

**Title:** Effect of a responsive parenting intervention on child emotional overeating is mediated by reduced maternal use of food to soothe: The INSIGHT RCT

**Authors:** Holly A. Harris<sup>1</sup>, Stephanie Anzman-Frasca<sup>2</sup>, Michele E. Marini<sup>1</sup>, Ian M. Paul<sup>3</sup>, Leann L. Birch<sup>4</sup>, Jennifer S. Savage<sup>1</sup>

**Affiliations:**

<sup>1</sup>Center for Childhood Obesity Research, The Pennsylvania State University, University Park, PA, USA.

<sup>2</sup>Department of Pediatrics, Jacobs School of Medicine and Biomedical Sciences, University at Buffalo, NY, USA.

<sup>3</sup>Pediatrics and Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA.

<sup>4</sup>Department of Foods and Nutrition, University of Georgia, Athens, GA, USA.

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**Running title:** INSIGHT's effect on emotional overeating

**Address for correspondence:** Dr Jennifer Savage, Center for Childhood Obesity Research, 129 Noll Laboratory, The Pennsylvania State University, University Park, PA 16802. Phone: 814-865-0514. E-mail: [jfs195@psu.edu](mailto:jfs195@psu.edu)

**Abbreviations:**

RP, Responsive parenting; INSIGHT, Intervention Nurses Start Infants Growing on Healthy Trajectories; RCT, Randomized Clinical Trial; BMI, Body Mass Index

1    **Abstract**

2    **Background:** Child emotional overeating is a risk factor for obesity that is learned in the home  
3    environment. Parents' use of food to soothe child distress may contribute to the development of  
4    children's emotional overeating.

5    **Objectives:** To examine the effect of a responsive parenting (RP) intervention on mother-  
6    reported child emotional overeating, and explore whether effects are mediated by mother-  
7    reported use of food to soothe child distress.

8    **Methods:** The sample included primiparous mother-infant dyads randomized to a RP  
9    intervention ( $n=105$ ) or home safety control group ( $n=102$ ). Nurses delivered RP guidance in  
10   four behavioral domains: sleeping, fussy, alert/calm, and drowsy. Mothers reported their use of  
11   food to soothe at age 18 months and child emotional overeating at age 30 months. Mediation was  
12   analyzed using the SAS PROCESS macro.

13   **Results:** RP intervention mothers reported less frequent use of food to soothe and perceived their  
14   child's emotional overeating as lower compared to the control group. Food to soothe mediated  
15   the RP intervention effect on child emotional overeating (mediation model:  $R^2=0.13$ ,  $P<0.0001$ ).

16   **Conclusions:** Children's emotional overeating may be modified through an early life RP  
17   intervention. Teaching parents alternative techniques to soothe child distress rather than feeding  
18   may curb emotional overeating development to reduce future obesity risk.

19

20     **Introduction**

21         Eating in response to negative emotions – ‘emotional overeating’ (1) – develops early in life  
22         (2) and is linked to poor diets (3) and higher weight status (4). Emotional overeating may reflect  
23         deficits in emotion regulation (5) and disrupted appetite self-regulation (6). Heritability analyses  
24         show that children learn to emotionally overeat in the family home environment (7, 8), but  
25         evidence related to its etiology is limited. Parents’ use of non-responsive feeding practices may  
26         teach young children that the pleasurable properties of eating can attenuate negative emotions  
27         which reinforces emotional overeating (9). The current analysis tests this theory empirically  
28         within the context of an early obesity prevention trial designed to promote responsive parenting  
29         (RP). RP broadly describes parents’ prompt and developmentally appropriate responses to their  
30         child’s cues, including hunger and satiety cues (10).

31         Parents’ use of food to soothe their child’s distress (or ‘emotional feeding’) may result in  
32         overfeeding and limit opportunities for the child to build self-soothing skills (11). Use of food to  
33         soothe is associated with increased weight gain in infancy (12) and childhood (13), and  
34         emotional overeating may play a role in this association (14). Infants who exhibit greater  
35         temperamental negativity may elicit parents’ use of food to soothe, and negative affect, which is  
36         broadly characterized by a child’s tendency to express fear, sadness, anger and discomfort (15),  
37         may exacerbate the bidirectional, longitudinal association between parent use of food to soothe  
38         and child emotional overeating (16). Parental feeding practices are known modifiable  
39         intervention targets (17), therefore teaching parents to use alternative soothing strategies may  
40         prevent emotional overeating.

