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

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ABSTRACT

Background: Parenting interventions during the first years of life on *what* and/or *how* to feed infants during complementary feeding can promote healthy eating habits.

Objectives: An intervention promoting repeated exposure to a variety of vegetables [repeated vegetable exposure (RVE); *what*] and an intervention promoting responding sensitively to child signals during mealtime [video-feedback intervention to promote positive parenting–feeding infants (VIPP-FI); *how*] were compared, separately and combined (COMBI), with 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 4-arm randomized controlled trial included 246 first-time Dutch mothers and their infants. Interventions started when infants were 4–6 mo old and ended at age 16 mo. The present study evaluated effects at 18 (t18) and 24 (t24) mo of age. Vegetable acceptance was assessed using three 24-h 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 with the VIPP-FI group at t18 (2% compared with 16%), and with the AC group at t24 (7% compared with 20%), although this finding needs to be interpreted cautiously due to the small number of infants with overweight and nonsignificant effects on the continuous BMI *z*-score measure (*P* values: 0.29–0.82). Finally, more sensitive feeding behavior and less pressure to eat was found in the VIPP-FI and COMBI groups, compared with the RVE and AC groups, mostly at t18 (significant effect sizes: $d = 0.23$–0.64).

Conclusions: Interventions were not effective in increasing vegetable intake or self-regulation of energy intake. Future research might usefully focus on risk groups such as families who already experience problems around feeding. This trial is registered at clinicaltrials.gov as NCT03348176. *J Nutr* 2022;152:386–398.

Keywords: complementary feeding, vegetables, self-regulation of energy intake, repeated exposure, responsive feeding, sensitive feeding, infant, toddler, child

Introduction

Adults with overweight or obesity have a higher risk of developing type 2 diabetes, cardiovascular disease, and certain cancers (1–3). Because overweight in childhood is predictive of overweight in adulthood, promoting healthy eating habits such as sufficient vegetable consumption (4, 5) and self-regulation of energy intake [i.e., the ability to act on one's feelings of hunger

and satiety (6, 7)] from an early age onwards is crucial (8, 9). Because parents largely determine *what* and *how* children are fed in the first years of life, early interventions focusing 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 (5, 10, 11). To foster self-regulation of energy intake and thereby reduce the risk of developing overweight (12, 13), promoting parental responsive feeding behavior (the *how* of CF) is thought to be important, because responsively feeding parents adequately respond to infant hunger and satiety cues and do not pressure infants to eat beyond satiation (12, 13). 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 (14). 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, 2 large randomized controlled trials (RCTs) showed that parenting interventions successfully promoted healthier child (dietary) outcomes [increased combined fruit and vegetable intake (15) and less rapid weight gain (16, 17)]: the NOURISH trial and the INSIGHT trial (18, 19). In the NOURISH trial, mothers received 12 interactive group sessions divided over 2 modules, 1 at the start of CF (age 4–6 mo), and 1 at the age of 13–16 mo. The content of the intervention sessions concerned repeated exposure to healthy foods, avoiding unhealthy foods, responsive feeding, modeling, and avoidance of coercion or food rewards (18). At 14 mo, less rapid weight gain and lower BMI *z*-scores (BMI-z) were found in the intervention group. Moreover, mothers reported less use of some nonresponsive feeding strategies (16). Finally, when averaging data of 3.7 and 5 y, a greater combined fruit and vegetable intake was reported for children in the intervention group. Effects on child BMI were no longer present at those time points. In the INSIGHT trial, 4 home visits took place at 3, 16,

28, and 40 wk 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, modeling, and family meals) were addressed (19). Moreover, advice was given on physical activity and sleeping behavior. At the age of 1 y, no effects on vegetable intake were found, but children in the intervention group showed less rapid weight gain (17). Moreover, less nonresponsive feeding practices were reported in the intervention group (20). 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* and *how* and their combined effect within the same study enables inferences about the efficacy of these different types of advice.

In the present study, a vegetable-exposure intervention promoting vegetable consumption [repeated vegetable exposure intervention (RVE), focusing on the "*what*"] was compared with a parenting intervention to promote sensitive feeding behavior [video-feedback intervention to promote positive parenting–feeding infants (VIPP-FI), focusing on the "*how*"] (21). Within an RCT design, the 2 interventions were administered separately as well as combined (COMBI), and were compared with an attention control condition (AC). The interventions started when children were offered their first bites of complementary foods (age 4–6 mo; baseline t0) and lasted throughout the first year of CF, until the age of 16 mo. In the present article, the effects of the interventions 2 mo after completion when the age of the child is 18 mo (t18), and at 8 mo follow-up when the age of the child is 24 mo (t24) are evaluated. With respect to child outcomes, we hypothesized that: *1*) all interventions (RVE, VIPP-FI, COMBI) would be more effective in improving vegetable intake than the control condition; *2*) the sensitive-feeding and combined intervention would be 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 *3*) the combined intervention would be more effective than the other 2 interventions alone in promoting vegetable intake. With respect to maternal outcomes, we hypothesized that *4*) the sensitive-feeding and combined intervention would be more effective in promoting positive maternal feeding behavior than the vegetable exposure or control conditions.

Methods

Participants

The Baby's First Bites study is a multicenter trial using a superiority randomized controlled design that was conducted from 2 study locations (Wageningen University and Research, and Leiden University) and carried out in 4 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** (21). 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

Abbreviations used: AC, attention-control condition; BEBQ, Baby Eating Behavior Questionnaire; BLW, baby-led weaning; BMI-z, body mass index *z*-score; CEBQ-T, Child Eating Behavior Questionnaire, Toddler; CF, complementary feeding; COMBI, combined intervention group receiving both RVE and VIPP-FI; EAH, eating in the absence of hunger; FR, food responsiveness; ICC, intraclass correlation coefficient; IFSQ, Infant Feeding Style Questionnaire; LMM, linear mixed model; RCT, randomized controlled trial; RVE, repeated vegetable exposure intervention; SR, satiety responsiveness; t0, baseline at child age 4–6 mo; t18, first follow-up measurement at child age 18 mo; t24, second follow-up measurement at child age 24 mo; VIPP-FI, video-feedback intervention to promote positive parenting–feeding infants.

