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Infant Temperament and Maternal Parenting Self-efficacy Predict Child Weight Outcomes

Stephanie Anzman-Frasca, Ph.D.,

The Center for Childhood Obesity Research, Penn State University

Cynthia A. Stifter, Ph.D.,

Department of Human Development & Family Studies, Penn State University

Ian M. Paul, M.D., MSc, and

Department of Pediatrics, Penn State College of Medicine

Leann L. Birch, Ph.D.

The Center for Childhood Obesity Research, and Department of Human Development & Family Studies, Penn State University

Abstract

Relationships between infant negative reactivity and self-regulation, parenting self-efficacy, and child weight outcomes were examined. Greater observed negative reactivity predicted more child weight gain when mothers had lower parenting self-efficacy. Lower mother-reported self-regulation predicted a greater child weight status. Results highlight potential early risk/protective factors.

Keywords

temperament; negative reactivity; self-regulation; parenting; parenting self-efficacy; obesity; weight status

Rates of childhood obesity are high (Ogden, Carroll, Kit, & Flegal, 2012), but there are individual differences in obesity risk. Early temperament is one factor that appears to differentially predict weight outcomes in the current environment (Anzman-Frasca, Stifter, & Birch, 2012). Rothbart and colleagues define temperament as individual differences in reactivity and self-regulation (Rothbart & Bates, 2006), and both of these aspects of temperament have been linked to weight outcomes (Anzman-Frasca et al., 2012). Greater negative reactivity has been linked to a greater weight status or weight gain in infancy and early childhood, and greater self-regulation has been associated with a lower weight status.

While temperament predisposes individuals to certain behaviors, outcomes are dependent on many factors, including parenting. In other words, certain parenting environments moderate the relationship between temperament and child outcomes. While temperament-by-parenting interactions predicting psychosocial adjustment have been well established (Putnam, Sanson, & Rothbart, 2002), less is known about relationships between aspects of

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temperament, parenting, and physical health outcomes like weight gain and obesity. Wu and colleagues (2011) recently found that infant negative reactivity was related to subsequent obesity risk only when coupled with insensitive parenting, demonstrating that relationships between temperament and obesity risk may be obscured if aspects of parenting are not considered. In the current study, we assessed parenting self-efficacy, which is defined as parents' beliefs that they can adequately care for their child and can handle situations involving their child (Johnston & Mash, 1989); this construct has been identified as a robust predictor of parent discipline, competence, and sensitivity (e.g., Sanders & Woolley, 2005; Teti & Gelfand, 1991).

In addition to including interactions with a parenting construct, this study also adds to the literature by measuring both mother-reported and observed infant negative reactivity and self-regulation, as most research in this area has focused on reported negative reactivity (Anzman-Frasca et al., 2012). Parent reports offer a global assessment of the child's behavioral tendencies across a number of contexts but may also be influenced by parents' own personalities and experiences (Kagan, Snidman, McManis, Woodward, & Hardway, 2002; Rothbart & Goldsmith, 1985). In contrast, laboratory-based measures provide a more fine-grained and objective snapshot of infant behavior within a particular context designed to elicit individual differences in reactivity and self-regulation (Rothbart & Goldsmith, 1985). Our goal was to examine whether maternal reports and laboratory observations of infant negative reactivity and self-regulation were related to concurrent and subsequent weight outcomes and to determine whether these relationships were moderated by early maternal parenting self-efficacy. We hypothesized that maternal parenting self-efficacy would moderate positive associations between reported and observed infant negative reactivity and weight outcomes, such that negative reactivity would predict greater weight gain in infants of mothers with lower self-efficacy. We also hypothesized that there would be a direct, inverse relationship between reported and observed infant self-regulation and weight outcomes.

Mothers were recruited from the maternity ward of an academic medical center in Pennsylvania and were eligible if they were primiparous, English-speaking, and intended to breastfeed and to follow up with a University-affiliated primary care provider. More detailed information about inclusion and exclusion criteria has been reported by Paul et al. (2011). Dyads were assessed at infant birth and ages 3 and 16 weeks and 1 year, and 110 mother-infant dyads completed the one-year study. Additional data were collected from a subsample of participants whose medical charts were available at child age 3 years ($n=75$). Among the 110 dyads who completed the one-year study, 51% of the infants were female, and the mean birth weight for gestational age percentile was 45.0 ($SD=28.7$). The majority of mothers were non-Hispanic (94%), White (91%), and college-educated (65%), with family incomes of more than \$50,000 per year (65%). Analyses predicting outcomes at age 1 year include the 110 dyads who completed the one-year study, and analyses predicting weight gain through age 3 years focus on the subsample for whom follow-up data were collected. This subsample did not differ from the sample of study completers on demographic variables or weight status at 1 year. Some participants were randomized to intervention groups (Paul et al., 2011), which were not the focus of the current study; models were adjusted for intervention participation.