41         The Intervention Nurses Start Infants Growing on Healthy Trajectories (INSIGHT)  
42         Randomized Clinical Trial (RCT) (18) showed that providing RP guidance to first-time mothers

43 prevented rapid infant weight gain (19) and obesity at 3 years (20) compared to a home safety  
44 control group. INSIGHT's central hypothesis is that RP anticipatory guidance promotes child  
45 self-regulation and shared parent-child responsibility for feeding to reduce children's risk for  
46 overeating and overweight (18). One component of the RP curriculum focused on providing  
47 mothers with alternative soothing strategies to feeding (18). Mothers who received the RP  
48 intervention reported using food to soothe less frequently than the control group (17); however,  
49 intervention effects on parental use of food to soothe have not been examined beyond infancy.

50 This analysis aims to examine the effects of the INSIGHT RP intervention on mother-  
51 reported child emotional overeating and determine if effects are mediated by mother-reported use  
52 of food to soothe child distress. We hypothesize that mothers receiving the RP intervention will  
53 report lower child emotional overeating than the control group, and that this effect is mediated by  
54 mothers' use of food to soothe. Based on previous data that infant negativity impacts mothers'  
55 use of food to soothe (21), an exploratory aim of this study was to examine whether this process  
56 varied by infant negative affect.

## 57 **Methods**

### 58 ***Study design and participants***

59 Details of the INSIGHT RCT study design, recruitment and CONSORT diagram have been  
60 published elsewhere (18). This study was approved by the Human Subjects Protection Office of  
61 the Penn State College of Medicine's Human Subjects Protection Office and registered at  
62 <http://www.clinicaltrials.gov> prior to participant enrollment (Registry number: NCT01167270;  
63 registered 21 July 2010). Mothers and their newborns were recruited from one maternity ward in  
64 central Pennsylvania between January 2012 and March 2014. Mothers were eligible to  
65 participate in the study if they were primiparous, English-speaking and  $\geq 20$  years of age, and if

66 their newborns were full-term ( $\geq 37$  weeks gestation), singleton and had a birth weight of  
67  $\geq 2500$ g. Mother-infant dyads were randomized to a RP intervention or a home safety control  
68 group using a computer-generated algorithm, stratified by birth weight for gestational age ( $< 50^{\text{th}}$   
69 percentile or  $\geq 50^{\text{th}}$  percentile) and intended feeding mode (breastfeeding or formula). Following  
70 randomization at infant age 2 weeks, intervention materials were mailed to all participants (18).  
71 Research nurses administered both the RP and control interventions at home visits conducted at  
72 child age 3-4, 16, 28, and 40 weeks and at research center visits at 1 and 2 years. Of the 279  
73 mother-infant dyads who completed the 3-4 week visit, 243 remained in the study by 2 years.  
74 The sample for the current analysis is 207, as 36 participants had missing data on emotional  
75 overeating ( $n=27$ ), food to soothe ( $n=19$ ), or negative affect ( $n=9$ ). Mothers included in the  
76 current analysis were more likely to be older (29.5 vs. 26.3 years,  $P < 0.0001$ ), married (82% vs.  
77 57%,  $P < 0.0001$ ), White (95% vs. 74%,  $P < 0.0001$ ), have a higher income (82% vs. 45% earned  
78  $\geq \$50,000$ ,  $P = 0.03$ ) and have a college/university education (73% vs. 33%,  $P < 0.0001$ ) compared  
79 to those who had missing data on the present variables of interest or had dropped out before child  
80 age 2 years.

81 ***Responsive Parenting (RP) Intervention***

82 A detailed description of the INSIGHT curriculum has been published (18). Briefly, the  
83 nurses delivered the RP intervention content to mothers which centered around anticipatory  
84 guidance for managing four infant behavioral states: sleeping, fussy, alert and calm, and drowsy.  
85 RP guidance for infant fussing included teaching mothers to identify hunger and distinguish  
86 hunger from other sources of infant distress. To provide mothers with alternative strategies to  
87 feeding to calm their infants, mothers were provided with an educational video, *The Happiest*  
88 *Baby on the Block* (22), in the first weeks following delivery. At the first home visit, the nurses