TABLE 1 Baseline characteristics of mother-child pairs allocated to RVE, VIPP-FI, COMBI, or AC[1]

Variable	Total ($n = 246$)	RVE ($n = 61$)	VIPP-FI ($n = 62$)	COMBI ($n = 60$)	AC ($n = 63$)
Mother					
Education (master's degree), n (%)	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 at baseline, kg/m^2	27.1 ± 5.5	26.7 ± 5.2	27.1 ± 6.1	26.9 ± 5.3	27.5 ± 5.5
Child					
Sex (male), n (%)	117 (47.6)	28 (45.9)	29 (46.8)	28 (46.7)	32 (50.8)
BMI-z at baseline[2]	− 0.20 ± 0.10	− 0.20 ± 0.92	− 0.29 ± 1.11	− 0.14 ± 1.04	− 0.15 ± 0.91
Age at baseline, wk	20.1 ± 3.9	20.5 ± 2.1	20.8 ± 2.5	20.0 ± 1.5	20.2 ± 1.9
Breastfeeding duration, median (range),[3] wk	19.0 (0–75)	20.0 (0–72)	14.0 (0–75)	24.0 (0–75)	14.0 (0–72)
Cared for by others at baseline,[4] n (%)					
<5 h/wk	69 (28.3)	17 (28.3)	19 (30.6)	17 (28.8)	16 (25.4)
5–10 h/wk	28 (11.5)	6 (10.0)	7 (11.3)	6 (10.2)	9 (14.3)
10–20 h/wk	66 (27)	15 (25.0)	13 (21.0)	17 (28.8)	21 (33.3)
>20 h/wk	81 (33.2)	22 (36.7)	23 (37.1)	19 (32.2)	17 (27.0)

[1] Values are means ± SDs, unless reported otherwise. No group differences were present for any of the variables. AC, attention-control condition; COMBI, combined condition of RVE and VIPP-FI; RVE, repeated vegetable exposure intervention; VIPP-FI, video intervention to promote positive parenting–feeding infants intervention.
[2] WHO standards (30).
[3] Breastfeeding duration was assessed when children were 18 mo of age.
[4] Hours the child is not taken care of by the parents at baseline (age 4–6 mo), e.g., daycare, grandparents.

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 postintervention assessment.

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 mo) was ready to start CF (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 ≥5 d to familiarize the infant with eating from a spoon. Subsequently, all participants started with a 19-d feeding schedule as described in more detail elsewhere (21), which specified 1 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 1 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 4 days all conditions received the same vegetable purées (green beans and cauliflower, in counterbalanced order). On days 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 5 sessions over the course of a year, timed in accordance with major transitions in eating. Two sessions took place at child age 4–6 mo and the other 3 at 8, 12, and 16 mo. 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 (21) and in **Supplemental Table 1**. At 18 mo as well as 24 mo another home visit took place, which contained the same elements as the pretest home visit. Finally, ∼1 wk before each home visit, mothers were asked to fill out several questionnaires online (see reference 21 for more detail).

Outcome measures
Child measures.

Primary outcome: vegetable intake. For the duration of the 19-d feeding schedule that all families commenced from the first bite onwards (age 4–6 mo), the child's consumption of purée was assessed daily by weighing the amount eaten from the provided jars (125 g per jar) on standard small kitchen scales (Fiesta 65106; Soehnle). Vegetable intake was assessed at t18 and t24, by asking mothers to fill out web-based 24-h dietary recalls on 3 randomly assigned, nonconsecutive days within a 3-wk period using the online program Compl-eat (22). 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. Prepackaged 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 e-mail or telephone to clarify their entry. More information on measuring vegetable intake is provided in the study protocol (21).

For outcome measures where a logical cutoff 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 cutoff of 50 g/d (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 4 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 y in a laboratory setting as described by Fisher and Birch (23), and adapted for 18-mo-old children in a home setting. The protocol for the present study and adaptations to the original procedure have recently been described elsewhere (24). 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 8-min free-play session of mother and child, after which the researcher provided the child with a plate of 2 savory (2 breadsticks and a handful of potato snack sticks) and 2 sweet (1 slice of gingerbread, and 2 plain biscuits) age-appropriate palatable finger foods (total 275 kcal) for 10 min. 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 (kilocalories) consumed by the child. To measure self-regulation, children's finger food intake in kilocalories, corrected for energy intake during the evening meal, was used in subsequent analyses. Because a cutoff 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 (25)] before starting the feeding schedule, and the Child Eating Behavior Questionnaire–Toddler [CEBQ-T (26)] 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 (27). The original CEBQ scale has been shown to have good internal consistency [Cronbach α ranging from 0.72 to 0.91 (28)], adequate 2-wk test-retest reliability [correlation coefficients ranging from 0.52 to 0.87 (28)], and adequate construct validity (29). In our sample, internal consistency ranged from $\alpha = 0.73$ (t0) to $\alpha = 0.80$ (t18/24) for FR, and $\alpha = 0.68$ (t0) to $\alpha = 0.81$ (t18/24) for SR. Because a cutoff 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 (robusta 813; SECA), 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, Seca)). BMI was calculated and transformed into age- and sex-standardized *z*-scores (BMI-z) using reference values from the WHO child growth standards (2019) (30) and the following formula (31):

$$BMI - z = ((BMI/M)L - 1)/(L \times S) \qquad (1)$$

As reported in earlier studies (32, 33), 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 cutoff for BMI-z of 2 (upper limit for normal weight) was used (34).

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 4 coders, yielding intercoder reliabilities [intraclass correlations (ICCs), single rater, absolute agreement] of >0.70 for all scales between all individual coders (35). The coders were not familiar with the families in the videos they were allocated, nor aware of these families' group status (experimental compared with 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 (36). Adaptations made to the original scale are described elsewhere (37). 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 at t0 $(ICC^{t0}) = 0.75–0.87$; $ICC^{t18} = 0.77–0.94$; $ICC^{t24} = 0.78–0.97$]. To establish the success rate in each condition, a cutoff of ≥ 4 (often or always responsive) was used.

Sensitivity: To rate maternal sensitivity toward all child behavior shown during the feed, the Ainsworth sensitivity scale was used (38). Mothers were scored on the original 9-point scale, ranging from highly insensitive (1) to highly sensitive (9). Interrater reliability was good to excellent ($ICC^{t0} = 0.73–0.85$; $ICC^{t18} = 0.79–0.87$; $ICC^{t24} = 0.78–0.93$). To establish the success rate in each condition, a cutoff 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 (39). 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 ($ICC^{t18} = 0.71–0.83$; $ICC^{t24} = 0.77–0.86$). To establish the success rate in each condition, a cutoff of ≤ 2 (never, or rarely used pressure to eat) was used.

