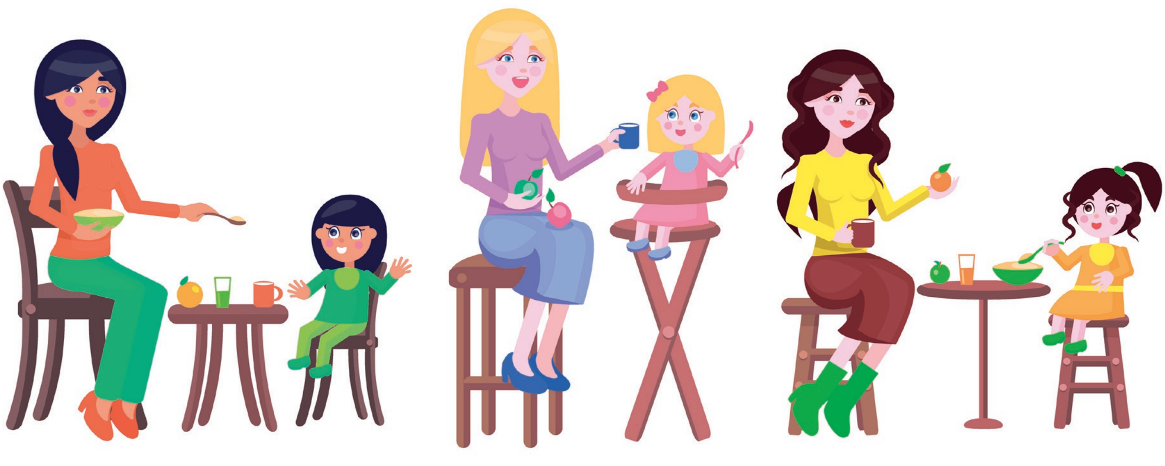
Mealtime interactions: the role of sensitive parental feeding behavior in the first years of life

Vliet, M.S. van

5



Chapter 5

The Baby's First Bites RCT: Evaluating a vegetable-exposure and a sensitive-feeding intervention in terms of child health outcomes and maternal feeding behavior during toddlerhood

Merel S. van Vliet, Janneke M. Schultink, Gerry Jager, Jeanne H.M. de Vries, Judi Mesman, Cees de Graaf, Carel M.J.L. Vereijken, Hugo Weenen, Victoire W.T. de Wild, Vanessa E.G. Martens, Hovannouhi Houniet, & Shelley M.C. van der Veek

Journal of Nutrition, 2022

Abstract

Background. Parenting interventions during the first years of life on *what* and/or *how* to feed infants during complementary feeding (CF) may promote healthy eating habits. **Objective.** An intervention promoting repeated exposure to a variety of vegetables (RVE; *what*) and an intervention promoting to respond sensitively to child signals during mealtime (VIPP-FI; *how*) were compared, separately and combined (COMBI), to an attention control condition (AC). Primary outcomes were vegetable consumption and self-regulation of energy intake; secondary outcomes were child anthropometrics and maternal feeding practices (sensitive feeding, pressure to eat). **Methods.** Our four-arm randomized controlled trial included 246 first-time Dutch mothers and their infants. Interventions started when infants were 4-6 months old and ended at age 16 months. The present study evaluated effects at 18 (t18) and 24 (t24) months of age. Vegetable acceptance was assessed using three 24h dietary recalls, self-regulation of energy intake by an eating-in-the-absence-of-hunger experiment and mother-report, and maternal feeding behavior by observation and mother-report. **Results.** Linear Mixed Model and ANOVA analyses revealed no follow-up group differences regarding child vegetable intake or self-regulatory behavior. The proportion of children with overweight was significantly lower in the COMBI group, compared to the VIPP-FI group at t18 (2% vs. 16%), and AC group at t24 (7 vs. 20%), although this finding needs to be interpreted cautiously due to the small number of infants with overweight and non-significant effects on the continuous BMI-z measure (*p*-values .29-.82). Finally, more sensitive feeding behavior and less pressure to eat was found in the VIPP-FI and COMBI groups, compared to the RVE and AC group, mostly at t18 (significant effect sizes: *d* = .23-.64). **Conclusion.** Interventions were not effective in increasing vegetable intake or self-regulation of energy intake. Future research might do well to focus on risk groups such as families who already experience problems around feeding.

Introduction

Adults with overweight or obesity have a higher risk of developing type II diabetes, cardiovascular disease and certain cancers (Carter, Gray, Troughton, Khunti, & Davies, 2010; Rotteveel et al., 2010; Sinha et al., 2002). Because overweight in childhood is predictive of overweight in adulthood, promoting healthy eating habits such as sufficient vegetable consumption (Aune et al., 2017; Barends et al., 2019) and self-regulation of energy intake (i.e. the ability to act on one's feelings of hunger and satiety; (Fox et al., 2006; Reigh, Rolls, Savage, Johnson, & Keller, 2020)) from an early age onwards is crucial (Whitaker et al., 1997; Williams, Mesidor, Winters, Dubbert, & Wyatt, 2015). Since parents largely determine *what* and *how* children are fed in the first years of life, early interventions focussing on parental feeding strategies during the transitional period of complementary feeding (CF) seem a promising way to foster healthy eating habits from the very beginning. To promote vegetable consumption (the "*What*" of CF), repeatedly exposing infants to a variety of vegetables is found to be an effective method (Ahern, Caton, Blundell, & Hetherington, 2014; Barends et al., 2019; Maier et al., 2007). To foster self-regulation of energy intake and thereby reduce the risk of developing overweight (DiSantis et al., 2011; Hurley et al., 2011), promoting parental responsive feeding behavior (the "*How*" of CF) is thought to be important, as responsively feeding parents adequately respond to infant hunger and satiety cues and do not pressure infants to eat beyond satiation (DiSantis et al., 2011; Hurley et al., 2011). Moreover, although not previously studied, responsive feeding might have beneficial effects on vegetable intake as well. Experimental evidence shows that *non*-responsive feeding strategies such as pressuring a child to eat can have adverse effects on vegetable intake and can foster negative affective responses to foods (Galloway et al., 2006). In contrast, parents who feed in a responsive way allow their child to be in control of its food intake, thereby possibly contributing to more appreciation and intake of vegetables in the long run.

To date, two large RCTs showed that parenting interventions successfully promoted healthier child (dietary) outcomes (increased combined fruit and vegetable intake (Hohman, Paul, Birch, & Savage, 2017) and less rapid weight gain (Daniels et al., 2012; Savage et al., 2016)): the NOURISH and the INSIGHT trial (Daniels et al., 2009; Paul et al., 2014). In the NOURISH trial, mothers received twelve interactive group sessions divided over two modules, one at the start of complementary feeding (age 4-6 months), and one at the age of 13-16 months. The content of the intervention sessions concerned repeated exposure to healthy foods, avoiding unhealthy foods, responsive feeding, modelling, and avoidance of coercion or food rewards (Daniels et al., 2009). At 14 months, less rapid weight gain and lower BMI-z scores were found in the intervention group. Moreover, mothers reported less use of some nonresponsive feeding strategies (Daniels et al., 2012). Finally, when averaging data of 3.7 and 5 years, a greater combined fruit and vegetable intake was reported for children in the intervention group. Effects on child BMI were no longer present on those time points. In the INSIGHT trial, four home visits took place at 3, 16, 28 and 40 weeks of age, where several topics on *what* (e.g. fruit and vegetables, water, and snacking), *when* (e.g. introducing solid food, introducing a cup or a spoon) and *how* (e.g. repeated exposure, hunger and fullness cues, avoiding pressure to eat, modelling, and family meals) were addressed (Paul et al., 2014). Moreover, advice was given on physical activity and sleeping behavior. At the age of 1 year, they did not find effects on vegetable intake, but did find children in the intervention group to show less rapid weight gain (Savage et al., 2016). Moreover, less non-responsive feeding practices were reported in the intervention group (Savage et al., 2018). Although both trials found some positive effects on dietary outcomes, no effects were found on vegetable intake alone. Moreover, (non-)responsive feeding behavior was assessed by self-report instead of observation, and therefore prone to social desirability. Finally, these interventions included many different elements on a broader level and included advice on the *what* and the *how* of CF simultaneously, making it impossible to determine the relative effect of these types of advice. Evaluating the effects of what, how and their combined effect within the same study allows for inferences about the efficacy of these different types of advice.