89 demonstrated these calming strategies to soothe a non-hungry infant (e.g. swaddling, swinging or  
90 offering a pacifier). Content related to using alternatives to food to soothe child distress was  
91 discussed at each home visit to promote the child's development of self-regulation and capacity  
92 to self-soothe. At child age 1 year, mothers were provided with an age-appropriate video, *The*  
93 *Happiest Toddler on the Block* (23), to support mothers in managing child tantrums. Mothers in  
94 the control group received an intervention of comparable intensity delivered by the same  
95 research nurses but focused on home safety (including food safety and choking prevention)  
96 within the framework of the four infant behavioral states. The home safety visits were designed  
97 as an 'attention control' such that the two study groups received distinct, non-overlapping  
98 interventions of equal intensity. Implementation fidelity was routinely assessed throughout the  
99 intervention (20). Adherence to message delivery was documented at every home visit by  
100 participating mothers indicating the topics addressed during each home visit on an evaluation  
101 form. Similarly, research nurses completed a self-report checklist of intervention messages  
102 delivered in each visit. Research nurses also audio-recorded the home visits every 6 months, after  
103 obtaining verbal consent from the participant to record the session. These recordings were  
104 monitored by project staff who provided ongoing coaching and supervision to the research  
105 nurses in a report.

106 **Measures**

107       **Sociodemographic characteristics.** Data were collected online and managed using  
108 REDCap (24). Paper surveys were mailed to participants without Internet connectivity ( $n=20$ ).  
109 Participants provided demographic information at enrollment (e.g., maternal race/ethnicity,  
110 marital status, annual household income and highest educational attainment). Maternal age, pre-  
111 pregnancy weight and height, and infant gestational age, sex, and birth weight were extracted

112 from medical charts. At child age 28 weeks, mothers reported on their frequency of breast and  
113 formula feeding. Predominant breastfeeding was defined if  $\geq 80\%$  of milk feedings were  
114 breastmilk, either at the breast or bottle. Researchers measured child weight and height/length at  
115 1, 2 and 3 year clinic visits. Anthropometric measures were converted to age- and sex-adjusted  
116 Body Mass Index (BMI) z-scores based on the World Health Organization growth standards (25)  
117 before child age 2 years, and Centers for Disease Control and Prevention growth reference (26)  
118 for children 2 years and older.

119       ***Mothers' use of food to soothe.*** Mothers self-reported their use of food to soothe child  
120 distress using 12 items from a modified version of the Baby's Basic Needs Questionnaire (27) at  
121 child age 18 months. These items were previously used to evaluate INSIGHT intervention effects  
122 at child age 8, 16, 32 and 44 weeks (17). Mothers rated how often they used food to soothe child  
123 distress across a variety of situations, regardless if hunger was the source of infant distress, on a  
124 5-point Likert scale with responses anchored from never (1) to always (5). This time-point was  
125 selected because age 18 months represents a developmental period when toddlers are becoming  
126 increasingly autonomous (28), acquiring emotion regulation skills (29), and are likely to be  
127 offered table foods that the parents are consuming (30). Items were averaged to create an overall  
128 score with higher scores indicating mothers' greater use of food to soothe ( $\alpha=0.85$ ). The food to  
129 soothe scale can also be divided into two factors: contextual-based (6 items:  $\alpha=0.74$ ) and  
130 emotion-based (6 items:  $\alpha=0.88$ ) food to soothe. Contextual-based food to soothe assesses the  
131 frequency of mothers' use of food to quiet, distract or manage a distressed child in a variety of  
132 day-to-day situations (e.g. in the car or shopping). Emotion-based food to soothe assesses the  
133 frequency of mothers' feeding children in response to child distress or maternal emotions (e.g.  
134 stress, frustration or anger).

135       ***Child emotional overeating.*** The Children's Eating Behaviour Questionnaire (CEBQ) (31),  
136      a 35 item validated parent-report measure, was assessed at child age 30 months. The emotional  
137      overeating subscale is used in the current analysis to measure mothers' perceptions of child  
138      emotional overeating. Mothers reported if their child ate more when worried, annoyed, anxious  
139      or has nothing else to do (4 items). Items were scored from never (1) to always (5) and averaged,  
140      with higher scores indicating children's greater tendency to emotionally overeat ( $\alpha=0.72$ ).