Self-reported feeding behavior. The Infant Feeding Style Questionnaire (IFSQ) (40) 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 compared with 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 3 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 ($\alpha^{t0} = 0.48$, $\alpha^{t18} = 0.47$, $\alpha^{t24} = 0.46$), 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 cutoff 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 compared with 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 ($\alpha^{t0} = 0.58$, $\alpha^{t18} = 0.73$, $\alpha^{t24} = 0.66$). To establish the success rate in each condition, a cutoff of ≤ 2 (never, or rarely used 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 with t0 (e.g., educational level, marital status). Child temperament was assessed by the Infant Behavior Questionnaire-Revised short form at baseline t0 (41), and the Early Childhood Behavioral Questionnaire at t18 (42). Child food neophobia was assessed by the Child Food Neophobia Scale (43, 44), and maternal depression by the Center for Epidemiologic Studies Depression Scale (45). Furthermore, because pressure to eat was not coded at t0 and the related construct of maternal intrusiveness was [by means of the Ainsworth Interference vs Cooperation scale (38)], 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-h 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 1 (4.4%), 2 (15.1%), or 3 (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 (21).

Linear mixed model (LMM) analysis was used to test if the interventions differentially affected outcome measures over time. Because LMM analysis facilitates an intention-to-treat analysis, all participants with data for ≥1 one time point (t0, t18, or t24) were included in the analyses. Therefore, imputations were not considered necessary. Because 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 Akaike Information Criterion value (AIC) (46)]. Within LMM, pairwise comparisons that were relevant for our hypotheses were performed, at t18 and t24 separately. No post hoc adjustments were undertaken, because only hypothesis-driven comparisons were performed (47, 48). 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 3 intervention groups were compared with the control group, and the COMBI group was compared with the VIPP-FI group as well as the RVE group. Vegetable intake was related to average daily energy intake [r(194) = 0.17, P = 0.02 and r(179) = 0.28, P = <0.001] 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 could 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 with 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 with 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 with 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 with 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 χ^2 measure was reported, as well as P values resulting from subsequent pairwise comparisons between relevant conditions.

Statistical significance was set at $P < 0.05$. Cohen d effect sizes were obtained and reported regarding mean differences between conditions (49). Values of 0.20, 0.50, and 0.80 were considered a small, moderate, and large effect, respectively (49). 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 compared with 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 significant baseline difference was vegetable intake at t0 ($P = 0.03$), 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 LMM analysis at t18 and t24 showed no significant differences between the RVE, VIPP-FI, and COMBI groups compared with the AC group (P values = 0.11–0.86; Figure 1A; Table 2). The COMBI group was also not superior to the RVE or VIPP-FI groups, because 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 ($P < 0.001$) and t0 to t24 ($P < 0.001$) for all groups, and a significant decrease from t18 to t24 ($P < 0.01$) (t0: 24 ± 23 g, t18: 87 ± 53 g, t24: 77 ± 54 g). Main effects of condition and the interaction effect of time × condition, which both compare all conditions simultaneously, were nonsignificant. With respect to success rate, at t18 and t24, the majority of all children achieved the daily recommended intake of ≥50 g. Corrected for vegetable intake at t0 and for daily energy intake, no main effect of condition was found at t18 ($\chi^2 = 2.82$, $P = 0.43$) or t24 ($\chi^2 = 0.43$, $P = 0.93$). In addition, planned pairwise comparisons did not reveal any group differences in achieving daily recommended vegetable intake at t18 or t24 ($P = 0.61–0.92$; Table 2). Taken together, in contrast to our hypotheses, no differences between the 3 intervention groups compared with AC emerged in terms of vegetable consumption.

To examine the effects of the interventions on self-regulation, absolute intake of finger foods during the EAH experiment was compared between conditions, corrected for energy intake
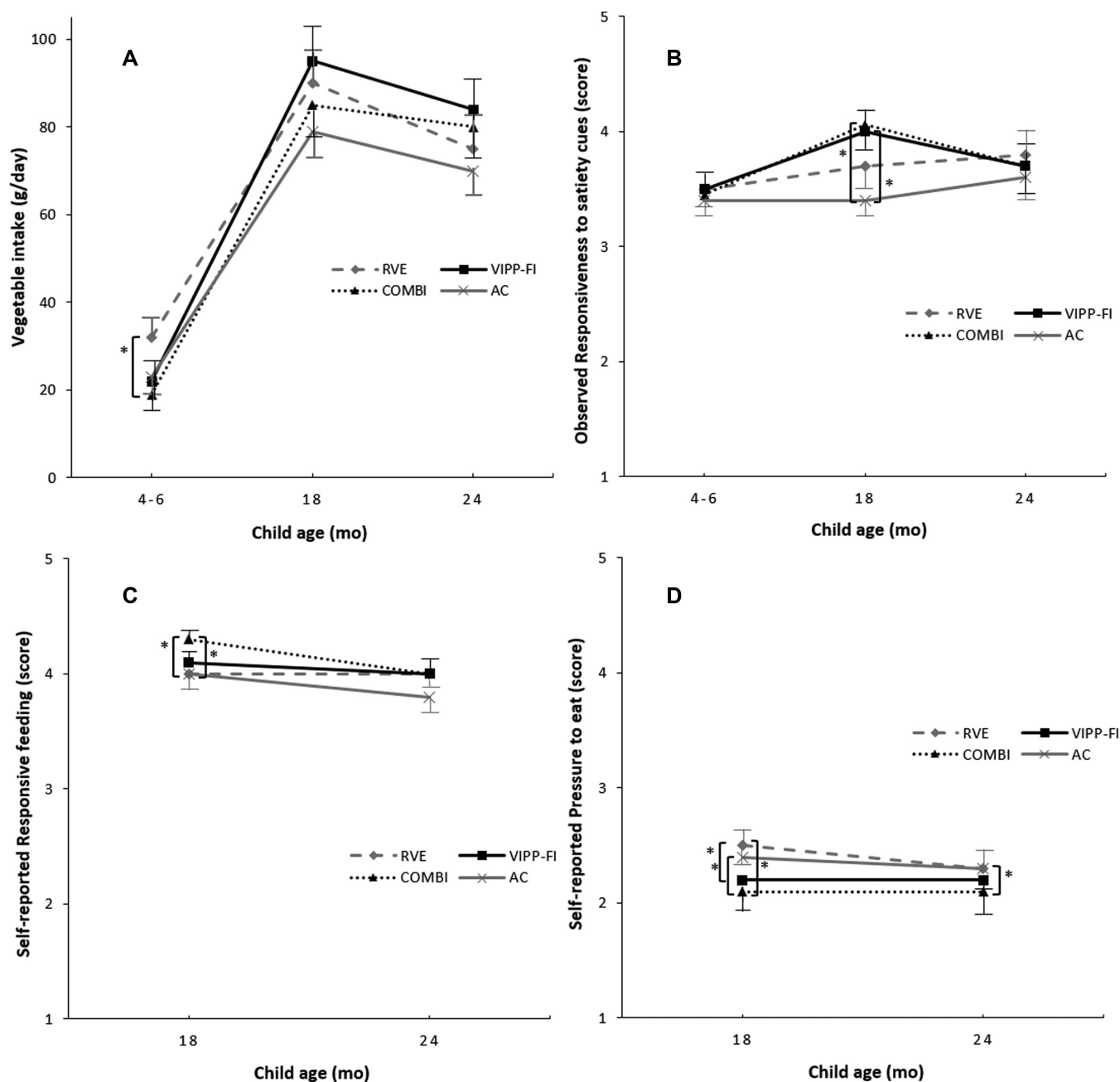
FIGURE 1 Analysis of outcome measures comparing RVE, VIPP-FI, COMBI, and AC at t0, t18, and t24 on (A) child vegetable intake ($n = 246$), (B) maternal responsiveness to satiety cues ($n = 246$), (C) maternal self-reported responsive feeding ($n = 212$), and (D) maternal self-reported pressure to eat ($n = 210$). Means shown are absolute values. Linear mixed model analysis was used to identify main effects of treatment and time and their interaction ($P < 0.05$), 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). AC, attention-control condition; COMBI, combined condition of RVE and VIPP-FI; RVE, repeated vegetable exposure intervention; t0, baseline at child age 4–6 mo; t18, first follow-up measurement at child age 18 mo; t24, second follow-up measurement at child age 24 mo; VIPP-FI, video intervention to promote positive parenting–feeding infants intervention.