In the present study, a vegetable-exposure intervention promoting vegetable consumption (RVE; focusing on the "*what*") was compared to a parenting intervention to promote sensitive feeding behavior (VIPP-FI; focusing on the "*how*") (Van der Veek et al., 2019). Within an RCT design, the two interventions were administered separately as well as combined (COMBI), and were compared to an attention control condition (AC). The interventions started when children were offered their first bites of complementary foods (age 4-6 months; baseline t0) and lasted throughout the first year of CF, up until the age of 16 months. In the present paper, the effects of the interventions two months after completion when the age of the child is 18 months (t18) and at eight months follow-up when the age of the child is 24 months (t24) are evaluated. With respect to child outcomes, we hypothesized that a) all interventions (RVE, VIPP-FI, COMBI) are more effective in improving vegetable intake than the control condition; b) the sensitive-feeding and combined intervention are more effective in supporting self-regulation of energy intake and in reducing anthropometric indicators of obesity risk than the vegetable-exposure or control condition; and c) the combined intervention is more effective than the other two interventions alone in promoting vegetable intake. With respect to maternal outcomes, we hypothesized that d) the sensitive-feeding and combined intervention are more effective in promoting positive maternal feeding behavior than the vegetable exposure or control conditions.

Subjects and Methods

Participants

The Baby's First Bites study is a multicenter trial using a superiority randomized controlled design that was conducted from two study locations (Wageningen University and Research, and Leiden University) and carried out in four provinces (Zuid-Holland, Noord-Holland, Gelderland and Utrecht) in the Netherlands. Information regarding for example recruitment of participants and randomization can be found in the study protocol, as well as in the flow chart depicted in Supplemental Figure 1 (Van der Veek et al., 2019). As soon as parents decided to participate, written informed consent was obtained from both parents. The protocol was approved by the Ethical Review Board of Education and Child Studies, Leiden University (protocol number ECPW-2015/116) and the Medical Ethical Review Board of Wageningen University and Research (METC-WU protocol number NL54422.081.15). The trial was registered during inclusion of participants at the Netherlands National Trial Register (identifier NTR6572) and at ClinicalTrials.gov (NCT03348176).

A total of 246 mother-child pairs started the intervention phase. Participant characteristics are shown in Table 1. Parents received a small present for their child after each home visit, as well as a €25 gift voucher for each post intervention assessment.

Table 1. Baseline characteristics of 246 mother-child pairs allocated to intervention or control conditions.

	Mean ± SD or n [%]				
Variable	**Total (n=246)**	**RVE (n=61)**	**VIPP-FI (n=62)**	**COMBI (n=60)**	**CONTROL (n=63)**
Mother					
Education (uni degree)	47 (19.1%)	15 (24.6%)	12 (19.4%)	10 (16.7%)	10 (15.9%)
Age at baseline (y)	31.0 ± 4.7	30.3 ± 4.8	31.4 ± 4.5	30.6 ± 4.8	31.7 ± 4.6
BMI (kg/m^2) at baseline	27.1 ± 5.5	26.7 ± 5.2	27.1 ± 6.1	26.9 ± 5.3	27.5 ± 5.5
Child					
Sex (male)	117 (47.6%)	28 (45.9%)	29 (46.8%)	28 (46.7%)	32 (50.8%)
BMI-z at baseline[a]	-0.20 ± 0.10	-0.20 ± 0.92	-0.29 ± 1.11	-0.14 ± 1.04	-0.15 ± 0.91
Age at baseline (wks)	20.1 ± 3.9	20.5 ± 2.1	19.7 ± 7.2	20.0 ± 1.5	20.2 ± 1.9
Ever breastfed	189 (77%)	8.5 ± 8.6	8.0 ± 7.9	11.6 ± 8.4	7.0 ± 7.0

[a] World Health Organization Standards
RVE = Repeated Vegetable Exposure Intervention, VIPP-FI = Video Intervention to Promote Positive Parenting Feeding Infants intervention, COMBI = Combined condition of RVE and VIPP-FI, CONTROL = attention-control condition

Procedure

As soon as parents consented to participate, they received a short list of signals to help them decide whether their infant (aged 4-6 months) was ready to start complementary feeding (e.g. "child can stabilize head"; "child shows interest in food"). After they indicated their child was ready, they were asked to give their infant rice-flour porridge with a spoon for at least five days to familiarize the infant with eating from a spoon. Subsequently, all participants started with a 19-day feeding schedule as described in more detail elsewhere (Van der Veek et al., 2019), which specified one purée meal per day in addition to usual milk feeding. These feeding schedules were provided for the benefit of the RVE intervention. For standardization purposes commercially available jars of vegetable and fruit purées were provided. Home visits were performed by one of the researchers on days 1, 2, 18 and 19 to videotape the feeding interaction between mother and child, assess how much the child had eaten, and perform other measurements, such as mother and infant weight and height. On these four days all conditions received the same vegetable purées (green beans and cauliflower, in counterbalanced order). On day 3-17 of the feeding schedule, the mother fed her child the purées at home without the presence of the researchers. During the feeding schedule, we advised families not to offer other complementary food besides the prescribed purée.

Intervention sessions started concurrently with the feeding schedules. These interventions took place in five sessions over the course of a year, timed in accordance with major transitions in eating. Two sessions took place at child age 4-6 months and the other three at 8, 12 and 16 months. The focus of the RVE intervention was to motivate mothers to repeatedly expose their children to vegetables. The focus of the VIPP-FI intervention was to enhance maternal sensitive responses to her child during mealtimes. More detailed information about the development and content of the interventions can be found in the protocol paper (Van der Veek et al., 2019) and in Supplemental Table 1. At 18 as well as 24 months another home visit took place, which contained the same elements as the pretest home visit. Finally, about a week before each home visit, mothers were asked to fill out several questionnaires online (see (Van der Veek et al., 2019) for more detail).

Supplemental Table 1. Content of each of the RVE and VIPP-FI intervention sessions.

Session	Child age	RVE			VIPP-FI	
		Theme	Topics discussed	Optional information	Situation filmed	Topics discussed
1	4-6 m	Discovering vegetables	· Why should children learn to eat vegetables? · Keep offering, also if child rejects (at least 10 times)	· Benefits of eating vegetables · Development of taste in young children	Mother feeding infant pureed vegetables/fruits	Learn to observe and interpret child feeding cues (hunger, satiation, liking)
2	4-6 m	Keep on offering vegetables	· How long should I persist? (at least 10 times) · Daily variation, steady increase of portion size	· Tips about offering vegetables to children on a daily basis and the preparation of age appropriate vegetable meals	Mother feeding infant pureed vegetables/fruits	Five tips: Timing, routine, adequate pacing, stop at the right time, enjoy
3	8 m	Being creative with vegetables	· Increase level and variety of texture · Set a good example	· Additional information about introducing more lumpy foods to children. · Tips about preparing and storing age appropriate vegetable meals · Tips to cut costs	Child eating sandwich with mother; new topping on sandwich	What to do when infants a) want more autonomy during mealtimes and b) don't want to eat
4	13 m	Vegetables are part of a balanced diet	· Eating with the whole family · Recommendations for vegetable intake	· Achieving the recommended intake for vegetables	Dinner with whole family; child is served a new vegetable	Positive ways of dealing with negative behavior during dinner
5	16 m	Keep eating vegetables	· Inform parents on possible food neophobia phase, and how to respond	· Involving children in the preparation of vegetables	Dinner with whole family; child is served something new	Inform parents on possible food neophobia phase, and how to respond to that

Note. m=month

5

Outcome measures

Child measures

Primary outcome: Vegetable intake

For the duration of the 19-day feeding schedule that all families commenced with from the first bite onwards (age 4-6 months), the child's consumption of purée was assessed daily by weighing the amount eaten from the provided jars (125g per jar) on standard small kitchen scales (Soehnle, Fiesta 65106). Vegetable intake was assessed at t18 and t24, by asking mothers to fill out web-based 24-hour dietary recalls on three randomly assigned, non-consecutive days within a 3 week period using the online program Compl-eat (Meijboom et al., 2017). Compl-eat used the Dutch food composition database (NEVO) edition 2016/5.0 for the calculation of energy and nutrient intake and food grouping of vegetables. Pre-packaged foods or jars of baby food that were not yet available in the database were manually added by checking the product's package label. The dietary data were processed by trained dietitians, and in case of uncertainties participants were contacted via email or telephone to clarify their entry. More information on measuring vegetable intake is provided in the study protocol (Van der Veek et al., 2019).