Negative reactivity and self-regulation were reported and observed at age 1 year. Mothers completed the Infant Behavior Questionnaire-Revised (Gartstein & Rothbart, 2003), which yielded negative reactivity and self-regulation super-factors. Infants were also observed during an adapted version of the LAB-TAB Toy Removal Task (Goldsmith & Rothbart, 1996). Trained research assistants coded infant negative reactivity and self-regulation when an interesting toy was taken away and placed within sight. Weighted intensity scores were

calculated from the proportion of time the infant showed mild, moderate, and high intensity negative reactivity: $(0 \times \text{proportion of time spent exhibiting non-negative emotions}) + (1 \times \text{mild negative reactivity proportion score}) + (2 \times \text{moderate negative reactivity proportion score}) + (3 \times \text{high negative reactivity proportion score})$; these scores reflect observed negative reactivity. Also coded was the proportion of time the infant spent engaging in self-comforting behaviors during the toy removal (e.g., twirling hair, sucking fingers); these scores reflect observed self-regulation. Mothers completed the Parenting Sense of Competence Scale (Gibaud-Wallston & Wandersman, 1978) at infant age 3 weeks, yielding a measure of early parenting self-efficacy.

Infant weights and lengths were measured by research nurses at age 1 year. Infant weights were measured using a calibrated Medela BabyChecker™ scale (McHenry, IL), and lengths were measured using the Seca 210 Mobile Measuring Mat for Infants and Toddlers (Hanover, MD). BMI-for-age z-scores were calculated using the World Health Organization growth charts (Grummer-Strawn, Reinold, Krebs, & Centers for Disease Control & Prevention, 2010). Birth weight was obtained from medical charts and was included as a covariate. Weight ($n=75$) and height ($n=72$) data from routine medical office visits were also collected from a subsample of participants at age 3 years. Residualized weight gain scores were calculated from the residuals of regression models where child weight at age 3 years was regressed on weight at age 1 year.

A series of eight regression analyses were conducted using SAS Version 9.2, to test whether maternal parenting self-efficacy moderated relationships between the four infant behavior variables (observed and reported negative reactivity and self-regulation at age 1 year) and two weight outcomes (BMI-for-age z-scores at 1 year and residualized weight gain from 1 to 3 years) and to investigate main effects of negative reactivity and regulation. Infant sex, birth weight, intervention group(s), and feeding mode at 16 weeks (breastfeeding versus formula-feeding, with breastfeeding defined as 80% of milk feeds as breast milk) were included as covariates in all analyses. Predictors were standardized, and significant interactions were probed as described by Aiken and West (1991).

Descriptive statistics showed that the sample's average standings on variables of interest were fairly consistent with the literature (Gartstein & Rothbart, 2003). Mean mother-reported infant negative reactivity at age 1 was 3.14 ($SD=.55$), and mean mother-reported self-regulation was 4.75 ($SD=.64$), on a 1–7 scale. The average BMI-for-age z-score at age 1 was .30 ($SD=.93$), and at age 3 it was .57 ($SD=1.06$), showing that on average, children were above growth standards for their age and sex, consistent with national data (Ogden et al., 2012). Corresponding mother-reported and observed measures of negative reactivity ($r=.00$, $p=.98$) and self-regulation ($r=-.02$, $p=.85$) were uncorrelated. Results revealed a significant interaction between observed negative reactivity and maternal self-efficacy in predicting weight gain from 1 to 3 years ($\beta=-.35$, $p<.01$), such that greater infant negative reactivity predicted greater weight gain when mothers had lower self-efficacy (-1 SD; $\beta=.38$, $p<.05$); the relationship was opposite when mothers had higher self-efficacy ($+1$ SD, $\beta=-.37$, $p<.05$; Figure 1). There were no significant interactions or main effects of reported negative reactivity on weight outcomes; this remained the case in post-hoc examinations, in which the more specific subscale of “distress to limitations” was used as the predictor, instead of the negative reactivity super-factor.