of the meal consumed before the task (Table 2). At t18, a 1-factor 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 groups (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 groups on the other hand, at t18 as well as t24 (P values FR: 0.07–0.91; P values SR: 0.17–0.92; 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 × condition, which both compare all conditions simultaneously, were not significant for both FR and SR (Table 2).

TABLE 2 Descriptives and analysis of child outcome measures comparing RVE, VIPP-FI, COMBI, and AC at t0, t18, and t24[1]

Assessment	*n*	t0	t18	t24	*P* T	*P* C	*P* T × C
Vegetable intake, g/d	246	24 ± 23	87 ± 53	77 ± 54	<0.001*	0.48	0.45
(%)			(79)	(67)			
RVE	61	32 ± 30	90 ± 54	75 ± 61			
(%)			(73)	(63)			
VIPP-FI	62	22 ± 20	95 ± 58	84 ± 62			
(%)			(86)	(67)			
COMBI	60	19 ± 16	85 ± 56	80 ± 53			
(%)			(77)	(69)			
AC	63	23 ± 20	79 ± 44	70 ± 40			
(%)			(77)	(68)			
BMI-z[2]	246	− 0.2 ± 1.0	0.4 ± 1.0	1.0 ± 1.1	<0.001*	0.89	0.88
(%)		(99)	(93)	(85)			
RVE	61	− 0.2 ± 0.9	0.3 ± 1.4	0.9 ± 1.0			
(%)		(100)	(94)	(86)			
VIPP-FI	62	− 0.3 ± 1.1	0.5 ± 1.2	1.0 ± 1.1			
(%)		(98)	(84*)	(82)			
COMBI	60	− 0.1 ± 1.0	0.6 ± 1.0	1.0 ± 1.1			
(%)		(97)	(98*)	(93*)			
AC	63	− 0.1 ± 0.9	0.4 ± 0.9	0.9 ± 1.1			
(%)		(94)	(94)	(80*)			
Self-regulation—finger food intake, kcal	205	—	39 ± 36	—		0.91[3]	
RVE	48		41 ± 34				
VIPP-FI	51		39 ± 38				
COMBI	54		37 ± 30				
AC	52		41 ± 43				
Self-regulation—FR[1]	213	—	2.6 ± 0.8	2.5 ± 0.8	<0.001*	0.20	0.35
RVE	50		2.4 ± 0.8	2.3 ± 0.6			
VIPP-FI	53		2.7 ± 0.9	2.7 ± 1.0			
COMBI	54		2.6 ± 0.7	2.5 ± 0.6			
AC	56		2.8 ± 0.8	2.5 ± 0.7			
Self-regulation—SR[1]	213	—	2.8 ± 0.6	3.1 ± 0.7	<0.001*	0.40	0.47
RVE	50		3.0 ± 0.6	3.2 ± 0.6			
VIPP-FI	53		2.7 ± 0.7	3.0 ± 0.8			
COMBI	54		2.9 ± 0.6	3.2 ± 0.6			
AC	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 means ± SDs together with percentages (%). Percentages refer to the success rate, applicable to the following outcome measures: vegetable intake—daily recommended intake ≥50 g achieved; BMI-z, normal weight between −2 and 2. 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 χ^2 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. Overall effects resulting from linear mixed model analysis: *significant at *P* < 0.05. AC, attention-control condition; BMI-z, body mass index *z*-score; C, main effect condition; COMBI, combined condition of RVE and VIPP-FI; FR, food responsiveness (mean score on scale 1–5); RVE, repeated vegetable exposure intervention; SR, satiety responsiveness (mean score on scale 1–5); T, time effect; T × C, interaction time × condition; t0, baseline at child age 4–6 mo; t18, first follow-up measurement at child age 18 mo; t24, second follow-up measurement at child age 24 mo; VIPP-FI, video intervention to promote positive parenting–feeding infants intervention.

[2] WHO standards.

[3] One-factor ANCOVA analysis, $F(3, 199) = 0.181$.

Regarding child BMI-z, planned pairwise comparisons resulting from LMM analysis at t18 and t24 showed no significant differences between the VIPP-FI and COMBI groups compared with the RVE and AC groups (*P* values 0.29–0.82; Table 2). The main effect of time was significant, with significant increases in BMI-z from t0 to t18 (*P* < 0.001), t0 to t24 (*P* < 0.001), and t18 to t24 (*P* < 0.001) (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 × condition, which both compare all conditions simultaneously, were nonsignificant (Table 2). With respect to child weight gain, there were no group differences from t0 to t18 (*P* = 0.79), t0 to t24 (*P* = 0.97), or t18 to t24 (*P* = 0.69). However, with respect to success rate at t18, corrected for BMI-z at t0, the main effect of condition revealed a trend ($\chi^2 = 6.86$; *P* = 0.07). 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* = 0.02; Table 2). At t24, the main effect of condition showed a trend as well ($\chi^2 = 7.60$; *P* = 0.06). Planned pairwise comparisons revealed that the COMBI group had a lower proportion of children with overweight (7%) than the AC group (20%; *P* = 0.02; Table 2).

