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Does child temperament modify the overweight risk associated with parent feeding behaviors and child eating behaviors?: An exploratory study

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Abstract

Background: Child temperament is a measure of an individual's behavioral tendencies. The primary objective of this study was to examine whether child temperament modified the overweight risk associated with parent feeding behaviors and child eating behaviors. **Methods:** A sample of predominantly African American, Midwest families (N = 120) recruited from four metropolitan primary care clinics participated in this cross-sectional, mixed methods study. Parents reported on feeding practices, child eating behaviors, and child temperament. **Results:** Difficult temperament was not statistically related to parent feeding practices or child eating behaviors ($p > 0.05$). Tests of interaction indicated that the risk of child overweight differed by difficult temperament and easy temperament for two child eating behaviors (emotional eating and food fussiness, $p < 0.05$). For example, the effect of food fussiness decreased the risk of overweight for difficult temperament children but increased overweight risk for easy temperament children. Further, the effect of emotional eating increased the risk of overweight for difficult temperament children but decreased overweight risk for easy temperament children. **Conclusions:** Tailoring parent-level interventions to child temperament or promoting environments that trigger less reactive individual responses may be effective in lowering risk of child overweight

Keywords: Child temperament, Parent feeding practices, Eating behaviors, Child overweight, Child obesity

1. Background

The prevalence of child overweight and obesity continues to be a global public health issue and a topic of concern for prevention and treatment (Lobstein, Baur & Uauy, 2004). In the United States, over thirty percent of school-age children are estimated to be overweight and almost a quarter of those are obese (Lobstein et al., 2004; Neumark-Sztainer, Story, Hannan, Perry & Irving, 2002). Efforts to affect child obesity rates are needed to reduce obesity prevalence into adulthood, (Agras, Hammer, McNicholas & Kraemer, 2004; Anzman-Frasca, Stifter & Birch, 2012) and information about how individuals respond to triggers in their environment may be useful in the design and implementation of childhood obesity interventions (Anzman-Frasca, Stifter, Paul & Birch, 2014).

Child temperament represents predispositions to behave in

certain ways given certain eliciting contexts (Anzman-Frasca et al., 2012) and is described as biologically based individual differences in behavioral and emotional responses to the environment (Rothbart, 2007). Temperament comprises both reactivity, which is the intensity and duration of an individual's behavioral or emotional response, and regulation, which is the individual's ability to modulate a response (Rothbart, 1988). Two temperament components, negative reactivity and low emotional regulation, characterize difficult temperament and have been associated with childhood obesity (Agras et al., 2004; Anzman-Frasca et al., 2012; Brummett et al., 2006; Carey, Hegvik & McDevitte, 1988; Chapman, Fiscella, Duberstein, Kawachi & Coletta, 2009; Sutin, Ferrucci, Zonderman & Terracciano, 2011). A better understanding of how temperament is expressed in the food environment may improve our ability to act on obesogenic risk behaviors in childhood.

Previous studies focusing on interpersonal determinants of child overweight have shown that parent feeding practices (e.g., restriction and pressure-to-eat) and child eating behaviors (e.g., food fussiness and emotional eating) are associated with weight status (Birch & Fisher, 2000; Birch, Fisher & Davison, 2003; Loth, MacLehose, Fulkerson, Crow & Neumark-Sztainer, 2013; Loth, MacLehose, Fulkerson, Crow & Neumark-Sztainer, 2014; Wardle, Sanderson, Guthrie, Rapoport & Plomin, 2002). Little information, however, is available about whether child temperament modifies the overweight risk associated with parent feeding practices and child eating behaviors. For example, one recent study has proposed that temperament may modify the child overweight risk associated with parent emotional feeding (e.g., soothing) (Anzman-Frasca et al., 2012). Parents who use this feeding practice with difficult temperament children may inadvertently promote more emotional eating behaviors than would occur with children who have easy temperament. As a result, children with difficult temperament may subsequently develop eating behaviors that are responsive to emotional triggers rather than to hunger and satiety cues. Information about these pathways would be useful for clinicians if child temperament were found to interact with parent feeding and child eating behaviors that affect obesity risk (Agras et al., 2004; Farrow, Galloway & Fraser, 2009; Haycraft, Farrow, Meyer, Powell & Blissett, 2011; Ventura & Birch, 2008).