Greater mother-reported infant self-regulation at 1 year was associated with lower BMI-for-age z-scores at 1 year ($\beta=-.23$, $p<.05$). The other analyses testing main effects of infant self-regulation and their interactions with parenting self-efficacy were not significant. Finding a significant main effect, but no significant interactions, in the analyses of self-regulation could indicate that relationships between self-regulation and weight outcomes are more

robust than those with early negative reactivity, which may depend more on the caregiver response to infant distress. This idea is supported by consistent findings in the literature linking lower self-regulation and increased obesity risk (Anzman-Frasca et al., 2012).

The current findings showed that reported and observed measures of negative reactivity and self-regulation related to weight outcomes differently, consistent with previous findings that parent reports and observer ratings do not always converge (e.g., Seifer, Sameroff, Barrett, & Krafchuk, 1994; Stifter & Grant, 1993; Stifter, Willoughby, & Towe-Goodman, 2008). Here, observed negative reactivity represents the expression of a specific emotion in a specific situation, akin to frustration or “distress to limitations”. This specific aspect of negative reactivity may drive relationships between negative reactivity and weight outcomes, and observed measures may be the best way to isolate it, as research linking parent-reported distress to limitations and weight outcomes has shown mixed results, potentially due to differing sample characteristics and thus heterogeneous parental biases (Anzman-Frasca et al., 2012). The incorporation of observed negative reactivity measures in subsequent obesity research may reveal that laboratory assessments are preferable in this case, to reduce the influences of context and parental biases, and to isolate which aspects of negative reactivity confer risk for or protection against obesity, at which points in development. Context is still critical to consider but can be operationalized by measuring aspects of the caregiving environment and testing interactions, as done here. For self-regulation, global, parent-report measures may be appropriate. Subsequent obesity research can evaluate these possibilities by including multiple aspects of early negative reactivity and self-regulation and by testing interactions with parenting.

Overall, the aspects of infant behavior that were related to weight outcomes in this study were observed negative reactivity (qualified by maternal parenting self-efficacy) and mother-reported self-regulation. To our knowledge, this study is the first to report links between observed negative reactivity and weight outcomes. The finding that parenting self-efficacy moderated this link highlights: 1) the importance of investigating parenting as a moderator, and 2) the longitudinal implications of this interaction, as it predicted weight gain over time. One interpretation of this interaction is that early maternal self-efficacy may be protective against increased obesity risk in infants who are prone to distress in frustrating situations, like the Toy Removal task. While parenting self-efficacy has been linked to numerous parenting behaviors in the literature, future research should also seek to explicitly measure parenting practices and styles and to recruit heterogeneous samples, as our results cannot be generalized beyond well-educated, White samples intending to breastfeed their first-born infant at birth.

Continuing to investigate multiple facets of negative reactivity, self-regulation, and parenting can further our understanding about which aspects of early temperament are linked to weight outcomes, under what conditions, and through which mechanisms. The current results suggest that a temperament comprised of high negative reactivity may be risk factor in some environments but does not imply that a child is destined to be overweight. These findings, in combination with parallel evidence of temperament-by-parenting interactions (e.g., Wu et al., 2011), underscore the importance of considering the ways in which relationships between temperament and weight outcomes may be modified by aspects of the caregiving environment in the context of current, high rates of childhood obesity.

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Highlights

- Infant temperament has been linked to obesity risk.
- We tested relations between temperament, parenting self-efficacy, and child weight.
- Observed negative reactivity predicted more weight gain when mothers had lower efficacy.
- Lower mother-reported self-regulation predicted a greater child weight status.
- Results support considering observed temperament measures and aspects of parenting.

Figure 1. Mothers' early parenting self-efficacy moderated the relationship between observed infant negative reactivity and child weight gain from age 1 to 3

The interaction term was statistically significant ($\beta = -.35, p < .01$). For children whose mothers had lower parenting self-efficacy at 3 weeks, observed infant negative reactivity during the Toy Removal task positively predicted weight gain from 1 to 3 years ($\beta = .38, p < .05$). For children whose mothers had higher parenting self-efficacy at 3 weeks, observed infant negative reactivity during the Toy Removal task inversely predicted weight gain from 1 to 3 years ($\beta = -.37, p < .05$).