Maternal feeding behavior
Observed.
With respect to maternal responsiveness to satiety cues, planned pairwise comparisons resulting from LMM analysis revealed higher levels of responsiveness in the COMBI and VIPP-FI groups compared with AC at 18 mo (*P* = 0.02, *d* = 0.55; and *P* = 0.03, *d* = 0.47, respectively; Figure 1B; Table 3). No

TABLE 3 Descriptives and analysis of maternal outcome measures comparing RVE, VIPP-FI, COMBI, and AC at t0, t18, and t24[1]

Assessment	_n_	t0	t18	t24	_P_ T	_P_ C	_P_ T × C
Responsiveness to satiety cues (Obs)	246	3.5 ± 1.1	3.8 ± 1.2	3.7 ± 1.2	0.06	0.20	0.60
(%)		49	(68)	(62)			
RVE	61	3.5 ± 1.0	3.7 ± 1.4	3.8 ± 1.3			
(%)		42	(68)	(64)			
VIPP-FI	62	3.5 ± 1.2	4.0* ± 1.1	3.7 ± 1.2			
(%)		53	(70)	(66)			
COMBI	60	3.5 ± 1.1	4.0* ± 1.0	3.7 ± 1.3			
(%)		52	(77*)	(63)			
AC	63	3.4 ± 1.1	3.4* ± 1.2	3.6 ± 1.1			
(%)		47	(57*)	(56)			
Sensitivity (Obs)	246	6.2 ± 1.5	6.8 ± 1.6	6.5 ± 1.7	0.03*	0.78	0.34
(%)		40	(58)	(47)			
RVE	61	6.1 ± 1.5	6.6 ± 1.8	6.3 ± 1.6			
(%)		38	(57)	(43)			
VIPP-FI	62	6.1 ± 1.7	7.0 ± 1.7	6.5 ± 1.8			
(%)		42	(65)	(48)			
COMBI	60	6.3 ± 1.6	6.9 ± 1.3	6.4 ± 1.7			
(%)		47	(67)	(53)			
AC	63	6.2 ± 1.4	6.4 ± 1.7	6.7 ± 1.6			
(%)		35	(52)	(51)			
Pressure (Obs)	220	—	2.1 ± 1.0	2.7 ± 1.0	<0.001*	0.53	0.27
(%)			(56)	(43)			
RVE	51		2.6 ± 1.1	2.8 ± 0.9			
(%)			(46*)	(38)			
VIPP-FI	55		2.1 ± 1.1	2.5 ± 1.1			
(%)			(62)	(54)			
COMBI	58		2.2 ± 0.8	2.9 ± 0.9			
(%)			(67*)	(38)			
AC	56		2.6 ± 1.0	2.7 ± 0.9			
(%)			(47*)	(41)			
Responsive feeding (self-report)	212	—	4.1 ± 0.5	3.9 ± 0.6	<0.001*	0.22	0.49
(%)			(73)	(61)			
RVE	50		4.0* ± 0.6	4.0 ± 0.6			
(%)			(64)	(66)			
VIPP-FI	52		4.1 ± 0.5	4.0 ± 0.6			
(%)			(76)	(59)			
COMBI	54		4.3* ± 0.5	4.0 ± 0.5			
(%)			(84)	(68)			
AC	56		4.0* ± 0.5	3.8 ± 0.6			
(%)			(69)	(53)			
Pressure (self-report)	210	—	2.4 ± 0.8	2.2 ± 0.8	0.26	0.02*	0.51
(%)			(45)	(45)			
RVE	48		2.5* ± 0.9	2.3* ± 0.9			
(%)			(36*)	(46)			
VIPP-FI	52		2.2* ± 0.8	2.2 ± 0.8			
(%)			(53*)	(51)			
COMBI	54		2.1* ± 0.8	2.1* ± 0.8			
(%)			(55*)	48)			
AC	56		2.4* ± 0.7	2.3 ± 0.8			
(%)			(35*)	(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 means ± SDs together with percentages (%). Percentages refer to the success rate, applicable to the following outcome measures: responsiveness (observation and self-report) score ≥4; sensitivity score ≥6; pressure (observation and self-report) score ≤2. 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 χ^2 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. Overall effects resulting from LMM analysis: *significant at _P_ < 0.05. AC, attention-control condition; C, main effect condition; COMBI, combined condition of RVE and VIPP-FI; Obs, observed outcome measure; RVE, repeated vegetable exposure intervention; T, time effect; T × C, interaction time × condition; t0, baseline at child age 4–6 mo; t18, first follow-up measurement at child age 18 mo; t24, second follow-up measurement at child age 24 mo; VIPP-FI, video intervention to promote positive parenting–feeding infants intervention.

differences in maternal responsiveness were present between COMBI and VIPP-FI compared with the RVE condition ($P = 0.14$, $P = 0.20$, respectively), and there were no group differences at 24 mo ($P = 0.49–0.98$). The main effect of time showed a marginally significant effect ($P = 0.052$), with a significant increase in responsiveness from t0 to t18 ($P = 0.03$) (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 × condition, which both compare all conditions simultaneously, were nonsignificant. With respect to success rate at t18, corrected for t0, the main effect of condition was nonsignificant ($\chi^2 = 5.88$; $P = 0.11$). 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 ($P = 0.01$). Other groups did not differ in terms of success rate at t18 ($P = 0.12–0.40$), and no significant main effect ($\chi^2 = 1.28$, $P = 0.73$) or significant planned pairwise comparisons were present at t24 ($P = 0.33–0.96$; Table 3).

Regarding maternal sensitivity, planned pairwise comparisons resulting from LMM analysis revealed a marginally significant effect for more sensitive behavior during the meal in the VIPP-FI group compared with AC at t18 ($P = 0.052$; Table 3). The difference between VIPP-FI and RVE was nonsignificant ($P = 0.21$). No differences in favor of the COMBI group compared with RVE and AC were found at t18 ($P = 0.42$, $P = 0.14$, respectively), and there were no differences in maternal sensitivity between any groups at t24 ($P = 0.34–0.91$). The main effect of time was significant, with an increase in sensitive behavior from t0 to t18 ($P < 0.001$) and t0 to t24 ($P = 0.03$), and a decrease in sensitive behavior from t18 to t24 ($P = 0.04$) (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 × condition, which both compare all conditions simultaneously, were nonsignificant. With respect to success rate (sensitivity score ≥ 6), the main effect of condition was nonsignificant at t18 ($\chi^2 = 2.71$, $P = 0.44$), as well as t24 ($\chi^2 = 0.34$, $P = 0.95$). Planned pairwise comparisons revealed no differences between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand (t18: $P = 0.10–0.83$; t24: $P = 0.67–0.95$).