For outcome measures where a logical cut-off could be determined, it was established whether a participant was unsuccessful (1) or successful (2) at this outcome measure (success rate). With respect to vegetable intake, a cut-off of 50 grams per day (Dutch daily recommended vegetable intake for children of this age) was used to determine if a child on average consumed enough vegetables or not, in order to compare the four study groups on this binary outcome.

Primary outcome: Self-regulation of energy-intake

Experimental task. Self-regulation of energy intake was assessed by an eating in the absence of hunger (EAH) experiment at t18. The procedure for measuring EAH was based on the free-access procedure for children aged 3-5 years old in a laboratory setting as described by Fisher and Birch (Fisher & Birch, 1999), and adapted for 18-month-old children in a home setting. The protocol for the present study and adaptations to the original procedure have recently been described elsewhere (Schultink et al., 2021). Parents were asked to prepare an evening meal for the child as usual and have dinner together as part of the daily routine. The type and amount of food the child consumed was carefully assessed by obtaining a detailed description of the meal, weighing all food and drinks and taking photographs before and after the meal. The data were processed by trained dietitians to obtain total energy content of the meal. This was followed by an eight-minute free-play session of mother and child after which the researcher provided the child with a plate of two savory (two breadsticks and a handful of potato snack sticks) and two sweet (one slice of gingerbread, and two plain biscuits) age-appropriate palatable finger foods (total 275 kcal) for ten minutes. If the child was allergic to a food or parents disapproved of a food, an alternative was offered, which was the case for 24 children. Mothers remained in the room but were asked not to interfere with the child's behavior, so the child had the opportunity to continue playing with the toys or eat the provided foods without interference. Finger foods were weighed before and after the free access procedure and the weight was multiplied by the energy content of each individual food to determine respectively the total weight (grams) and energy (kcal) consumed by the child. To measure self-regulation, children's finger food intake in kcal, corrected for energy intake during the evening meal, was used in subsequent analyses. Because a cut-off score of finger food intake could not be determined based on theoretical or empirical grounds, no success rate was established for this measure.

Mother-report. Mothers were asked to fill out the Baby Eating Behavior Questionnaire (BEBQ; (Llewellyn et al., 2011)) before starting the feeding schedule, and the Child Eating Behavior Questionnaire – Toddler (CEBQ-T; (Herle et al., 2016)) prior to the home visits at t18 and t24. The BEBQ and CEBQ-T assess several aspects of child eating behavior, including food responsiveness (FR) and satiety responsiveness (SR). Mothers reported on a 5-point Likert scale (from "1= never" to "5= always") how frequently they observed their child demonstrate several eating behavior characteristics on a typical day (e.g., *If (s)he was allowed, my child would overeat* (FR)*; My child cannot eat a meal if (s)he has had a snack just before* (SR)). The FR and SR scales are used as indicators of the child's self-regulation of energy-intake, where scoring lower on FR and higher on SR indicates better self-regulation skills (Sleddens et al., 2008). The original CEBQ scale has been shown to have good internal consistency (Cronbach's alphas ranging from 0.72 to 0.91; (Wardle et al., 2001b)), adequate two-week test-retest reliability (correlation coefficients ranging from 0.52 to 0.87; (Wardle et al., 2001)), and adequate construct validity (Carnell & Wardle, 2007). In our sample, internal consistency ranged from $\alpha = 0.73$ (t0) to $\alpha = 0.80$ (t18/24) for Food Responsiveness, and $\alpha = 0.68$ (t0) to $\alpha = 0.81$ (t18/24) for Satiety Responsiveness. Because a cut-off score of FR and SR could not be determined based on theoretical or empirical grounds, no success rate was established for this measure.

Secondary outcome: Anthropometrics

Child bodyweight was measured during each follow-up assessment at home using a calibrated digital scale (SECA robusta 813), in kilograms to the nearest 0.1 kg. Up until t18 the child's height was measured on an infant measuring mat to the nearest 0.5 cm. At t24 children's height was measured with a portable stadiometer (SECA 213, Chino, USA/Garant). Body Mass Index (BMI) was calculated and transformed into age and sex-standardized z-scores (BMI-z) using reference values from the WHO child growth standards (2019) (WHO, 2019) and the following formula: BMI-z=$[(BMI/M)L-1]/(L\times S)$ (Cole, Bellizzi, Flegal, & Dietz 2000). As reported in earlier studies (Ezzahir et al., 2005; Olsen et al., 2021), change in BMI-z was calculated (t0 to t18, t0 to t24 and t18 to t24) as a measure of weight gain. To establish the success rate in each condition, a cut-off for BMI-z of 2 (upper limit for normal weight) was used (Organization, 2006).

Secondary outcome: Maternal feeding behavior

Observed feeding behavior. Maternal feeding behavior was observed during mother-child feeding interactions in the home setting. Feeding interactions of t0, t18 and t24 were videotaped and coded from the beginning of the feed (first spoon offer until the moment the mother decided to end the meal) to measure, among others, responsiveness-to-stop signals of the child, maternal sensitivity during feeding and pressure to eat. After intensive training, a reliability set of 30 videos was coded by four coders, yielding intercoder reliabilities (intraclass correlations, single rater, absolute agreement) of > .70 for all scales between all individual coders (Cortina, 1993). The coders were not familiar with the families in the videos they were allocated, nor aware of these families' group status (experimental vs control).

Responsiveness to stop signals. The Responsiveness-To-Stop-Signals scale was based on the responsiveness-to-child-fullness-cues scale as described in the Responsiveness-To-Child-Feeding-Cues Scale coding instrument (Hodges et al., 2013). Adaptations made to the original scale are described elsewhere (Van Vliet et al., 2021). The responsiveness of the mother was based on her response to the fullness cues expressed by the child, taking into account the frequency and intensity of child fullness cues prior to the mother's decision to stop the feed. Maternal responsiveness was scored on a 5-point scale, ranging from highly unresponsive (1) to highly responsive (5). In case this maternal behavior could not be observed, for example when the child finished all the food without showing any stop signals, or the mother restricted the child from finishing all the food, mother was given a score of 9 (not applicable). Interrater reliability was good to excellent (ICC^{t0} = .75 - .87; ICC^{t18} = .77 - .94; ICC^{t24} = .78 - .97). To establish the success rate in each condition, a cut-off of ≥4 (often or always responsive) was used.

Sensitivity. To rate maternal sensitivity towards all child behavior shown during the feed, the Ainsworth sensitivity scale was used (Ainsworth et al., 1974). Mothers were scored on the original 9-point scale, ranging from highly insensitive (1) to highly sensitive (9). Interrater reliability was good to excellent (ICC^{t0} = .73 - .85; ICC^{t18} = .79 - .87; ICC^{t24} = .78 - .93). To establish the success rate in each condition, a cut-off of ≥6 (high sensitivity scores indicating the absence of behaviors clearly out of tune with the child's signals) on the Ainsworth scale was used.

Pressure to eat. Our observed pressure to eat scale was adapted from the "received pressure to eat scale" as designed by Camfferman and colleagues (Camfferman, 2017). Pressure to eat was defined as any encouragement, either physically or verbally, by the mother to make the child eat more, and was coded on a 5-point scale (1 = no pressure at all, 5 = extreme pressure). Extreme pressure to eat could be defined either in terms of quantity (pressure throughout the entire interaction) or in terms of intensity (e.g. force feeding the child). Pressure to eat was only coded at t18 and t24. Internal consistency was good (ICC^{t18} = .71 - .83; ICC^{t24} = .77 - .86). To establish the success rate in each condition, a cut-off of ≤2 (never, or rarely use of pressure to eat) was used.

Self-reported feeding behavior. The Infant Feeding Style Questionnaire (IFSQ, (Thompson et al., 2009)) was used to measure responsive feeding and pressure to eat. Mothers reported on a 5-point Likert scale varying from never (1) to always (5), and were asked which answer was most applicable to their situation.

Responsive feeding. The original IFSQ Responsive-Feeding scale consists of 6 to 8 items, depending on the age and the diet of the infant (milk only versus including solid food). However, because some items show overlap with concepts other than responsive feeding (e.g., modeling, or child behavior instead of maternal behavior), we decided to select the three items of this scale that clearly represent responsive feeding (i.e., *I let C decide how much s/he eats; I pay attention when C seems to be telling me that s/he is full or hungry; I allow C to eat when s/he is hungry*). Internal consistency of the adapted responsive feeding scale was rather low (α^{t0} = .48, α^{t18} = .47, α^{t24} = .46), which reflects the fact that these behaviors do not necessarily have to occur simultaneously, but all represent different manifestations of responsive feeding. To establish the success rate in each condition, a cut-off of ≥4 (often or always responsive) was used.