141       ***Temperament.*** The Infant Behavior Questionnaire (IBQ - Revised) – Very Short Form (15)  
142      was assessed at infant age 16 weeks. The negative affectivity super-factor is examined in the  
143      current study (12 items;  $\alpha=0.81$ ). Mothers also completed three subscales of the Early Childhood  
144      Behavior Questionnaire (ECBQ) (32) at age 2 years: frustration (12 items;  $\alpha=0.82$ ), inhibitory  
145      control (12 items;  $\alpha=0.87$ ) and soothability (9 items;  $\alpha=0.82$ ). Items in both temperament  
146      measures were scored from never (1) to always (7) and averaged within each subscale/super-  
147      factor. Higher scores indicated higher levels of that temperament dimension. The earliest  
148      measure of infant temperament (age 16 weeks) was used to address the exploratory research aim,  
149      while the early childhood measure (age 2 years) is included for descriptive purposes.

150      ***Statistical analysis***

151      Data were analyzed using SAS 9.4 (SAS Institute, Cary, NC). Statistical significance was  
152      defined as  $P<0.05$ , and all inferential tests were 2-sided. Sociodemographics and the main  
153      variables of interest were compared by study group using independent samples t-tests and  $\chi^2$  tests  
154      for continuous and categorical variables, respectively.

155      Mediation analysis was used to examine if mothers' use of food to soothe explained study  
156      group effects on child emotional overeating. Mediation analysis was planned if the following  
157      criteria were met: the mediator (food to soothe) was significantly associated with both the

158 independent variable (study group; **Figure 1**, *a* pathway) and the outcome variable (emotional  
159 overeating), controlling for the independent variable (study group; **Figure 1**, *b* pathway) in  
160 separate multivariate linear regressions, adjusting for covariates. We planned to include  
161 participant sociodemographic characteristics in the model as covariates if they were significantly  
162 associated with maternal use of food to soothe and child emotional overeating. The SAS  
163 PROCESS macro (33) was used to analyze whether food to soothe mediated the association  
164 between study group and child emotional overeating (model 4). Bias-corrected bootstrapping  
165 Confidence Intervals (CI) at the 95% level were used for 10 000 resamples to establish direct (*c'*)  
166 and indirect (*ab*) effects. Mediation was established if the indirect effect's CI did not include '0'  
167 (33). In the case of significant overall effects, dimensions of food to soothe (i.e., contextual- and  
168 emotion-based food to soothe) will be probed further.

169 A conditional process analysis was used to examine whether early infant negative affect  
170 altered the study group effect on maternal food to soothe, which, in turn, may influence  
171 intervention effects on child emotional overeating. This corresponds to moderation of the '*a*'  
172 pathway in **Figure 1** or '*action theory*' (34). Infant negative affect was entered into the  
173 conditional process model in the SAS PROCESS macro (33). Moderated mediation was  
174 established if the index of moderated mediation's bias-corrected bootstrapping CI did not include  
175 '0' (33).

176 Multiple imputation (Markov chain Monte Carlo) was used to account for missing values  
177 and confirm the results in the full sample of participants who remained active in the study at age  
178 2 years (*n*=243). Information on maternal pre-pregnancy BMI, marital status, age at recruitment,  
179 education, study group and use of food to soothe (18 months); and child sex, gestational age,  
180 birth weight, negative affect (16 weeks) and emotional overeating (30 months) were used to

181 estimate imputations. Analyses examining study group effects on the main variables of interest  
182 and the mediation analyses were based on pooled results of 9 imputed data sets. Similar results  
183 were found using the imputed data sets (except where indicated), and therefore results are  
184 reported for the complete cases ( $n=207$ ).

185 **Results**

186 Participant characteristics are shown in **Table 1**. Mothers were primiparous,  
187 predominantly white, non-Hispanic, married, and college educated with the majority of mothers  
188 reporting annual household incomes  $\geq \$50,000$ . Maternal and child sociodemographic  
189 characteristics, and child frustration, inhibitory control and soothability, did not differ by study  
190 group.

191 Pearson correlations showed no association between child BMI z-scores at ages 1, 2 and 3  
192 years and child emotional overeating ( $P>0.11$ ). In the analytic sample ( $n=207$ ), child frustration  
193 ( $r=0.31, P<0.0001$ ), inhibitory control ( $r=-0.26, P=0.0002$ ) and soothability ( $r=-0.26,$   
194  $P=0.0002$ ) at 2 years was associated with child emotional overeating at 30 months. Infant  
195 negative affect at 16 weeks was not associated with mothers' use of food to soothe at 18 months  
196 ( $r=0.12, P=0.08$ ), but was positively associated with child emotional overeating at 30 months  
197 ( $r=0.26, P<0.001$ ). Mothers' use of food to soothe at 18 months was positively associated with  
198 child emotional overeating at 30 months ( $r=0.36, P<0.0001$ ).