Other research related to parent feeding practices indicates that controlling feeding practices may interfere with the natural development of child eating behaviors (Horn, Galloway, Webb & Gagnon, 2011). Although parents may manage caloric intake with controlling feeding practices, food restriction may have an unintended effect of promoting eating when children are not hungry (Horn et al., 2011). Other studies suggest that controlling feeding practices may promote healthy eating behaviors (Rhee et al., 2010). More work is needed to understand the specific pathways by which temperament affects weight status and examining these pathways is of practical importance for intervention design (Anzman-Frasca et al., 2012; Anzman-Frasca et al., 2014).

The objective of this paper is to (1) evaluate whether child temperament is related to child overweight, (2) examine whether child eating behaviors differ according to temperament, and (3) investigate if parents use similar feeding practices with difficult and easy temperament children. The primary aim of this study is to perform an exploratory analysis (4) to explore whether child temperament modifies the child overweight risk associated with parent feeding practices and with child eating behaviors. Results from this study may provide new information about obesity risk factors modifiable in childhood and could potentially inform the development of future preventive interventions, particularly with respect to parent feeding practices.

2. Methods

2.1. Study design

The Family Meals LIVE! study (FML) is a two-year, mixed-methods, cross-sectional study designed to identify key risk and protective factors for childhood obesity in the home food environment (Berge et al., 2014). FML recruited children ($N = 120$) ages 6–12 years and their families from four primary care clinics primarily serving diverse and low-income families in the Minneapolis/ St. Paul metropolitan area between 2012 and 2013. Recruitment was stratified by child weight status defined as (a) nonoverweight: >5 th body mass index (BMI) percentile < 85 th BMI percentile, and (b) overweight/obese: ≥ 85 th percentile (Berge et al., 2015; Fulkerson, Neumark-Sztainer, Hannan & Story,

2008). BMI percentiles were calculated using CDC guidelines (Centers for Disease Control and Prevention, 2000).

Families participated in two home visits, two weeks apart. Data collected at home visits included anthropometric data on all family members, child 24-h dietary recalls, a home food inventory, parent qualitative interview, and child and parent surveys. In between home visits, participants were provided an iPad and asked to videorecord eight days of family dinner meals.

Heights and weights were taken in the first home visit by trained researchers following standardized procedures (Lohman, Roche & Martorell, 1988). Feeding practices and child eating behaviors were assessed by a quantitative survey, which was completed by the primary caregiver at the second home visit. The survey was developed for FML and was guided by Family Systems Theory. It used standardized measures identified by in-depth literature reviews and by examining other pre-existing validated instruments and surveys. The research team and other experts in the fields of family relations and nutrition reviewed the survey to ensure content validity. Comprehensive study procedures have been previously documented (Berge et al., 2014).

2.2. Measures

Temperament was operationalized based on nine questions drawn from the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997) to assess individual reactivity and self-regulation in children. Component items were reverse coded where appropriate to reflect a difficult temperament scale. Items were selected to characterize low self-regulation and negative reactivity. Parents rated their children on a scale of “(1) Not true, (2) Somewhat true, and (3) Certainly true.” The temperament scale measure was constructed as an average across the nine temperament trait questions (min/max: 1–3), and tests of internal consistency indicate good reliability of the measure ($\alpha : 0.80$). Children receiving an average score of two or higher on the scale measure were categorized as having a difficult temperament. All other children receiving a mean score below two were placed in the referent category representing easy temperament.

Subscales were created to represent the average scale response for parent feeding practices (restriction $\alpha : 0.84$, pressure to eat $\alpha : 0.68$, and monitoring $\alpha : 0.89$), parent feeding style (encouragement, $\alpha : 0.76$) and child eating behaviors (emotional eating $\alpha : 0.72$, food responsiveness $\alpha : 0.68$, and food fussiness $\alpha : 0.63$) and were assessed using items drawn from previously validated scales, including the Child Feeding Questionnaire (CFQ), Parent Feeding Style Questionnaire (PFSQ), and the Child Eating Behavior Questionnaire (CEBQ) (Birch et al., 2001; Carnell & Wardle, 2007; Wardle, Guthrie, Sanderson & Rapoport, 2001). Scale representations were evaluated as indicator categorized “high” and “low” at the median value for the interaction analysis.

Height was assessed to the nearest 0.1 cm using a stadiometer and weight to the nearest 0.1 kg using a calibrated scale. To ensure inter-rater reliability, both measures were taken twice, and agreement of less than 1 cm for height and 0.5 kg for weight was required. Body mass index (BMI) percentiles were calculated using CDC guidelines (Centers for Disease Control and Prevention, 2000).