With respect to observed maternal pressure to eat, t18 and t24 were examined with correction for intrusiveness during feeding at baseline. Resulting from LMM analysis, planned pairwise comparisons at t18 and t24 showed no significant differences between the VIPP-FI and COMBI groups compared with the RVE and AC groups over time (P values $0.17–0.48$; 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 × condition, which both compare all conditions simultaneously, were nonsignificant. With respect to success rate at t18, the main effect of condition revealed a trend ($\chi^2 = 6.68$, $P = 0.08$). 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 with the RVE and AC group ($P = 0.04$ and $P = 0.04$, respectively; Table 3). The VIPP-FI group did not significantly differ from RVE or AC ($P = 0.10$, $P = 0.11$, respectively). At t24, the main effect of condition was nonsignificant ($\chi^2 = 3.66$, $P = 0.30$), nor did any differences emerge between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand ($P = 0.13–0.85$).

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 LMM analysis, planned pairwise comparisons at t18 revealed that more responsive feeding behavior was reported in the COMBI group compared with the RVE and AC groups ($P = 0.04$, $d = 0.45$; and $P = 0.02$, $d = 0.64$, respectively; Table 3; Figure 1C). No differences in favor of the VIPP-FI group were found compared with RVE or AC at t18 ($P = 0.16$ and $P = 0.32$, respectively), nor any differences at t24, between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand ($P = 0.31–0.82$). 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 × condition, which both compare all conditions simultaneously, were nonsignificant. With respect to success rate (sensitivity score ≥ 6), the main effect of condition was nonsignificant at t18 ($\chi^2 = 3.66$, $P = 0.30$). Planned pairwise comparisons revealed only a marginally significant effect for the difference between COMBI and RVE ($P = 0.054$), with more responsive feeding behavior reported in the COMBI group. The difference between COMBI and AC at t18 was nonsignificant ($P = 0.33$), as were differences between VIPP-FI and RVE or AC ($P = 0.25$, $P = 0.90$, respectively). At t24, the main effect of condition was nonsignificant ($\chi^2 = 1.55$, $P = 0.67$), nor did any differences emerge between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand ($P = 0.30–0.92$).

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 LMM analysis, at t18 planned pairwise comparisons indicated less pressure in the VIPP-FI group compared with the RVE group ($P = 0.01$, $d = 0.35$), and less pressure in the COMBI group compared with the RVE and AC groups ($P = 0.01$, $d = 0.47$; and $P = 0.04$, $d = 0.40$, respectively; Figure 1D; Table 3). A trend was found for the difference between VIPP-FI and AC at t18 ($P = 0.07$). At t24, less pressure was reported in the COMBI group compared with the RVE group, and a trend was found for the difference with AC ($P = 0.08$). No differences were found in favor of the VIPP-FI group compared with RVE and AC ($P = 0.21$, $P = 0.33$, respectively). The main effect of time was nonsignificant, but the main effect of condition, comparing all 4 conditions amongst each other, was significant. With respect to success rate, at t18, a significant main effect of condition was present ($\chi^2 = 9.34$, $P = 0.03$). Planned pairwise comparisons revealed a higher proportion of the mothers in the COMBI and VIPP-FI groups that reported hardly using pressure to eat techniques (score ≤ 2), compared with both RVE ($P = 0.02$ and $P = 0.04$, respectively) and AC conditions ($P = 0.01$ and $P = 0.04$, respectively; Table 3). At t24, the main effect of condition was nonsignificant ($\chi^2 = 3.84$, $P = 0.28$), nor did any differences emerge between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand ($P = 0.08–0.56$).

Discussion

The present study reports on the posttest (18 mo) and first follow-up (24 mo) 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 with the VIPP-FI group at 18 mo and the AC group at 24 mo. 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-FI intervention was effective in enhancing sensitive maternal feeding behavior at 18 mo—yet this effect disappeared at 24 mo.

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 mo, the average daily vegetable intake of our sample was 87 g and 77 g, respectively, compared with an average of 52 g/d in the Dutch toddler population (age 12–36 mo) as reported in the Dutch National Food Consumption Survey (50). The overall high vegetable intake could 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 might 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 could have increased parental awareness of the importance of healthy eating practices for their child, which might 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 g), which could have further complicated detection of an effect. This heterogeneity in intake might point to the existence of subgroups within our sample, which was found in another study (51). In this particular study of Caton and colleagues (51), different types of "eaters" were identified: "learners," who were defined as children whose intake increased over time; "plate-clearers," or children who consistently consumed a high amount; "non-eaters," who consistently consumed very few vegetables; or "others," who were children with a variable pattern. 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, to derive "what works for whom." In addition, future studies might need to focus on certain risk groups, such as caregivers who encounter difficulties feeding their child vegetables. Because in our sample vegetable intake was quite high in all study groups, for some children there was little need to improve their intake. 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 (20, 52–54). One study found only short-term effects of repeated vegetable exposure in the first year of life and no longer at 24 mo, suggesting that intervention effects might not be robust enough to have long-lasting effects (55, 52). Interestingly, another study did show a lasting effect of repeated exposure to a high compared with a low variety of vegetables at the start of CF on vegetable intake and liking at age 3 and 6 y (11, 54). The absence of an effect at age 15 mo in the same study might suggest that children can

still benefit from exposure to vegetables at the start of CF 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 mo, 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 (56–58), 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 (59, 60). In that case interventions might 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 can 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 mo (16, 17), and on BMI-z at 36 mo (61). However, those intervention programs included elements on a much broader level, such as avoiding unhealthy foods, portion sizes, and daily physical activity (18, 19). 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 mo was present in the VIPP-FI condition, compared with 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 (62).

Taken together, our interventions were not effective in changing child outcomes. Our follow-up measurement at 36 mo 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 (16, 20); however, to the best of our knowledge, 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 might have caused a ceiling effect, VIPP-FI was still effective in improving maternal sensitive feeding behavior.

Most effects of VIPP-FI were found only at 18 mo; at 24 mo 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 children at some point between the age of 1.5 and 6 y (23–25). Indeed, time effects from 18 to 24 mo 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 mo, 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 with 41% in the general Dutch population (63)]. Moreover, all families had to commit to participate in a highly intensive program. These sample characteristics might 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 3 approaches to parental guidance in CF 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 CF, future research should aim to include a more heterogeneous sample or perhaps specifically focus on risk groups, such as picky eaters. Finally, intervention programs might need to pay more attention to toddlerhood, when new child behavior, such as food refusal during mealtimes, can challenge positive parental feeding practices as well as healthy child outcomes.

Data Availability

The anonymized dataset analyzed during the current study is available upon request. Video files are not publicly available for privacy reasons.