199 Compared to the control group ( $n=102$ ), mothers who received the RP intervention  
200 ( $n=105$ ) reported using less food to soothe at child age 18 months [ $M (SE)= 1.81 (0.06) vs. 1.58$   
201  $(0.05), P=0.002, d=0.44$ ] and perceived their child to be lower in emotional overeating at age 30  
202 months [ $1.47 (0.05) vs. 1.35 (0.04), P=0.046, d=0.27$ ]. Compared to the control group, mothers  
203 who received the RP intervention also perceived their infant to have lower negative affect at age

204 16 weeks [3.53 (0.09) vs. 3.26 (0.09),  $P=0.04$ ,  $d=0.30$ ]. However, the effect of study group on  
205 infant negative affect did not reach significance in the imputed dataset [3.47 (0.08) vs. 3.26  
206 (0.08),  $P=0.053$ ,  $d=0.25$ ], reflecting trend-level data previously reported in the full INSIGHT  
207 sample (35).

208 ***Mediation analyses***

209 Mothers' use of food to soothe met the criteria for mediation and was examined as a  
210 mediator of study group effects on child emotional overeating. No sociodemographic covariates  
211 were associated with both mothers' use of food to soothe and child emotional overeating. The  
212 unstandardized path coefficients and standard errors for the mediation model of study group on  
213 child emotional overeating through maternal use of food to soothe are shown in **Table 2**. There  
214 was a significant indirect effect (*ab*) of study group on child emotional overeating through  
215 maternal use of food to soothe [ $B(SE) = -0.06 (0.03)$ , 95% CI: -0.12 to -0.02]. The mediation  
216 model explained 13% of the variance in mothers' perceptions of child emotional overeating at  
217 age 30 months. Mediation models for contextual- and emotional-based food to soothe yielded  
218 similar results (data not shown).

219 Next, we tested whether the indirect effect of study group on child emotional overeating  
220 through mothers' use of food to soothe varied by infant negative affect using moderated  
221 mediation. The index of moderated mediation indicated that the indirect effect was not  
222 moderated by infant negative affect [ $B (SE) = 0.02 (0.02)$ , 95% CI: -0.03 to 0.07]. In other words,  
223 the intervention effect on child emotional overeating through mothers' use of food to soothe  
224 occurred independent of child temperament. The indirect effect of study group on child  
225 emotional overeating through mothers' use of food to soothe also occurred independent of child  
226 sex (data not shown). We reran the mediation and moderated mediation analyses, replacing

227 mothers' use of food to soothe measured at 18 months with earlier measures (infant age 8, 16, 32  
228 and 44 weeks). Results were similar, with the exception of mothers' use of food to soothe at  
229 infant age 8 weeks, where the indirect effect was not significant (data not shown).

230 **Discussion**

231 We extend the knowledge of emotional overeating etiology within the context of a  
232 randomized obesity prevention intervention focused on responsive parenting (RP). Mothers who  
233 received a RP intervention that began during the early postpartum period reported using less food  
234 to soothe child distress at child age 18 months compared to a home safety control group,  
235 indicating maintenance in study group differences from infancy (17) to toddlerhood. Further,  
236 mediation analyses supported the hypothesis that mothers' use of food to soothe child distress  
237 could be one mechanism driving the development of emotional overeating. Mothers' less  
238 frequent use of food to soothe appears to explain the RP intervention effect on decreased child  
239 emotional overeating at 30 months, regardless of negative affect during infancy. However,  
240 emotional overeating at 30 months was not associated with child weight up to age 3 years.

