Using food to soothe in infancy is prospectively associated with childhood BMI in a population-based cohort

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ABSTRACT

Background: Feeding practices have been implicated in childhood overweight, but the long-term effects of using food to comfort a distressed child remain unknown.
Objective: This study examined whether the use of food to soothe in infancy was associated with later body composition, and whether children's eating behaviors mediate this relation.
Methods: Participants were 3960 children of Generation R, a population-based birth cohort in the Netherlands. Parents reported on the use of food to soothe when infants were 6 months old and on child eating behavior (food responsiveness, emotional eating) at ages 4 and 10 years. Body Mass Index, fat mass and fat-free mass were measured at ages 6 and 10 years. Linear regression and mediation analyses were conducted, accounting for various potential confounding factors.
Results: The use of food to soothe when infants were 6 months old predicted a higher BMI from age 6 onwards, independently of infant weight, maternal BMI and other confounders. Specifically, frequent use was associated with a 0.13 higher BMI z-score at age 10 years (95% CI: 0.03, 0.22) as compared with never use. Children's emotional eating mediated this association (indirect effect B=0.04, 95% CI: 0.02, 0.06). The feeding – body composition association was most evident for fat mass (p for trend= 0.014) and somewhat less for fat-free mass (p for trend= 0.079).
Conclusions: The use of food to comfort a distressed infant was consistently associated with obesogenic eating behaviors and an unhealthy body composition throughout middle and late childhood. As our design precludes conclusions on causal associations, we recommend further studies with precise, repeated assessments of infant feeding practices. Such research can help ascertaining the direction of effect, which is needed for establishing evidence-based guidelines for parents regarding the use of food to soothe early in life.

INTRODUCTION

Childhood overweight is a worldwide public health problem, given its high prevalence and adverse health consequences.[1] Eating behaviors and appetitive traits play a key role in dietary intake and maintaining a healthy weight.[2,3] The roots for these behaviors most often lie early in life.[4]

In early childhood, parents shape child behavior to a large extent.[5-8] In particular, feeding strategies may contribute to children's development of both healthy and unhealthy eating behaviors.[5,7,8] Research on feeding mostly focused on controlling feeding practices, used to influence quality and quantity of children's food intake.[5,7-9] Less attention has been paid to parents' use of food for non-nutrient purposes, including the use of food to soothe which is the tendency of parents to give their child food or a drink when the child is crying, anxious, angry, distressed or upset.[10] The immediate effects of offering food to soothe (also called emotional feeding) are often positive, as the child's negative mood quickly diminishes.[11] However, through repeated exposure to this feeding practice, children may learn that eating food can effectively soothe distress.[12] Moreover, as the food offered usually contains high levels of sugar,[10] it has been postulated that emotional feeding could be a risk factor for obesity.

Nevertheless, studies evaluating this hypothesis were restricted to infancy and toddlerhood, mostly had a cross-sectional design and reported contradicting findings.[10, 12-18] While some studies showed that the use of food to soothe a distressed infant or toddler was associated with a higher BMI in early childhood[13] or with weight gain in infancy,[14] others found no relation.[10,15-21] A few researchers also reported that the use of food to soothe was associated with more (emotional) overeating,[12,17,21,22] snacking and a preference for sweet, fatty foods in childhood.[18,19] Because such behaviors contribute to the development of overweight,[2] a possible effect of the use of food to soothe on child BMI could potentially be explained by these eating behaviors.

In this large, population-based study, we evaluated whether the use of food to soothe in infancy is prospectively associated with BMI and fat mass across childhood. We hypothesized that more often use of food to soothe predicts a higher BMI and fat mass in later childhood, and that this association is mediated by children's tendencies towards external and emotional eating.

METHODS

Design and study population

This study was embedded in Generation R, a population-based cohort on health and development from fetal life onwards.[23,24] All pregnant women living in Rotterdam, the

Netherlands, with an expected delivery date between April 2002 and January 2006 were invited to participate (participation rate: 61%). The study was conducted in accordance with the guidelines proposed in the World Medical Association Declaration of Helsinki and has been approved by the Medical Ethical Committee of the Erasmus Medical Center Rotterdam. Written informed consent was obtained from parents of all children.

Full consent for the postnatal preschool phase of the Generation R Study was obtained from 7 295 children and their parents. Children without information on parents' use of food to soothe when infants were 6 months old (n=2 683, 36.8%) and those with missing data on BMI at all four follow-up assessments (3, 4, 6 and 10 years, n=652, 8.9%) were excluded, yielding a sample of 3 960 mother-child dyads for the current study (54.3%, Supplementary Figure 9.1). Because data on the outcomes is not complete for all children, the study population varies slightly per analysis.

Comparison of the included and excluded children indicated that children with missing data on the use of food to soothe or all BMI assessments (n=3 335) were more often of non-Western origin and had lower educated mothers (both $p<0.001$) than children with information on feeding and BMI (n=3 960). The children with missing data also had a lower birth weight (3 375 vs. 3 436 gram, $p<0.001$).