2.3. Statistical analysis

Generalized linear models were used to assess the relationship between explanatory variables and dichotomous child overweight status. All analyses are adjusted for child sex, child gender, and parent race status. Binomial variance family and identity links were used to produce risk difference estimates for dichotomous outcomes. For ordinal outcomes, Gaussian variance family and

identity links were used. Sampling weights were applied to produce estimates that were generalizable to the clinic level population. Analyses were performed in Stata 13.1 SE (StataCorp, College Station, TX 77845).

3. Results

3.1. Sample characteristics

Demographic characteristics of the sample population are presented in Table 1. Families were predominantly African-American and nearly all caregivers were female. The sample of children was evenly split on sex, and the children were on average 9 years old ($SD = 2$). Parents provided information on household characteristics including employment status and household income. Thirty-one percent of caregivers reported working full time, 18% reported working part time, and 15% reported that they were home caregivers. Sixteen percent reported that they were unemployed and seeking work and 20% reported that they were not currently working. Fifty-one percent of households earned < \$20,000 annually, and 16% reported income of \$50,000 or more.

3.2. Descriptive results

Mean temperament score was 1.6 ($SD = 0.4$; min: 1 and max: 2.6; possible range: 1–3) and the prevalence of difficult temperament was 28% ($n = 33$). Among children with difficult temperament, 55% ($n = 18$) were overweight and 45% ($n = 15$) were non-overweight. Of the children with an easy temperament, 48% ($n = 42$) were overweight and 52% ($n = 45$) were non-overweight.

3.3. Associations between child temperament, parent feeding practices and childhood overweight and obesity

Results showed that difficult temperament was not independently associated with child overweight ($p = 0.92$) after controlling for child sex, child gender, and parent race. Additionally, mean differences in child eating behaviors and parent feeding practices for difficult and easy temperament children were examined (Table 2). Difficult and easy temperament children did not differ statistically on child eating and parent feeding practices ($p > 0.05$).

3.4. Evaluation of interaction

In an exploratory analysis, temperament was evaluated as an effect measure modifier to determine if the association between parent feeding style and child overweight and child eating behaviors and child overweight differed within strata of difficult or easy temperament. Statistically significant interactions are presented in Table 3. The overweight risk associated with food fussiness (p -interaction < 0.05) and emotional eating (p -interaction < 0.02) was found to differ by child temperament status. Overweight risk associated with parent feeding practices was not found to statistically differ by temperament status.

Evidence of a temperament interaction was found for two child eating behaviors: food fussiness and emotional eating. First, among difficult temperament children, the risk of overweight was -0.38 lower for fussy eaters (i.e., picky eaters) compared to less fussy eaters (95% CI: $-0.73, -0.04$). Among easy temperament children, the risk of overweight was 0.07 higher for fussy eaters compared to less fussy eaters (95% CI: $-0.25, 0.41$). Similarly, within the stratum of fussy eaters, difficult temperament children had -0.29 lower risk of overweight compared to easy temperament children (95% CI: $-0.67, 0.08$). Within the less fussy eater stratum, the risk of overweight was 0.16 higher among difficult temperament children compared to easy temperament

Table 1. Child demographic characteristics.

	<i>n</i> (%)
Sex	
Female	55 (46%)
Male	65 (54%)
Mean age in years (sd)	9 (2)
Weight status	
Overweight ($\geq 85\%$ ile)	60 (50%)
Non-overweight ($< 85\%$ ile)	60 (50%)
Race	
Black or African American	77 (64%)
White	15 (13%)
American Indian or Alaskan native	4 (3%)
Asian	5 (4%)
Mixed/other	19 (16%)
Primary caregiver employment status	
Full time	37 (31%)
Part time	21 (18%)
Home caregiver	18 (15%)
Unemployed, seeking work	19 (16%)
Not working	24 (20%)
Annual household income	
<\$20,000	62 (51%)
\$20,000–\$35,000	25 (21%)
\$35,000–\$50,000	13 (11%)
\$50,000–\$75,000	12 (10%)
\$75,000+	7 (6%)
Non-response	1 (1%)

children (95% CI: $-0.13, 0.46$). Thus, overweight risk associated with food fussiness was found to depend on child temperament.