241 Aparicio et al.(5) propose that emotional overeating, as a function of maladaptive emotion  
242 regulation, may be one pathway that links stress to child obesity. Results from the current study  
243 show that indicators of child self-regulation (i.e., lower inhibitory control, capacity to self-  
244 soothe, and tolerance for frustration) were inversely associated with child emotional overeating.  
245 This is consistent with findings in older children. Emotional and behavioral problems in 3 year  
246 old Dutch children predicted increasing trajectories of emotional overeating from the ages of 4 to  
247 10 years (36). In the same cohort, Derkx et al.(4) showed that emotional overeating was both a  
248 predictor and consequence of higher weight status from 4 to 10 years, yet these factors were not  
249 cross-sectionally associated at 4 years. Associations between emotional overeating and weight

250 may be age-dependent, emerging with children's increasing autonomy and access to foods (4) or  
251 adiposity rebound (14). This may explain our non-significant association between emotional  
252 overeating and weight status in younger children. Future research should examine these  
253 associations prospectively in the INSIGHT study, or in trials with school-aged children or  
254 adolescents to further understand whether and how the modification of emotional overeating can  
255 impact weight status.

256 Current findings provide further support for emotional overeating as a learned and  
257 therefore modifiable behavior, corroborating findings from heritability analyses (2, 7, 8) and  
258 another obesity prevention intervention (37). Two British twin cohort studies show that 71-93%  
259 of variability in emotional overeating is explained by the 'shared home environment' (2, 7). As  
260 architects of their child's home environment, parents are therefore appropriate targets for  
261 intervention. The NOURISH RCT (37) reported that mothers who received a responsive feeding  
262 intervention perceived their 2 year old child to be lower in emotional overeating than the  
263 'standard care' control group at 6 months post-intervention. Like the current study, small effects  
264 on emotional overeating were reported ( $d=0.24$ ) (37). However, the intervention effect on  
265 emotional overeating in NOURISH did not persist to child age 5 years ( $P=0.09$ ) (38). While both  
266 shared a similar focus on responsive feeding practices, INSIGHT took on a broader approach to  
267 RP across infant behavioral states and was implemented earlier in infancy compared to  
268 NOURISH (3-4 weeks old vs. 4-7 months old). Examining whether the INSIGHT RP  
269 intervention effects on child emotional overeating are sustained later in child development will  
270 further the understanding of *how* and *when* to ideally modify emotional eating trajectories.

271 The INSIGHT intervention effects on mothers' self-reported use of food to soothe child  
272 distress previously reported (17) persisted into toddlerhood. Toddlerhood is a particularly

273 sensitive period in which children acquire skills to regulate their own emotions through  
274 interactions with the social environment (29). Concurrently, this period may also represent a time  
275 in which children's ability to compensate for variations in energy density (i.e., appetite self-  
276 regulation) may diminish (39). Parents are therefore critical in scaffolding children's appropriate  
277 responses to both emotions and appetite. While feeding may temporarily suppress children's  
278 distress by activating the reward system (40), feeding for reasons unrelated to hunger may  
279 undermine children's appetite self-regulation or encourage them to adopt maladaptive emotion  
280 regulation strategies. In an experimental study, children of parents who reported using food as a  
281 tool to control their behavior during the preschool years (3-5 years old) ate more in the absence  
282 of hunger under a stress-induced condition 2 years later (41). Our current study shows that  
283 anticipatory RP guidance decreases mothers' use of food to soothe child distress, which in turn,  
284 may reduce children's tendency to eat in response to stressors.

285 Individual children differ in their clarity of expressing cues, making RP guidance (and  
286 therefore, avoiding feeding to soothe) easier or more difficult to follow depending on child  
287 characteristics (42). For example, mothers of children who exhibit greater negative affect may  
288 respond to aversive emotions by feeding to quickly soothe an upset child (27). However,  
289 differential susceptibility theory (43) posits that children with certain behavioral predispositions  
290 (i.e., negativity) may be more sensitive to changes in their environment, suggesting that those  
291 intervention-group children with high levels of negativity might benefit the most from an  
292 intervention like INSIGHT (44). However, when focusing on the present outcomes of interest,  
293 findings suggest that an RP intervention can reduce child emotional overeating through mothers'  
294 decreased use of food to soothe child distress, regardless of early infant negative affect. Similar  
295 to our prior findings of main effects on child self-regulation (44), these results suggest that the

296 RP intervention's effects on feeding to soothe and child emotional overeating are robust across  
297 levels of infant negative affect. While these findings are encouraging in terms of the  
298 generalizability of the RP intervention's effects in these areas, it is important to note that we  
299 were unable to assess negativity earlier than age 16 weeks. At 16 weeks, there is some evidence  
300 to suggest that the experience of being in the RP intervention group was already starting to affect  
301 mothers' perceptions of their child's negativity (35). Although not statistically significant,  
302 mothers in the RP intervention reported their child to be lower in negativity compared to the  
303 control group (3.3 vs. 3.5,  $P<0.10$ ). Ideally, moderated mediation performed in the current  
304 analysis would have used an earlier, "purer" measure of negative affect, however this was not  
305 possible.