Pressure to eat. The original pressure to eat scale consists of 5 to 7 items, depending on the age and the diet of the infant (milk only versus including solid food). However, because for some items it was ambiguous whether parents actually meant to pressure their child to eat by performing this behavior (e.g., the item "adding rice flour to the bottle"), we decided to use only 4 items that clearly defined pressure to eat (i.e., *I try to get C to finish his/her food; If C seems full, I encourage him/her to finish his/her food anyway; I try to get C to eat even if not hungry; I insist to retry new food refused at same meal*). Internal consistency of the adapted pressure scale was highest at later time-points (α^{t0} = .58, α^{t18} = .73, α^{t24} = .66). To establish the success rate in each condition, a cut-off of ≤2 (never, or rarely use of pressure to eat) was used.

Covariates

At t0 a baseline structured interview was conducted. This interview consisted of questions about perinatal characteristics, family situation, and parental characteristics such as education, health, job status and income, marital situation and information about type of milk feeding (e.g., duration of breastfeeding). In addition, prior to the home visits at t0, t18 and t24, all mothers filled out online questionnaires, for assessing covariates such as child temperament, child food neophobia, maternal depression, or changes in the family's situation compared to t0 (e.g. educational level, marital status). Child temperament was assessed by the Infant Behavior Questionnaire-Revised short form at baseline t0 (Putnam et al., 2014), and the Early Childhood Behavioral Questionnaire at t18 (Putnam et al., 2006). Child food neophobia was assessed by the Child Food Neophobia Scale (Pliner, 1994; Pliner & Hobden, 1992), and maternal depression by the Center for Epidemiologic

Studies Depression Scale (Radloff, 1977). Furthermore, because pressure to eat was not coded at t0 and the related construct of maternal intrusiveness was (by means of Ainsworth's Interference vs. Cooperation scale; (Ainsworth et al., 1974)), the latter was used as a covariate. A similar baseline correction was performed for the self-report measures of maternal feeding behavior, by using the baseline data concerning type of milk feeding as a covariate. Maternal height (t0) and bodyweight were measured at all time points and used to calculate BMI in kg/m^2. Finally, children's dietary intake was assessed at t18 and t24 using the same three 24-hour dietary recalls as for assessing vegetable intake. Energy intake was calculated per recall day and an average daily energy intake was calculated per child for t18 and t24 separately. The data collected on days that a child was sick were excluded, therefore the average daily energy intake was based on one (4.4%), two (15.1%) or three (80.5%) recall days.

Statistical analysis

Detailed information about the inclusion phase and retention from initial contact with potential participants to randomization, as well as justification of the sample size are described elsewhere (Van der Veek et al., 2019).

Linear mixed model analysis (LMM) was used to test if the interventions differentially affected outcome measures over time. Because LMM facilitates an intention-to-treat analysis, all participants with data on at least one time point (t0, t18 or t24) were included in the analyses. Therefore, imputations were not considered necessary. As no baseline group differences were detected on relevant covariates (Table 1), adjustment for covariates was not undertaken, unless considered necessary based on other grounds (e.g. baseline correction). The covariance structure was determined for each outcome measure separately, by choosing the structure with the optimal fit (i.e. lowest AIC value, (Ngo & Brand, 1997)). Within LMM, pairwise comparisons that were relevant for our hypotheses were performed, at t18 and t24 separately. No posthoc-adjustments were undertaken, because only hypotheses-driven comparisons were performed (Baron, Perrodeau, Boutron, & Ravaud, 2013; Freidlin, Korn, Gray, & Martin, 2008). Effects of condition, time, and their interaction (comparing all groups simultaneously over time), were analyzed and reported as well, and considered exploratory analyses.

With respect to vegetable intake, a square root transformation was performed because of severe positive skewness. By means of planned pairwise comparisons in LMM, all three intervention groups were compared to the control group, and the COMBI group was compared to the VIPP-FI as well as the RVE group. Vegetable intake was related to average daily energy intake ($r(194) = .17$, $p = .02$ and $r(179) = .28$, $p < .001$) at t18 and t24, respectively. Therefore, the LMM analysis was run with and without correction for average daily energy intake to account for variations in appetite, which in turn may also influence vegetable intake. Because energy intake was not assessed at t0, baseline vegetable intake was expressed as grams per kilogram bodyweight.

To test differences in finger food intake between the conditions at t18 in order to measure self-regulation, an ANCOVA was performed. Planned pairwise analyses were performed, comparing the VIPP-FI and COMBI group to the RVE and AC group. Energy intake of the evening meal was added to the model as covariate. Regarding the FR and SR scales of the CEBQ-T, planned pairwise comparisons were performed in LMM, by comparing the VIPP-FI and COMBI group to the RVE and AC group. Data were analyzed at t18 and t24, corrected for pretest data concerning milk feeding.

Regarding child BMI-z scores, planned pairwise comparisons were performed in LMM, by comparing the VIPP-FI and COMBI group to the RVE and AC group. To test whether changes in child BMI-z scores (weight gain) differed between the intervention groups stated above (baseline to t18 and t24 and t18 to t24), ANOVA analyses were performed.

With respect to the parenting measures, planned pairwise comparisons were performed in LMM, by comparing the VIPP-FI and COMBI group to the RVE and AC group. Observed pressure to eat (corrected for maternal intrusiveness at t0), as well as the self-report measures maternal responsive feeding and maternal pressure to eat (corrected for pretest data concerning milk feeding) were only analyzed at t18 and t24. The observational measures responsiveness-to-stop-signals and maternal sensitivity did include a pretest measure equal to the measures at t18 and t24.

Finally, differences in success rates between groups were analyzed by means of Generalized Linear Models with a binary outcome, correcting for pretest data. An overall Chi-square measure was reported, as well as *p*-values resulting from subsequent pairwise comparisons between relevant conditions.

Statistical significance was set at $p < .05$. Cohen's *d* effect sizes were obtained and reported regarding mean differences between conditions (Cohen, 1992). Values of .20, .50 and .80 were considered a small, moderate and large effect, respectively (Cohen, 1992). All analyses were performed with statistical software IBM SPSS version 25.