Last, among difficult temperament children, the risk of overweight was 0.48 higher for high emotional eaters compared to low emotional eaters (95% CI: 0.12, 0.82). Among easy temperament children, the risk of overweight was -0.11 lower for emotional eaters compared to low emotional eaters (95% CI: $-0.38, 0.17$). Within the stratum of emotional eaters, difficult temperament children had 0.32 greater risk of overweight compared to easy temperament children (95% CI: $-0.09, 0.71$). Within the low emotional eater stratum, the risk of overweight was -0.27 lower among difficult temperament children compared to easy temperament children (95% CI: $-0.54, 0.01$). Thus, emotional eating was found to be an overweight risk factor for difficult temperament children, however it was a protective factor for easy temperament children.

4. Discussion

Child temperament may play a complex role in obesity outcomes as other research has suggested (Zeller, Boles & Reiter-Purtill, 2008). An important finding in the current study was that the risk of overweight due to child eating behaviors (emotional eating and food fussiness) might depend on a child's temperament. These two eating behaviors were found to be relevant for future study.

First, the risk of overweight associated with emotional eating (i.e., eating more due to worry or irritation) was higher among difficult temperament children compared to easy temperament children. This finding may support a view that certain contexts may affect difficult temperament children who are emotional eaters more than easy temperament children. In other words, overweight risk corresponding to environmental triggers (e.g., interpersonal relationships (Eisenberg, Neumark-Sztainer, Story & Perry, 2005; Lieberman, Gauvin, Bukowski & White, 2001) or salient foods (Wansink, 2004)) might differentially affect difficult and easy temperament children. Difficult temperament, emotional eaters may be less self-regulated than easy temperament, emotional eaters (Rothbart & Bates, 2006). In the presence of low nutrient density foods (i.e., salient foods (Wansink,

2004)), difficult temperament emotional eaters may be particularly responsive to the presence of obesogenic foods as compared to easy temperament emotional eaters. These triggers could affect children differently through by either frequency of exposure or through duration of exposure from the eliciting context.

Second, difficult temperament children who are fussy eaters had lower risk of overweight compared to easy temperament children. Although these children might be more at risk to environmental triggers due to temperament, this risk might be explained by variations in repeated exposure to obesogenic food environments (Sullivan & Birch, 1990). In the presence of energy-dense food environments, difficult temperament children may receive a lower dose of obesogenic foods due to rejecting foods that may be commonly available in low quality food environments. Experimental studies that manipulate the food environment (e.g., restriction of salient foods (Fisher & Birch, 1999) or modification of repeated exposure to foods (Sullivan & Birch, 1990)) may provide more information about how to promote healthy weight for children with different temperament.

Although we did not find evidence in this sample that temperament modifies overweight risk associated with parent feeding practices (e.g., restriction and food pressuring), the relationship between difficult temperament and parent feeding practices is practically important for prevention and may be especially harmful for difficult temperament children. For example, restriction and pressure to eat have been found to be positively associated with disordered eating (Loth et al., 2014). Although not different statistically in this sample, parent use of these feeding practices was elevated (5–8% of the scale range) with difficult temperament

children relative to easy temperament children. Evidence suggests that these feeding practices may shape obesogenic eating behaviors (Loth et al., 2013). Future interventions that tailor more structured parental feeding behaviors to difficult temperament children and promote less controlling feeding behaviors with easy temperament children is both actionable and supports innovative approaches to intervention development. In addition, results drawn from such interventions have potential implications for primary care settings. Well-child visits may be a reasonable intervention point to discuss temperament and how tailoring child eating behaviors and parent feeding practices to a child's temperament may promote healthy eating and healthy weight.

The current study had both strengths and limitations. Strengths included the use of a racially/ethnically and socio-economically diverse sample. Given the increased risk of childhood obesity with children from minority and low-income households this is an important population to study. In addition, measuring child temperament is a strength of the study because very few studies have measured this construct in relation to child eating behaviors and parent feeding practices. In relation to previous studies that have measured these constructs, this study had substantially larger sample size, thus improving our ability to detect effects.

A fundamental limitation of these cross-sectional data is that we can only speculate about the direction of associations for risk and protective factors on child overweight. For example, parents may modify feeding practices due to child weight status rather than the view proposed here (i.e., that parent feeding practices affect weight status). Scale measure validity may also

Table 2. Adjusted temperament association with child eating behaviors and parent feeding practices.

	Temperament (difficult/easy reference)		
	Mean scale response (% of scale range)	95% CI	P value
Child eating behavior			
Emotional eating	0.09 (2%)	(−0.23, 0.41)	0.59
Food responsiveness	0.45 (11%)	(−0.10, 1.00)	0.11
Food fussiness	−0.34 (−9%)	(−0.72, 0.04)	0.08
Parent feeding practices			
Restriction	0.18 (5%)	(−0.40, 0.77)	0.53
Pressure to eat	0.33 (8%)	(−0.27, 0.93)	0.28
Monitoring	−0.31 (−8%)	(−0.87, 0.25)	0.28
Encouragement	−0.42 (−11%)	(−0.96, 0.12)	0.13

Models are adjusted for child sex, child gender, and parent race.