306 Other limitations of the present study include the use of mother reports of both maternal  
307 feeding to soothe and child emotional overeating. While mother-reported measures allow  
308 representation of behaviors over a period of time, they may be subject to social desirability bias,  
309 including higher reporting of behaviors encouraged by the RP intervention in the RP group.  
310 Common methods of parent-report may also have resulted in inflated associations (i.e., shared  
311 method variance). Further, given the complex nature of parent-child interactions, there may be  
312 additional mediators involved in the etiology of child emotional overeating which are not  
313 explored in the current study. For example, future research could examine the role of maternal  
314 eating behaviors, including mothers' own emotional overeating, on the development of child  
315 emotional overeating. Both interventions were delivered by the same research nurses to eliminate  
316 any potential biases introduced by nurse characteristics. While contamination between the RP  
317 intervention and the home safety control group is a possibility, the research nurses followed a  
318 strict curriculum with routine fidelity assessment to prevent intervention drift. The observed

319 effects on primary and secondary outcomes (17, 19, 20) and fidelity results (20) suggest that this  
320 possibility did not preclude the implementation of an effective RP intervention. Lastly, the  
321 sample was relatively homogenous, consisting of predominantly white, middle-income, well-  
322 educated and English-speaking primiparous mothers, limiting the generalizability of findings.

323 There were several strengths to the current analysis. The mediation analysis undertaken is  
324 novel and responds directly to recent calls for understanding pathways involved in nutrition-  
325 related outcomes (45). The analysis reveals not only mechanisms underlying child health  
326 outcomes, but *how* to intervene in these processes. The mediation model examined was grounded  
327 within a strong theoretical framework (5) and also informed by empirical observational findings  
328 in older children (16). We found consistent indirect effects of study group on child emotional  
329 overeating through mothers' use of food to soothe at infant age 16, 32 and 44 weeks, affirming  
330 the mechanism examined during toddlerhood. Current findings provide further support for the  
331 efficacy of the INSIGHT RP intervention (17, 19, 20).

332 Our results suggest that the development of child emotional overeating can be modified in  
333 the context of an early-life obesity prevention intervention. Parents appear to play an important  
334 role in the etiological pathway of emotional overeating through how they respond to children's  
335 distress. Using food to soothe child distress may teach children that negative emotions can be  
336 suppressed through the pleasant effects of eating, thus reinforcing emotional overeating. Guiding  
337 parents to use alternative methods to soothe their child's distress rather than feeding could  
338 ultimately reduce the expression of emotional overeating in early childhood. This causal  
339 evidence supporting RP as a predictor of these outcomes can inform future study designs aiming  
340 to prevent emotional overeating and attendant effects on poor diet and obesity.

341

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**Table 1:** INSIGHT child and maternal sociodemographic characteristics by study group

	RP intervention (n = 105)	Control (n = 102)	P-value
<b>Child</b>			
Male sex, N (%)	54 (51)	51 (50)	0.84
Gestational age (wk), mean (SD)	39.5 (1.3)	39.5 (1.2)	0.82
Birth weight (kg), mean (SD)	3.42 (0.45)	3.46 (0.42)	0.52
Predominantly breastfed at 6 mo, N (%)	39 (37.1)	36 (17.4)	0.78
Temperament at 24 mo, mean (SD)			
Frustration	3.1 (0.7)	3.3 (0.8)	0.08
Inhibition	4.4 (0.8)	4.5 (0.8)	0.89
Soothability	5.5 (0.7)	5.4 (0.6)	0.27
<b>Mother</b>			
Age (y) at recruitment, mean (SD)	29.4 (4.2)	29.6 (4.8)	0.77
Pre-pregnancy BMI, mean (SD)	25.6 (5.0)	25.6 (5.2)	0.97
White, N (%)	98 (93.3)	98 (96.1)	0.38
Hispanic, N (%)	6 (2.9)	5 (2.4)	0.78
Married, N (%)	85 (81)	84 (82)	0.79
Annual household income, N (%)			0.30
≤\$24,999	7 (6.7)	7 (6.9)	
\$25,000-\$49,999	2 (1.9)	15 (14.7)	
\$50,000-\$99,999	67 (63.8)	38 (37.3)	
\$100,000 or more	27 (25.7)	38 (37.3)	
Do not know or refuse to answer	2 (1.9)	4 (3.9)	
Education, N (%)			0.84
High school graduate or less	7 (6.7)	8 (7.8)	
Some college	23 (21.9)	19 (18.6)	
College graduate	43 (41.0)	47 (46.1)	
Graduate degree +	32 (30.5)	28 (27.5)	