Results

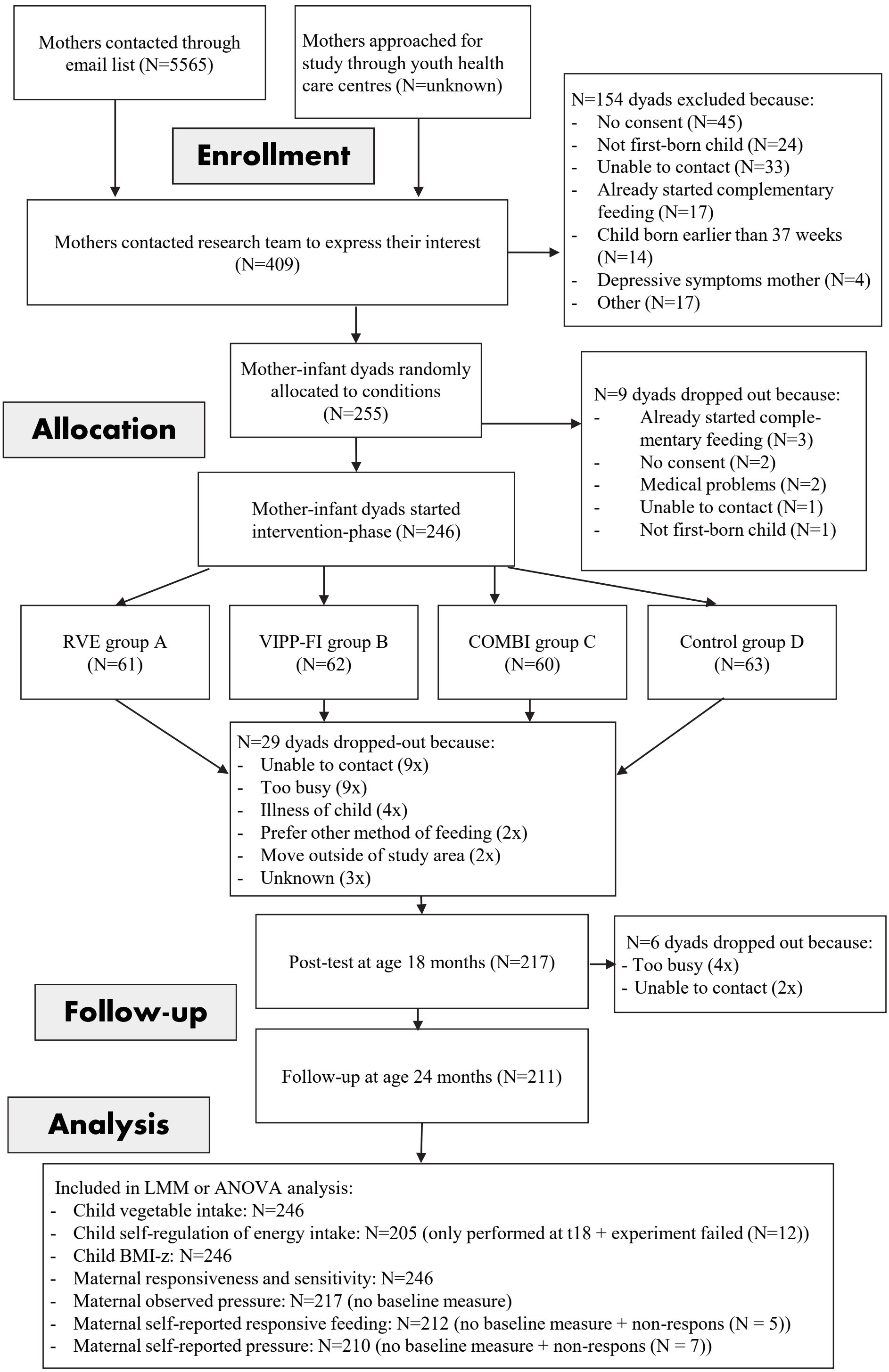
Participant characteristics

Participant flow throughout the study and baseline characteristics are depicted in Supplemental Figure 1 and Table 1, respectively. With respect to attrition, mothers who prematurely dropped out tended to have a lower educational level (2.6% of dropouts vs 22.2% of remaining participants had a university degree). Dropping out was not related to maternal BMI, maternal age, maternal vegetable intake, intervention group or household income. The only baseline difference found significant was vegetable intake at t0 ($p = .03$), with higher vegetable intake in the RVE condition than in the COMBI condition (Figure 1; Table 2).

Child outcomes

With respect to child vegetable intake, planned pairwise comparisons resulting from Linear Mixed Model analysis at t18 and t24 showed no significant differences between the RVE, VIPP-FI and COMBI groups compared to the AC group (*p*-values .11-.86; Figure 1A; Table 2). The COMBI group was also not superior to the RVE or VIPP-FI groups, as pairwise comparisons revealed no significant differences between these groups. The main effect of time was significant, with significant increases in vegetable intake in grams from t0 to t18 ($p < .001$) and t0 to t24 ($p < .001$) for all groups, and a significant decrease from t18 to t24, $p < .01$ (t0: 24 ± 23 g, t18: 87 ± 53 g, t24: 77 ± 54 g). Main effects of condition and the interaction effect of time x condition, which both compare all conditions simultaneously, were not significant). With respect to success rate, at t18 and t24, the majority of all children achieved the daily recommended intake of at least 50 grams. Corrected for vegetable intake at t0 and for daily energy intake, no main effect of condition was found at t18 ($X^2 = 2.82$, $p = .43$) or t24 ($X^2 = .43$, $p = .93$). In addition, planned pairwise comparisons did not reveal any group differences in achieving daily recommended vegetable intake at t18 or t24 (p = .61-.92; Table 2). Taken together, in contrast to our hypotheses, no differences between the three intervention groups compared to AC emerged in terms of vegetable consumption.

To examine the effects of the interventions on self-regulation, absolute intake of finger foods during the eating in the absence of hunger experiment was compared between conditions, corrected for energy intake of the meal consumed before the task (Table 2). At t18, a one-way ANCOVA analysis revealed no main effect of condition, indicating that children in the VIPP-FI and COMBI groups did not show better self-regulation skills than children in the RVE and AC group (Table 2). With respect to mother-reported self-regulation skills by means of the FR and SR scales of the CEBQ-T, t18 and t24 were examined with correction for mother-reported FR and SR concerning milk feeding at baseline. Planned pairwise comparisons revealed no significant differences between the VIPP-FI and COMBI groups on the one hand, and the RVE and AC group on the other hand, at t18 as well as t24



Supplemental Figure 1. Study flowchart.

(p-values FR: .07-.91; p-values SR: .17-.92; Table 2). The main effect of time was significant for FR as well as SR, with significant decreases in FR from t18 to t24 (t18: 2.6 ± 0.8, t24: 2.5 ± 0.8), and significant increases in SR from t18 to t24 (t18: 2.8 ± 0.6, t24: 3.1 ± 0.7). Main effects of condition and the interaction effect of time x condition, which both compare all conditions simultaneously, were not significant for both FR and SR (Table 2).

Regarding child BMI-z score, planned pairwise comparisons resulting from Linear Mixed Model analysis at t18 and t24 showed no significant differences between the VIPP-FI and COMBI groups compared to the RVE and AC group (p-values .29-.82; Table 2). The main effect of time was significant, with significant increases in BMI-z from t0 to t18 ($p < .001$), t0 to t24 ($p < .001$) and t18 to t24, $p < .001$ (t0: -0.2 ± 1.0, t18: 0.4 ± 1.1, t24: 1.0 ± 1.0). Main effects of condition and the interaction effect of time x condition, which both compare all conditions simultaneously, were not significant (Table 2). With respect to child weight gain, there were no group differences from t0 to t18 ($p = .79$), t0 to t24 ($p = .97$) or t18 to t24 ($p = .69$). However, with respect to success rate at t18, corrected for BMI-z at t0, the main effect of condition revealed a trend ($X^2 = 6.86$, $p = .07$). When examining planned pairwise comparisons, the COMBI group had a significantly lower proportion of children with overweight (2%) than the VIPP-FI group (16%; $p = .02$; Table 2). At t24, the main effect of condition showed a trend as well, $X^2 = 7.60$, $p = .06$. Planned pairwise comparisons revealed that the COMBI group had a lower proportion of children with overweight (7%) than the AC group (20%; $p = .02$; Table 2).

Maternal feeding behavior

Observed. With respect to maternal responsiveness to satiety cues, planned pairwise comparisons resulting from Linear Mixed Model analysis revealed higher levels of responsiveness in the COMBI and VIPP-FI group compared to AC at 18 months ($p = .02$, $d = 0.55$, and $p = .03$, $d = .47$, respectively; Table 3; Figure 1B). No differences in maternal responsiveness were present between COMBI and VIPP-FI compared to the RVE condition ($p = .14$, $p = .20$, respectively), and there were no group differences at 24 months (p = .49-.98). The main effect of time showed a marginally significant effect ($p = .052$), with a significant increase in responsiveness from t0 to t18, $p = .03$ (t0: 3.5 ± 1.1, t18: 3.8 ± 1.2, t24: 3.7 ± 1.2). Main effects of condition and the interaction effect of time x condition, which both compare all conditions simultaneously, were not significant. With respect to success rate at t18, corrected for t0, the main effect of condition was not significant, $X^2 = 5.88$, $p = .11$. However, planned pairwise comparisons revealed a higher proportion of the mothers in the COMBI condition that was considered *(very) Responsive* (score ≥4) than in the AC condition ($p = .01$). Other groups did not differ in terms of success rate at t18 (p = .12-.40), and no significant main effect ($X^2 = 1.28$, $p = .73$) or significant planned pairwise comparisons were present at t24 (p = .33-.96; Table 3).

Regarding maternal sensitivity, planned pairwise comparisons resulting from Linear Mixed Model analysis revealed a marginally significant effect for more sensitive behavior during the meal in the VIPP-FI group compared to AC at t18 (p = .052; Table 3). The difference between VIPP-FI and RVE was not significant, p = .21. No differences in favor of the COMBI group compared to RVE and AC were found at t18 (p = .42, p = .14, respectively), and no differences in maternal sensitivity between any groups at t24 (p = .34-.91). The main effect of time was significant, with an increase in sensitive behavior from t0 to t18 (p < .001) and t0 to t24 (p = .03), and a decrease in sensitive behavior from t18 to t24, p = .04 (t0: 6.2 ± 1.5, t18: 6.8 ± 1.6, t24: 6.5 ± 1.7). Main effects of condition and the interaction effect of time x condition, which both compare all conditions simultaneously, were not significant. With respect to success rate (sensitivity score ≥6), the main effect of condition was not significant at t18 (X^2 = 2.71, p = .44), as well as t24 (X^2 = 0.34, p = .95). Planned pairwise comparisons revealed no differences between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand (t18: p = .10-.83; t24: p = .67-.95).