References

1. Carter P, Gray LJ, Troughton J, Khunti K, Davies MJ. Fruit and vegetable intake and incidence of type 2 diabetes mellitus: systematic review and meta-analysis. BMJ 2010;341:c4229.
2. Rotteveel J, Felius A, van Weissenbruch MM, Delemarre-Van de Waal HA. Insulin resistance and the metabolic syndrome in obese children referred to an obesity center. J Pediatr Endocrinol Metab 2010;23(9):943–51.
3. Sinha R, Fisch G, Teague B, Tamborlane WV, Banyas B, Allen K, Savoye M, Rieger V, Taksali S, Barbetta G, et al. Prevalence of impaired glucose tolerance among children and adolescents with marked obesity. N Engl J Med 2002;346(11):802–10.
4. Aune D, Giovannucci E, Boffetta P, Fadnes LT, Keum N, Norat T, Greenwood DC, Riboli E, Vatten LJ, Tonstad S. Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality—a systematic review and dose-response meta-analysis of prospective studies. Int J Epidemiol 2017;46(3):1029–56.
5. Barends C, Weenen H, Warren J, Hetherington MM, de Graaf C, de Vries JHM. A systematic review of practices to promote vegetable acceptance in the first three years of life. Appetite 2019;137:174–97.
6. Fox MK, Devaney B, Reidy K, Razafindrakoto C, Ziegler P. Relationship between portion size and energy intake among infants and toddlers: evidence of self-regulation. J Am Diet Assoc 2006;106(1):S77–83.
7. Reigh NA, Rolls BJ, Savage JS, Johnson SL, Keller KL. Development and preliminary testing of a technology-enhanced intervention to improve energy intake regulation in children. Appetite 2020;155:104830.
8. Williams EP, Mesidor M, Winters K, Dubbert PM, Wyatt SB. Overweight and obesity: prevalence, consequences, and causes of a growing public health problem. Curr Obes Rep 2015;4(3):363–70.
9. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. N Engl J Med 1997;337(13):869–73.
10. Ahern SM, Caton SJ, Blundell P, Hetherington MM. The root of the problem: increasing root vegetable intake in preschool children by repeated exposure and flavour learning. Appetite 2014;80:154–60.
11. Maier A, Chabanet C, Schaal B, Issanchou S, Leathwood P. Effects of repeated exposure on acceptance of initially disliked vegetables in 7-month old infants. Food Qual Preference 2007;18(8):1023–32.
12. DiSantis KI, Hodges EA, Johnson SL, Fisher JO. The role of responsive feeding in overweight during infancy and toddlerhood: a systematic review. Int J Obes 2011;35(4):480–92.
13. Hurley KM, Cross MB, Hughes SO. A systematic review of responsive feeding and child obesity in high-income countries. J Nutr 2011;141(3):495–501.
14. Galloway AT, Fiorito LM, Francis LA, Birch LL. 'Finish your soup': counterproductive effects of pressuring children to eat on intake and affect. Appetite 2006;46(3):318–23.
15. Hohman EE, Paul IM, Birch LL, Savage JS. INSIGHT responsive parenting intervention is associated with healthier patterns of dietary exposures in infants. Obesity 2017;25(1):185–91.

16. Daniels LA, Mallan KM, Battistutta D, Nicholson JM, Perry R, Magarey A. Evaluation of an intervention to promote protective infant feeding practices to prevent childhood obesity: outcomes of the NOURISH RCT at 14 months of age and 6 months post the first of two intervention modules. Int J Obes 2012; 36(10): 1292–8.

17. Savage JS, Birch LL, Marini M, Anzman-Frasca S, Paul IM. Effect of the INSIGHT responsive parenting intervention on rapid infant weight gain and overweight status at age 1 year: a randomized clinical trial. JAMA Pediatr 2016;170(8):742–9.

18. Daniels LA, Magarey A, Battistutta D, Nicholson JM, Farrell A, Davidson G, Cleghorn G. The NOURISH randomised control trial: positive feeding practices and food preferences in early childhood - a primary prevention program for childhood obesity. BMC Public Health 2009;9(1):387.

19. Paul IM, Williams JS, Anzman-Frasca S, Beiler JS, Makova KD, Marini ME, Hess LB, Rzucidlo SE, Verdiglione N, Mindell JA, et al. The intervention nurses start infants growing on healthy trajectories (INSIGHT) study. BMC Pediatr 2014;14:184.

20. Savage JS, Hohman EE, Marini ME, Shelly A, Paul IM, Birch LL. INSIGHT responsive parenting intervention and infant feeding practices: randomized clinical trial. Int J Behav Nutr Phys Act 2018;15(1):64.

21. Van der Veek SMC, de Graaf C, de Vries JHM, Jager G, Vereijken C, Weenen H, Van Winden N, Van Vliet MS, Schultink JM, De Wild VWT, et al. Baby's first bites: a randomized controlled trial to assess the effects of vegetable-exposure and sensitive feeding on vegetable acceptance, eating behavior and weight gain in infants and toddlers. BMC Pediatr 2019;19(1):266.

22. Meijboom S, Van Houts-Streppel MT, Perenboom C, Siebelink E, Van de Wiel AM, Geelen A, Feskens EJM, de Vries JHM. Evaluation of dietary intake assessed by the Dutch self-administered web-based dietary 24-h recall tool (Compl-eattm) against interviewer-administered telephone-based 24-h recalls. J Nutr Sci 2017;6(6):e49.

23. Fisher JO, Birch LL. Restricting access to foods and children's eating. Appetite 1999;32(3):405–19.

24. Schultink JM, De Vries JHM, De Wild VWT, Van Vliet MS, Van der Veek SMC, Martens VEG, De Graaf C, Jager G. Eating in the absence of hunger in 18-month-old children in a home setting. Pediatr Obes 2021;16(11):12800.

25. Llewellyn CH, van Jaarsveld CH, Johnson L, Carnell S, Wardle J. Development and factor structure of the baby eating behaviour questionnaire in the Gemini birth cohort. Appetite 2011;57(2):388–96.

26. Herle M, Fildes A, van Jaarsveld C, Rijsdijk F, Llewellyn CH. Parental reports of infant and child eating behaviors are not affected by their beliefs about their twins' zygosity. Behav Genet 2016;46(6):763–71.

27. Sleddens EF, Kremers SP, Thijs C. The children's eating behaviour questionnaire: factorial validity and association with body mass index in Dutch children aged 6-7. Int J Behav Nutr Phys Act 2008;5:49.

28. Wardle J, Guthrie CA, Sanderson S, Rapoport L. Development of the children's eating behaviour questionnaire. J Child Psychol Psychiatry 2001;42(7):963–70.

29. Carnell S, Wardle J. Measuring behavioural susceptibility to obesity: validation of the child eating behaviour questionnaire. Appetite 2007;48(1):104–13.

30. WHO. Child growth standards birth to 2 years. [Internet]. 2019[cited 1 Jul 2020]. Available from: https://www.who.int/tools/child-growth-standards/standards/weight-for-age.

31. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ 2000;320(7244):1240–3.

32. Ezzahir N, Alberti C, Deghmoun S, Zaccaria I, Czernichow P, Lévy-Marchal C, Jaquet D. Time course of catch-up in adiposity influences adult anthropometry in individuals who were born small for gestational age. Pediatr Res 2005;58(2): 243–7.

33. Olsen NJ, Ängquist L, Frederiksen P, Mortensen EL, Heitmann BL. Primary prevention of fat and weight gain among obesity susceptible healthy weight preschool children. Main results from the "Healthy start" randomized controlled intervention. Pediatr Obes 2021;16(4):e12736.

34. WHO. Child growth standards. Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development. World Health Organization; 2006.

35. Cortina JM. What is coefficient alpha? An examination of theory and applications. J Appl Psychol 1993;78(1):98–104.

36. Hodges EA, Johnson SL, Hughes SO, Hopkinson JM, Butte NF, Fisher JO. Development of the responsiveness to child feeding cues scale. Appetite 2013;65:210–19.

37. Van Vliet MS, Mesman J, Schultink JM, De Vries JHM, Vereijken C, Rippe RCA. Baby's first bites: association between observed maternal feeding behavior and infant vegetable intake and liking. Appetite 2021;165:105316.

38. Ainsworth MDS, Bell SM, Stayton DJ. Infant-mother attachment and social, development: socialization as a product of reciprocal responsiveness to signals. In: Richards MPM , editor. The integration of a child into a social world. London: Cambridge University Press; 1974. p. 9–135.

39. Camfferman R. Happy healthy homes – the role of parenting in early childhood overweight. Leiden: Leiden University; 2017.

40. Thompson AL, Mendez MA, Borja JB, Adair LS, Zimmer CR, Bentley ME. Development and validation of the infant feeding style questionnaire. Appetite 2009;53(2):210–21.

41. Putnam SP, Helbig AL, Gartstein MA, Rothbart MK, Leerkes E. Development and assessment of short and very short forms of the infant behavior questionnaire-revised. J Pers Assess 2014;96(4):445–58.

42. Putnam SP, Gartstein MA, Rothbart MK. Measurement of fine-grained aspects of toddler temperament: the early childhood behavior questionnaire. Infant Behav Dev 2006;29(3):386–401.

43. Pliner P. Development of measures of food neophobia in children. Appetite 1994;23(2):147–63.

44. Pliner P, Hobden K. Development of a scale to measure the trait of food neophobia in humans. Appetite 1992;19(2):105–20.

45. Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. Appl Psychol Meas 1977;1(3):385–401.

46. Ngo L, Brand R. Model selection in linear mixed effects models using SAS. Mathematics 1997:1–6.

47. Baron G, Perrodeau E, Boutron I, Ravaud P. Reporting of analyses from randomized controlled trials with multiple arms: a systematic review. BMC Med 2013;11:84.

48. Freidlin B, Korn EL, Gray R, Martin A. Multi-arm clinical trials of new agents: some design considerations. Clin Cancer Res 2008;14(14):4368–71.

49. Cohen J. Statistical power analysis. Curr Dir Psychol Sci 1992;1(3):98–101.

50. Van Rossum CTM, Buurma-Rethans EJM, Vennemann FBC, Beukers M, Brants HAM, De Boer EJ, Ocke MC. The diet of the Dutch: results of the first two years of the Dutch National Food Consumption Survey 2012-2016. Rijksinstituut voor Volksgezondheid en Milieu RIVM; 2016.

51. Caton SJ, Blundell P, Ahern SM, Nekitsing C, Olsen A, Møller P, Hausner H, Remy E, Nicklaus S, Chabanet C, et al. Learning to eat vegetables in early life: the role of timing, age and individual eating traits. PLoS One 2014;9(5):e97609.

52. Barends C, de Vries JH, Mojet J, de Graaf C. Effects of starting weaning exclusively with vegetables on vegetable intake at the age of 12 and 23 months. Appetite 2014;81:193–9.

53. Magarey A, Mauch C, Mallan K, Perry R, Elovaris R, Meedeniya J, Byrne R, Daniels L. Child dietary and eating behavior outcomes up to 3.5 years after an early feeding intervention: the NOURISH RCT. Obesity 2016;24(7):1537–45.

54. Maier-Nöth A, Schaal B, Leathwood P, Issanchou S. The lasting influences of early food-related variety experience: a longitudinal study of vegetable acceptance from 5 months to 6 years in two populations. PLoS One 2016;11(3):e0151356.

55. Barends C, De Vries JHM, Mojet J, De Graaf C. Effects of repeated exposure to either vegetables or fruits on infant's vegetable and fruit acceptance at the beginning of weaning. Food Qual Preference 2013;29:157–65.

56. Anzman SL, Rollins BY, Birch LL. Parental influence on children's early eating environments and obesity risk: implications for prevention. Int J Obes 2010;34(7):1116–24.

57. Savage JS, Fisher JO, Birch LL. Parental influence on eating behavior: conception to adolescence. J Law Med Ethics 2007;35(1):22–34.

58. Schneider-Worthington CR, Berger PK, Goran MI, Salvy SJ. Learning to overeat in infancy: concurrent and prospective relationships between

maternal BMI, feeding practices and child eating response among Hispanic mothers and children. Pediatr Obes 2021;16 (6);e12756.

59. Llewellyn CH, van Jaarsveld CH, Johnson L, Carnell S, Wardle J. Nature and nurture in infant appetite: analysis of the Gemini twin birth cohort. Am J Clin Nutr 2010;91(5):1172–9.

60. Llewellyn CH, van Jaarsveld CH, Plomin R, Fisher A, Wardle J. Inherited behavioral susceptibility to adiposity in infancy: a multivariate genetic analysis of appetite and weight in the Gemini birth cohort. Am J Clin Nutr 2012;95(3):633–9.

61. Paul IM, Savage JS, Anzman-Frasca S, Marini M, Beiler J, Hess L, Loken E, Birch L. Effect of a responsive parenting educational intervention on childhood weight outcomes at 3 years of age: the INSIGHT randomized clinical trial. JAMA 2018;320(5): 461–8.

62. Taylor RW, Williams SM, Fangupo LJ, Wheeler BJ, Taylor BJ, Daniels L, Fleming EA, McArthur J, Morison B, Williams Erickson L, et al. Effect of a baby-led approach to complementary feeding on infant growth and overweight: a randomized clinical trial. JAMA Pediatr 2017;171(9):838–46.

63. Central Bureau for Statistics. Statistics Netherlands: educational level [Internet]. 2021 [cited 3 May 2021]. Available from: https://opendata.cbs.nl.