Interpretation example: Parents provided information about their child's temperament and eating behaviors. The adjusted child mean food responsiveness was 0.45 higher, corresponding to 11% of the scale range, for difficult temperament children compared to easy temperament children (95% CI: −0.10, 1.00; $p = 0.11$).

Table 3. Interaction tests: stratified overweight risk differences (RD).

Child eating behaviors	Difficult temperament	Easy temperament	Risk difference
High food fussiness	0.28	0.57	−0.29 (−0.67, 0.08)
Low food fussiness	0.66	0.50	0.16 (−0.13, 0.46)
<i>Risk difference</i>	−0.38 (−0.73, −0.04)	0.07 (−0.25, 0.41)	
High emotional eating	0.79	0.47	0.32 (−0.09, 0.71)
Low emotional eating	0.31	0.58	−0.27 (−0.54, 0.01)
<i>Risk difference</i>	0.48 (0.12, 0.82)	−0.11 (−0.38, 0.17)	

Interactions are significant at $p < 0.05$. Models are adjusted for child sex, child gender, and parent race.

Interpretation Example: Tests of interaction indicated that the risk of child overweight differed by difficult temperament and easy temperament for two child eating behaviors (emotional eating and food fussiness, $p < 0.05$). The effect of food fussiness decreased the risk of overweight for difficult temperament children but increased overweight risk for easy temperament children. Emotional eating was positively associated with the risk of overweight for difficult temperament children but negatively associated with overweight risk for easy temperament children.

be a limitation as the temperament scale measure was created using the SDQ in the absence of the widely used Child Behavior Questionnaire (Putnam & Rothbart, 2006). These were exploratory analyses and replication is needed in better-powered studies, and interpretation of point estimates is recommended for hypothesis-generation. Similarly, failure to find statistically significant findings may be due to sample size. For example, we were surprised that overweight risk associated with restrictive feeding practices (and other parent feeding practices) did not differ by temperament status, particularly because restrictive feeding practices have been proposed to deregulate formation of healthy eating behaviors (Fisher & Birch, 1999; Fisher & Birch, 2000). Other research has theorized that exposure to restrictive feeding environments disrupts formation of healthy eating habits by failing to foster self-regulation in children (Birch et al., 2003). Children with difficult temperament have, by definition, lower levels of self-regulation. We expected that individual differences in self-regulation due to temperament and the combination of restrictive feeding practices would be particularly detrimental for promoting healthy weight for children with difficult temperament. Future studies with more power may elucidate whether temperament interacts along the pathways examined here. Longitudinal studies are needed to measure childhood exposures and to capture the formation of early eating behaviors and related parent feeding practices into middle childhood. Experimental designs may provide the most convincing evidence that parent feeding practices and child eating behaviors could give rise to child overweight with regard to individual differences in temperament and the eliciting context of the food environment.

5. Conclusion

This exploratory analysis provides evidence that difficult temperament may synergistically increase the risk of overweight among emotional eaters. Difficult temperament may also decrease overweight risk for fussy eaters. Temperament interactions with eating behaviors provide new information that overweight risk may depend on individual differences that could confer greater or lower risk in obesogenic environments. Tailoring parent level interventions to child temperament or modifying environments to elicit less reactive eating responses when individual characteristics are difficult to modify may be effective in lowering risk of child overweight.

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What's known on this subject

A growing body of evidence has identified difficult temperament as a risk factor for child overweight. Few studies have evaluated whether temperament modifies the overweight risk associated with parent feeding practices and child eating behaviors.

What this study adds

Difficult temperament was found to synergistically increase the risk of overweight among emotional eaters. Difficult temperament was also found to reduce the risk of overweight for fussy eaters.

Contributions — Mr. Tate wrote all drafts of the paper and conducted the data analysis. Ms. Trofholz assisted with data acquisition and data interpretation. Dr. Rudasill assisted in conceptualizing and critically reviewing the paper. Dr. Neumark-Sztainer assisted in conceptualizing the paper and contributed to the design of the study. Dr. Berge is the principal investigator on the grant, assisted with data analysis, and the interpretation and conceptualization of the paper.

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