With respect to observed maternal pressure to eat, t18 and t24 were examined with correction for intrusiveness during feeding at baseline. Resulting from Linear Mixed Model analysis, planned pairwise comparisons at t18 and t24 showed no significant differences between the VIPP-FI and COMBI groups compared to the RVE and AC group over time (p-values .17-.48; Table 3). The main effect of time was significant, indicating an increase in pressure to eat from t18 to t24 (t18: 2.4 ± 1.0, t24: 2.7 ± 1.0). Main effects of condition and the interaction effect of time x condition, which both compare all conditions simultaneously, were not significant. With respect to success rate at t18, the main effect of condition revealed a trend (X^2 = 6.68, p = .08). Planned pairwise comparisons revealed a higher proportion of the mothers in the COMBI group that hardly used pressure to eat or did not use it at all (score ≤2), compared to the RVE and AC group (p = .04 and p = .04, respectively; Table 3). The VIPP-FI group did not significantly differ from RVE or AC (p = .10, p = .11, respectively). At t24, the main effect of condition was not significant (X^2 = 3.66, p = .30), nor did any differences emerge between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand (p = .13-.85).

Self-report. Regarding self-reported maternal responsive feeding, t18 and t24 were examined with correction for self-reported responsive feeding concerning milk feeding at baseline. Resulting from Linear Mixed Model analysis, planned pairwise comparisons at t18 revealed that more responsive feeding behavior was reported in the COMBI group compared to RVE and AC group (p = .04, d = .45 and p = .02, d = .64, respectively; Table 3; Figure 1C). No differences in favor of the VIPP-FI group were found compared to RVE or AC at t18 (p = .16 and p = .32, respectively), nor any differences at t24, between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand (p = .31-.82). The main effect of time was significant, indicating a significant decrease in responsive feeding behavior from t18 to t24 (t18: 4.1 ± 0.5, t24: 3.9 ± 0.5). Main effects of condition and the interaction effect of time x condition, which both compare all conditions simultaneously, were not significant. With respect to success rate (sensitivity score ≥6), the main effect of condition was not significant at t18 (X^2 = 3.66, *p* = .30). Planned pairwise comparisons only revealed a marginally significant effect for the difference between COMBI and RVE (*p* = .054), with more responsive feeding behavior reported in the COMBI group. The difference between COMBI and AC at t18 was not significant (*p* = .33), nor differences between VIPP-FI and RVE or AC (*p* = .25, *p* = .90, respectively). At t24, the main effect of condition was not significant (X^2 = 1.55, *p* = .67), nor did any differences emerge between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand (*p* = .30-.92).

With respect to self-reported maternal pressure to eat, t18 and t24 were examined with correction for self-reported pressure concerning milk feeding at baseline. Resulting from Linear Mixed Model analysis, at t18, planned pairwise comparisons indicated less pressure in the VIPP-FI group compared to the RVE group (*p* = .01, *d* = .35), and less pressure in the COMBI group compared to the RVE and AC group (*p* = .01, *d* = .47, and *p* = .04, *d* = .40, respectively; Table 3; Figure 1D). A trend was found for the difference between VIPP-FI and AC at t18 (*p* = .07). At t24, less pressure was reported in the COMBI group compared to the RVE group, and a trend was found for the difference with AC (*p* = .08). No differences were found in favor of the VIPP-FI group compared to RVE and AC (*p* = .21, *p* = .33, respectively). The main effect of time was not significant, but the main effect of condition, comparing all four conditions amongst each other, was. With respect to success rate, at t18, a significant main effect of condition was present (X^2 = 9.34, *p* = .03). Planned pairwise comparisons revealed a higher proportion of the mothers in the COMBI and VIPP-FI groups that reported to hardly use pressure to eat techniques (score ≤2), compared to both RVE (*p* = .02 and *p* = .04, respectively) and AC condition (*p* = .01 and *p* = .04, respectively; Table 3). At t24, the main effect of condition was not significant (X^2 = 3.84, *p* = .28), nor did any differences emerge between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand (*p* = .08-.56).

Table 2. Descriptives and analysis of child health outcomes comparing RVE, VIPP-FI, COMBI and AC at t0, t18 and t24.

	M ± SD	%	M ± SD	%	M ± SD	%	*p*T	*p*C	*p*TxC
Vegetable intake (grams; *n* = 246)	24 ± 23		87 ± 53	79	77 ± 54	67	< .001*	.48	.45
A – RVE (*n* = 61)	32 ± 30		90 ± 54	73	75 ± 61	63			
B – VIPP-FI (*n* = 62)	22 ± 20		95 ± 58	86	84 ± 62	67			
C – COMBI (*n* = 60)	19 ± 16		85 ± 56	77	80 ± 53	69			
D – AC (*n* = 63)	23 ± 20		79 ± 44	77	70 ± 40	68			
BMI-z[3] (*n* = 246)	-0.2 ± 1.0	99	0.4 ± 1.0	93	1.0 ± 1.1	85	< .001*	.89	.88
A – RVE (*n* = 61)	-0.2 ± 0.9	100	0.3 ± 1.4	94	0.9 ± 1.0	86			
B – VIPP-FI (*n* = 62)	-0.3 ± 1.1	98	0.5 ± 1.2	84*	1.0 ± 1.1	82			
C – COMBI (*n* = 60)	-0.1 ± 1.0	97	0.6 ± 1.0	98*	1.0 ± 1.1	93*			
D – AC (*n* = 63)	-0.1 ± 0.9	94	0.4 ± 0.9	94	0.9 ± 1.1	80*			
Self-regulation - finger food intake in kcal; (*n* = 205)	-	-	39 ± 36	-	-	-		.91[4]	
A – RVE (*n* = 48)			41 ± 34						
B – VIPP-FI (*n* = 51)			39 ± 38						
C – COMBI (*n* = 54)			37 ± 30						
D – AC (*n* = 52)			41 ± 43						
Self-regulation – FR[5] (*n* = 213)	-	-	2.6 ± 0.8	-	2.5 ± 0.8	-	< .001*	.20	.35
A – RVE (*n* = 50)			2.4 ± 0.8		2.3 ± 0.6				
B – VIPP-FI (*n* = 53)			2.7 ± 0.9		2.7 ± 1.0				
C – COMBI (*n* = 54)			2.6 ± 0.7		2.5 ± 0.6				
D – AC (*n* = 56)			2.8 ± 0.8		2.5 ± 0.7				
Self-regulation – SR[5] (*n* = 213)	-	-	2.8 ± 0.6	-	3.1 ± 0.7	-	<0.001*	.40	.47
A – RVE (*n* = 50)			3.0 ± 0.6		3.2 ± 0.6				
B – VIPP-FI (*n* = 53)			2.7 ± 0.7		3.0 ± 0.8				
C – COMBI (*n* = 54)			2.9 ± 0.6		3.2 ± 0.6				
D – AC (*n* = 56)			2.8 ± 0.7		3.0 ± 0.6				

1 Baseline and follow-up measurements at child age in months (mean ± SD) at each time point: t0 (4.6 ± 0.9) t18 (18.5 ± 0.7) t24 (24.4 ± 0.5). Values are means ± SDs or percentages. Per outcome measure, for each condition, the number of participants (*n* =) is reported. Differences in means were assessed using Linear Mixed Model (LMM) analysis, differences in percentages were assessed using Chi-square tests with subsequent pairwise comparisons, which are reported in the text. Regarding pairwise comparisons following from LMM, exact *P*-values and effect sizes are reported in the text. * Significant at $p < .05$. RVE= Repeated Vegetable Exposure Intervention, VIPP-FI = Video Intervention to Promote Positive Parenting Feeding Infants intervention, COMBI = Combined condition of RVE and VIPP-FI, AC= attention-control condition. FR = Food Responsiveness; SR = Satiety Responsiveness; % = Success rate: Vegetable intake – Daily recommended intake of ≥50gr achieved; BMI-z, normal weight between -2 and 2.
2 Overall effects resulting from Linear Mixed Model analysis. *PT* = time effect, *PC* = main effect condition, *PTxC* = interaction time x condition.
3 World Health Organization Standards
4 One-way ANCOVA analysis, $F(3, 199) = 0.181$

5

Table 3. Descriptives and analysis of maternal outcome measures comparing RVE, VIPP-FI, COMBI and AC at t0, t18 and t24.