BMI: Body Mass Index; kg: kilograms; RP: Responsive Parenting; SD: Standard Deviation.

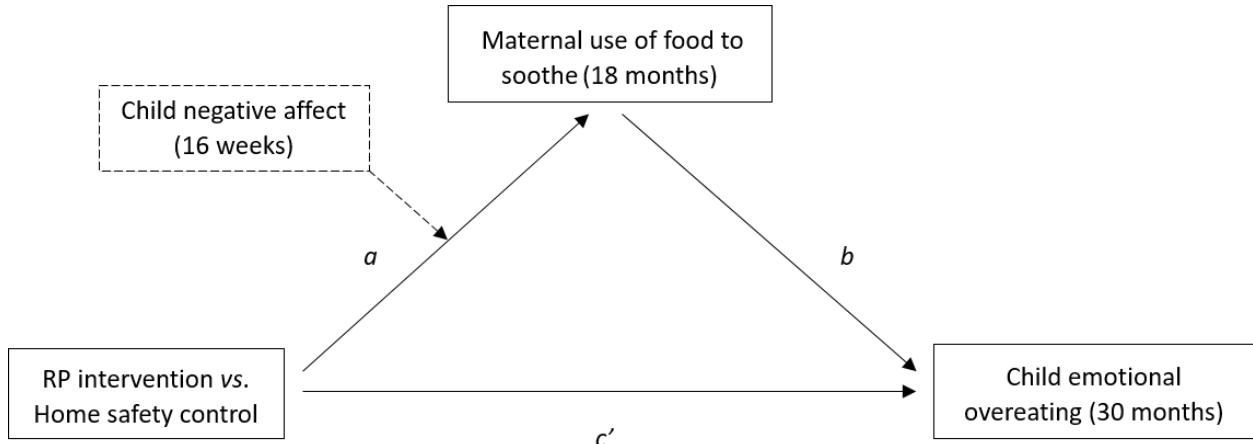
Child temperament measured using the Early Childhood Behavior Questionnaire (32).

**Table 2:** Estimated path coefficients for the mediation model of the INSIGHT RP intervention on child emotional overeating through mothers' use of food to soothe ( $n=207$ )

Antecedent	Consequent						$P$ -value	
	Maternal food to soothe (‘ $a$ ’ pathway)			Child emotional overeating (‘ $b$ ’ pathway)				
	B	SE		B	SE			
Study group (Home safety control vs. RP intervention)	$a$	-0.22	0.07	0.002	$c'$	-0.06	0.06	0.32
Maternal food to soothe	-	-	-	$b$	0.29	0.06	<0.0001	
Constant	$i$	1.81	0.05	<0.001	$i_2$	0.95	0.11	<0.0001
$R^2 = 0.04$ $F(1, 205) = 9.52, P = 0.002$				$R^2 = 0.13$ $F(2, 204) = 15.71, P < 0.0001$				

RP: Responsive Parenting; maternal food to soothe at child age 18 months assessed via the Baby's Basic Needs Questionnaire (27), child emotional overeating at age 30 months via the Children's Eating Behaviour Questionnaire (31). Study group is dummy coded such that safety control = 0; and RP intervention = 1.

**Figure 1:** Model specification for mediation of the INSIGHT RP intervention on child emotional overeating through maternal food to soothe, moderated by infant negative affect



RP: Responsive Parenting. Maternal use of food to soothe from the Baby's Basic Needs Questionnaire (27); Child emotional overeating from the Children's Eating Behaviour Questionnaire (31); Negative affect from the Infant Behavior Questionnaire (Revised) – Very Short Form (15). Solid lines denote the pathways for the main mediation analysis; the dotted lines indicate the exploratory, moderated mediation analysis