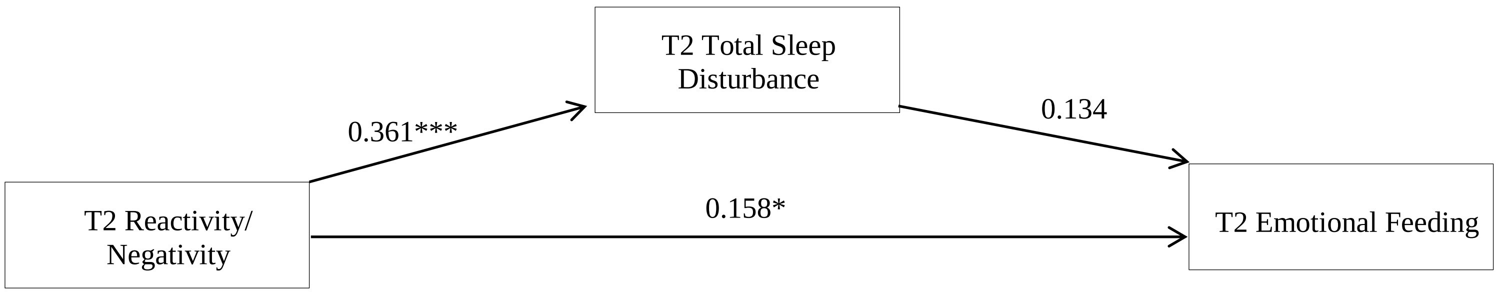
Figure 2. *Final longitudinal analysis model*



Note: Covariate paths and covariance between emotional feeding and sleep not illustrated

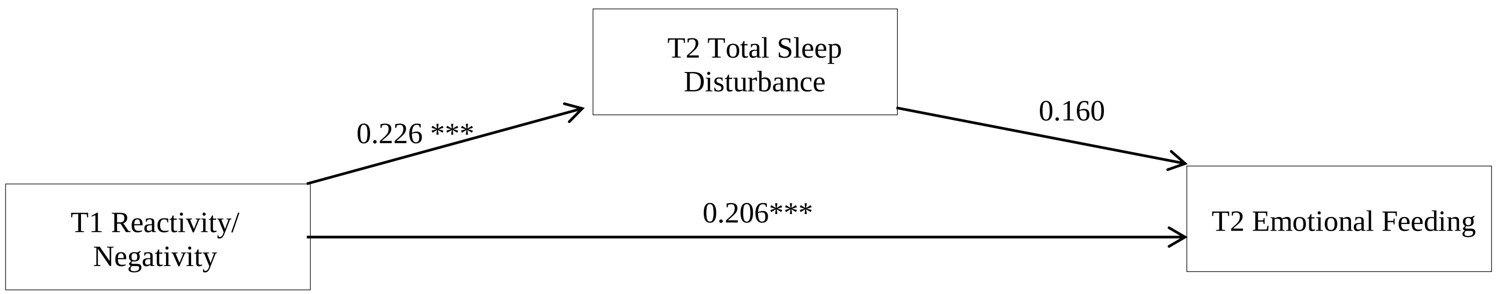
Note: $^{**}p < 0.01$

Figure 3. *Exploratory Model 1: Direct and indirect relationship among T2 Reactivity/Negativity, T2 Total Sleep Disturbance, and T2 Emotional Feeding*



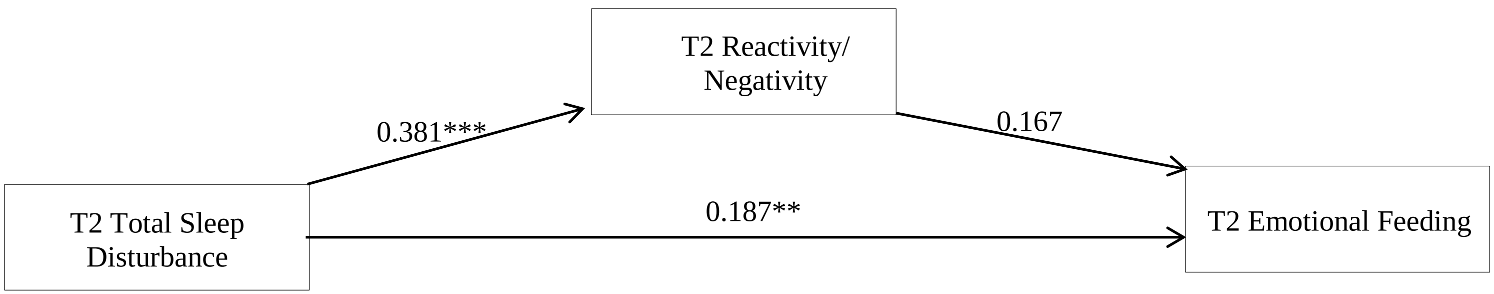
Note: *$p < 0.05$; ***$p < 0.001$

Figure 4. *Exploratory Model 2: Direct and indirect relationship among T1 Reactivity/Negativity, T2 Total Sleep Disturbance, and T2 Emotional Feeding*



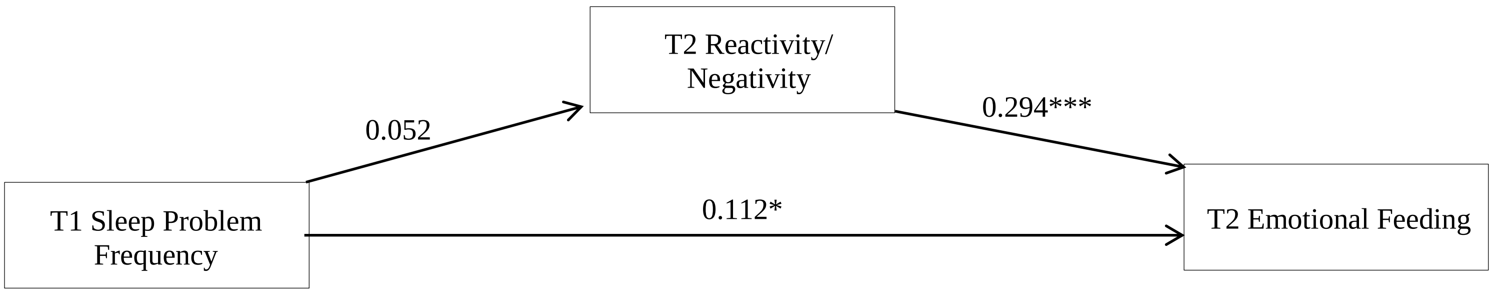
Note: ***$p < 0.001$

Figure 5. *Exploratory Model 3: Direct and indirect relationship among T2 Total Sleep Disturbance, T2 Reactivity/Negativity, and T2 Emotional Feeding*



Note: *$p < 0.05$; ***$p < 0.001$

Figure 6. *Exploratory Model 4: Direct and indirect relationship among T1 Sleep Problem Frequency, T2 Reactivity/Negativity, and T2 Emotional Feeding*



Note: *$p < 0.05$; ***$p < 0.001$