Assessment[1]	**t0**		**t18**		**t24**		**Overall**[2]		
	M ± SD	%	M ± SD	%	M ± SD	%	*p*T	*p*C	*p*TxC
Responsiveness to satiety cues (Obs; *n* = 246)	3.5 ± 1.1	49	3.8 ± 1.2	68	3.7 ± 1.2	62	.06	.20	.60
A – RVE (*n* = 61)	3.5 ± 1.0	42	3.7± 1.4	68	3.8 ± 1.3	64			
B – VIPP-FI (*n* = 62)	3.5 ± 1.2	53	4.0* ± 1.1	70	3.7 ± 1.2	66			
C – COMBI (*n* = 60)	3.5 ± 1.1	52	4.0* ± 1.0	77*	3.7 ± 1.3	63			
D – AC (*n* = 63)	3.4 ± 1.1	47	3.4* ± 1.2	57*	3.6 ± 1.1	56			
Sensitivity (Obs; *n* = 246)	6.2 ± 1.5	40	6.8 ± 1.6	58	6.5 ± 1.7	47	.03*	.78	.34
A – RVE (*n* = 61)	6.1 ± 1.5	38	6.6 ± 1.8	57	6.3 ± 1.6	43			
B – VIPP-FI (*n* = 62)	6.1 ± 1.7	42	7.0 ± 1.7	65	6.5 ± 1.8	48			
C – COMBI (*n* = 60)	6.3 ± 1.6	47	6.9 ± 1.3	67	6.4 ± 1.7	53			
D – AC (*n* = 63)	6.2 ± 1.4	35	6.4 ± 1.7	52	6.7 ± 1.6	51			
Pressure (Obs; *n* = 220)	-	-	2.1 ± 1.0	56	2.7 ± 1.0	43	< .001*	.53	.27
A – RVE (*n* = 51)			2.6 ± 1.1	46*	2.8 ± 0.9	38			
B – VIPP-FI (*n* = 55)			2.3 ± 1.1	62	2.5 ± 1.1	54			
C – COMBI (*n* = 58)			2.3 ± 0.8	67*	2.9 ± 0.9	38			
D – AC (*n* = 56)			2.6 ± 1.0	47*	2.7 ± 0.9	41			
Responsive feeding (self-report; *n* = 212)	-	-	4.1 ± 0.5	73	3.9 ± 0.6	61	< .001*	.22	.49
A – RVE (*n* = 50)			4.0* ± 0.6	64	4.0 ± 0.6	66			
B – VIPP-FI (*n* = 52)			4.1 ± 0.5	76	4.0 ± 0.6	59			
C – COMBI (*n* = 54)			4.3* ± 0.5	84	4.0 ± 0.5	68			
D – AC (*n* = 56)			4.0* ± 0.5	69	3.8 ± 0.6	53			
Pressure (self-report; *n* = 210)	-	-	2.3 ± 0.8	45	2.2 ± 0.8	45	.26	.02*	.51
A – RVE (*n* = 48)			2.5* ± 0.9	36*	2.3* ± 0.9	46			
B – VIPP-FI (*n* = 52)			2.2* ± 0.8	53*	2.2 ± 0.8	51			
C – COMBI (*n* = 54)			2.1* ± 0.8	55*	2.1* ± 0.8	48			
D – AC (*n* = 56)			2.4* ± 0.7	35*	2.3 ± 0.8	36			

1 Baseline and follow-up measurements at child age in months (mean ± SD) at each time point: t0 (4.6 ± 0.9) t18 (18.5 ± 0.7) t24 (24.4 ± 0.5). Values are means ± SDs or percentages. Per outcome measure, for each condition, the number of participants (*n* =) is reported. Differences in means were assessed using Linear Mixed Model (LMM) analysis, differences in percentages were assessed using Chi-square tests with subsequent pairwise comparisons, which are reported in the text. Regarding pairwise comparisons following from LMM, exact *P*-values and effect sizes are reported in the text. * Significant at $p < .05$. RVE= Repeated Vegetable Exposure Intervention, VIPP-FI = Video Intervention to Promote Positive Parenting Feeding Infants intervention, COMBI = Combined condition of RVE and VIPP-FI, AC= attention-control condition. Obs = Observed outcome measure; % = Success rate: Responsiveness (observation and self-report) - score ≥4; Sensitivity - score ≥6; Pressure (observation and self-report) – score ≤2.
2 Overall effects resulting from Linear Mixed Model analysis. *P*T = time effect, *P*C = main effect condition, *P*TxC = interaction time x condition.

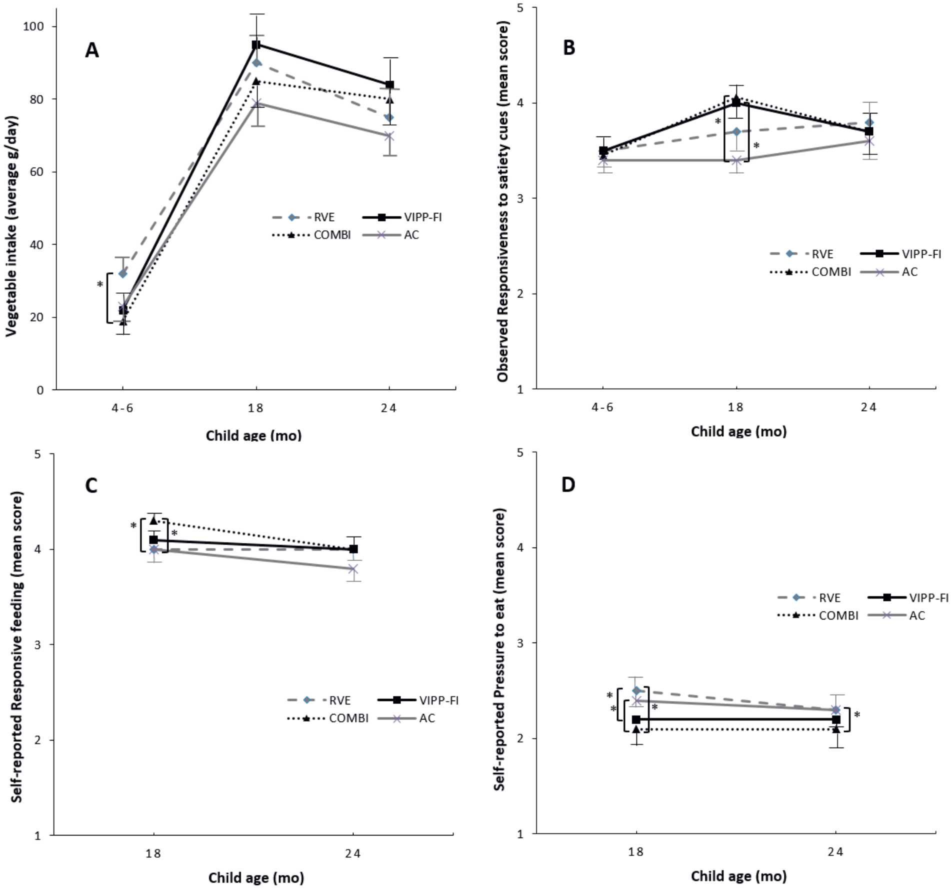


Figure 1. Analysis of outcome measures comparing RVE, VIPP-FI, COMBI and AC at t0, t18 and t24 on (A) child vegetable intake *(n* = 246), (B) maternal responsiveness to satiety cues (*n* = 246), (C) maternal self-reported responsive feeding *(n* = 212), and (D) maternal self-reported pressure to eat (*n* = 210). Means shown are absolute values. Linear Mixed Model analysis was used to identify main effects of treatment and time and their interaction (*p* < .05), followed by pairwise comparisons to identify mean differences between groups. Values are means ± SEs. Condition (*n*) per group in each figure: A and B – RVE (61), VIPP-FI (62), COMBI (60), AC (63); C - RVE (50), VIPP-FI (52), COMBI (54), AC (56); D - RVE (48), VIPP-FI (52), COMBI (54), AC (56).

Discussion

The present study reports on the post-test (18 months) and first follow-up (24 months) effects in the Baby's First Bites trial. No intervention effects were found on child vegetable intake and self-regulation of energy intake. There were fewer children with overweight in the COMBI group compared to the VIPP-FI group at 18 months and the AC group at 24 months. However, this finding needs to be interpreted cautiously due to the small number of infants with overweight and the fact that differences between those groups were absent on the continuous measure of BMI-z. Finally, although effects of the interventions were not reflected in child outcomes, the VIPP Feeding Infants intervention was effective in enhancing sensitive maternal feeding behavior at 18 months - yet this effect disappeared at 24 months.

Despite the lack of effect of the interventions on vegetable intake in our study, overall vegetable intake of children (intervention and control) was relatively high. At 18 and 24 months, the average daily vegetable intake of our sample was 87 and 77 grams, respectively, compared to an average of 52 grams a day in the Dutch toddler population (age 12-36 months) as reported in the Dutch National Food Consumption Survey (2016). The overall high vegetable intake may have been related to sample characteristics. Although participants were recruited from the general Dutch population, recruitment was partly targeted at parents who had signed up for the 'Nutricia for parents' group, thereby showing special interest in information on child nutrition. As a consequence, the topic of our study may have attracted parents with an above average interest in infant food products and healthy eating practices (including vegetable consumption). Moreover, mere participation in an RCT like the current study may have increased parental awareness of the importance of healthy eating practices for their child, which may have had a positive effect on vegetable intake in all groups.

In addition, a large interindividual variation in vegetable intake was observed within all conditions (SDs 44-69 grams), which may have further complicated detection of an effect. This heterogeneity in intake may point to the existence of subgroups within our sample, which was found in another study as well (Caton et al., 2014). In this particular study of Caton and colleagues, different types of "eaters" were identified: "learners", who were defined as children who's intake increased over time; "plate-clearers", or children that consistently consumed a high amount; "non-eaters", that consistently consumed very little vegetables, or "others", which were children with a variable pattern (Caton et al., 2014). It is plausible that such subgroups are present in our sample as well, and that interventions affect certain types of eaters differently. Other possible moderators such as child picky eating or family factors such as socioeconomic status might be studied as well, in order to derive "what works for whom". In addition, future studies may need to focus on certain risk groups, such as caregivers that encounter difficulties feeding their child vegetables. Because in our sample vegetable intake was quite high in all study groups, for quite some children there was little need to improve their intake. In order to further test the effectiveness of our interventions, it would be fruitful to see if children with low intake would benefit from the intervention program.

The lack of an effect on absolute vegetable intake is in line with other RCTs studying this age group (Barends et al., 2014; Magarey et al., 2016; Maier-Nöth et al., 2016; Savage et al., 2018). One study only found short-term effects of repeated vegetable exposure in the first year of life and no longer at 24 months, suggesting that intervention effects might not be robust enough to have long lasting effects (Barends et al., 2013; 2014). Interestingly, another study did show a lasting effect of repeated exposure to a high vs. low variety of vegetables at the start of complementary feeding on vegetable intake and liking at age 3 and 6 years (Maier-Nöth et al., 2016; Maier et al., 2007). The absence of an effect at age 15 months in the same study might suggest that children may still benefit from exposure to vegetables at the start of complementary feeding later in life, but other studies to confirm this theory are lacking.

Although the VIPP-FI intervention effectively improved maternal sensitive feeding behavior at 18 months, we did not find children in those conditions to have better self-regulation skills. An explanation might be that a possible positive effect of sensitive feeding on self-regulation was not yet present or not large enough, and that it might evolve later on. Another possibility is that VIPP-FI did not lead to improved self-regulatory eating behavior. Although parents are known to have a key influence on their children's eating behaviors (Anzman et al., 2010; Savage, Fisher, & Birch, 2007; Schneider-Worthington, Berger, Goran, & Salvy, 2020), evidence that self-regulation of eating in toddlerhood can be influenced by improving maternal feeding practices is still lacking. Alternatively, it has been posed that heritability of appetitive traits of the child plays a role in both children's appetite regulation and their susceptibility to environments that stimulate overeating (Llewellyn, Van Jaarsveld, Johnson, Carnell, & Wardle, 2010; Llewellyn, Van Jaarsveld, Plomin, Fisher, & Wardle, 2012). In that case interventions may need to specifically target children's environment and behavioral traits rather than focus on maternal feeding alone. Finally, because our study included an evening meal, the EAH experiment was often conducted during the early evening. Because a toddler's appetite may be different during the evening than during the day, the timing of the experiment might have influenced the results. It would be interesting to repeat the experiment at a different time of day, for example around lunchtime.

With respect to anthropometrics, we did not find effects on BMI-z or rapid weight gain for any of the tested interventions, which is in contrast with other similar RCTs that found effects on rapid weight gain at 12-14 months (Daniels et al., 2012; Savage et al., 2016), and on BMI-z at 36 months; (Paul et al., 2018). However, those intervention programs included elements on a much broader level, such as avoiding unhealthy foods, portion sizes, and daily physical activity (Daniels et al., 2009; Paul et al., 2014). It is possible that solely focussing on the *what* and *how* is not enough to achieve effects on child weight (gain). Our findings regarding the proportion of healthy weight *do* provide some indication that the combined advice on vegetable intake and sensitive feeding positively affected child weight. However, the prevalence of children with overweight was low. Moreover, children's average daily energy intake did not differ between intervention groups. Contrary to our expectations, a higher prevalence of overweight at 18 months was present in the VIPP-FI condition, compared to the COMBI condition. Although this finding needs to be interpreted with caution as well, it is plausible that feeding sensitively with more room for child autonomy in eating leads to greater enjoyment of food, a higher food intake and thereby a higher weight. Indeed, a study on Baby Led Weaning (BLW) found that children who were introduced to solid food with a BLW approach displayed more eating behavior characteristics associated with obesity risk (Taylor et al., 2017).

Taken together, our interventions were not effective in changing child outcomes. Our follow-up measurement at 36 months will reveal whether our intervention programs affect child health outcomes after a longer period of time.

The sensitive feeding intervention VIPP-FI was effective in promoting sensitive maternal feeding behavior. Other trials incorporating similar feeding advice as part of a broader prevention program also found positive effects (Daniels et al., 2012; Savage et al., 2018), however we are the first to show effects for *observed* maternal feeding behavior. Although we did find moderate effect sizes, absolute differences between groups on maternal behavior were small. Very insensitive behavior or extreme levels of pressure to eat were not often observed or reported, resulting in relatively high levels of positive behavior in all groups. Although this may have caused a ceiling effect, VIPP-FI was still effective in improving maternal sensitive feeding behavior.

However, most effects of VIPP-FI were only found at 18 months: at 24 months all differences between conditions, except for self-reported pressure to eat, disappeared. This might be explained by the onset of the so-called 'picky eating' phase: a phase of selectiveness in eating, present in about half of the children at some point between the age of 1.5 and 6 years (Dovey et al., 2008). Indeed, time effects from 18 to 24 months showed an overall decrease in vegetable intake, a decrease in observed maternal sensitivity and self-reported responsive feeding, and an increase in observed pressure to eat. This suggests that mealtimes are more challenging at 24 months, making it harder for all parents, including those in the intervention groups, to keep on showing positive feeding behavior. Therefore, it might be fruitful to offer more guidance on how to deal with the picky eating phase, for example by designing more VIPP-FI sessions around toddler age.

There are several limitations that should be noted. Our sample consisted mainly of well-educated Caucasian families and was not fully representative of the Dutch population (e.g., 57% obtained at least a bachelor's degree, compared to 41% in the general Dutch population (Statistics Netherlands, 2021). Moreover, all families had to commit to participate in a highly intensive program. These sample characteristics may have led to a well performing control condition, and a ceiling effect among intervention groups in most outcome measures. In addition, mothers who prematurely dropped out tended to have a lower educational level. Another limitation is that our study focused solely on mothers and did not take other caregivers into account.

In summary, the present study tested whether three approaches to parental guidance in complementary feeding promote health outcomes in toddlers: advising parents on *what* to feed, *how* to feed or both. Although our intervention on how to feed effectively enhanced sensitive maternal feeding behavior, we did not prove effectiveness of our interventions regarding child health outcomes. To determine if child health outcomes can be influenced in the first years of life by advising parents on the *what* and/or *how* of complementary feeding, future research should aim to include a more heterogeneous sample or perhaps specifically focus on risk groups, such as picky eaters. Finally, intervention programs may need to pay more attention to toddlerhood, when new child behavior, such as food refusal during mealtimes, may challenge positive parental feeding practices as well as healthy child outcomes.