Measures

The use of food to soothe

Emotional feeding was assessed when children were 6 months old using a single item question. In a postal questionnaire, mothers were asked whether they had tried to comfort their child by giving something to eat or drink in the last two weeks. Three answering options were provided: never, sometimes and often. This question was part of an assessment of diverse soothing techniques that parents may use to calm their crying infants.[25]

Child body composition

Children´s growth characteristics were measured at the municipal Child Health Centers as part of a routine health care program at ages 3 and 4 years. At ages 6 and 10 years, children´s growth characteristics and body composition were measured at the Generation R research center. At all assessments, trained staff measured children´s height and weight using standard procedures. Height was measured in standing position using a Harpenden stadiometer. Weight was measured with light clothing using a mechanical personal scale. BMI was calculated as weight/height^2 (kg/m^2).

Body composition was measured at ages 6 and 10 years by Dual-energy-X-ray absorptiometry (DXA) scans (iDXA, GE-Lunar. 2008, Madison, WI, USA), using encore software v13.6. Measurements included body fat mass, bone mass and lean mass. Fat mass index (FMI) was calculated as total fat mass (kg) divided by squared height (m^2).

Children's fat free mass index (FFMI) was calculated as the sum of bone and lean mass (kg) divided by squared height (m^2).

Child eating behavior

Eating behavior of children was assessed with the validated Children's Eating Behavior Questionnaire (CEBQ).[26] Parents were asked to fill in this questionnaire twice, when children were 4 and 10 years old. Two eating behavior dimensions of the CEBQ were included in this study: emotional overeating (4 items, e.g. 'My child eats more when anxious') and food responsiveness (5 items, e.g. 'Even if my child is full up, s/he finds room to eat his/her favorite food'). Parents (mothers in 89% of the children) answered the items on a five-point Likert scale from 1=never to 5=always. Continuous scale scores were standardized to facilitate effect size comparisons. The CEBQ has good psychometric properties, including good test-retest reliability, internal consistency and concurrent validity with actual eating behavior.[26,27] Internal consistency in the Generation R study population was high for emotional overeating (α=0.85 and 0.92 at ages 4 and 10 years, respectively) and food responsiveness (α=0.84 and 0.86 at ages 4 and 10 years, respectively).[3]

Covariates

Several possible confounding factors were included in the analyses. Information on maternal age and child gender was obtained from hospital/midwife registries. Maternal ethnicity (categorized as Dutch, Western and Non-western) and educational level were assessed by postal questionnaire during pregnancy. In the same period, maternal psychopathology symptoms were assessed using the Brief Symptom Inventory, a 53-item validated self-report on a diverse range of psychiatric symptoms.[28,29] Mothers' height and weight were measured at the Generation R research center, which was used to calculate maternal BMI (kg/m^2). Information on whether children were breastfed or not (ever breast fed and breast feeding at 6 months) was obtained from postal questionnaires in the first year of children's lives. Infant weight and height at 6 months was measured at the municipal Child Health Centers as part of routine health care, and was used to calculate infant BMI.

Statistical analyses

The body composition measures and the CEBQ scales were standardized. For BMI, sex- and age- adjusted z-scores were calculated according to the Dutch reference growth curves by using a growth analyzer program (www.growthanalyzer.nl).[30] For fat mass, fat free mass and the CEBQ scales, the standardization was based on internal references (i.e. the Generation R cohort), as external references were not available. Associations between the use of food to soothe in infancy and covariates were examined using ANOVAs for continuous variables and χ^2 test for categorical variables. Next, the association between

feeding, and children's eating behavior and BMIz were explored using Pearson correlation coefficients. Then, linear regression analyses were conducted to examine (1) associations of feeding with child BMIz and body composition measures at the various ages, and (2) associations of feeding with eating behavior, separately for each CEBQ scale at 4 and 10 years. Analyses were first conducted unadjusted, and then repeated while accounting for potential confounding factors. Covariates were only included in the multivariate analyses if they changed the effect estimates of the associations by >5%. The linear regression analyses were repeated including using food to soothe as a continuous rather than categorical variable in order to obtain p-values for trend.

Next, we conducted mediation analyses to test whether the feeding – BMI relation was explained by differences in children's eating behaviors. Direct effects of the use of food to soothe an infant on later BMIz and indirect effects via eating behavior were calculated using the 'MODEL CONSTRAINT' command in Mplus 7.2 for multiple imputation datasets. Models were estimated using the maximum likelihood estimation with robust standard errors (MLR) to account for non-normality of the data.[31]

Multiple imputations were performed to estimate missing values of the covariates. The presented effect estimates are the pooled results of 20 imputed datasets. Missing values ranged from n=1 for breast feeding to n=764 for maternal psychopathology. All statistical analyses, except the mediation analyses, were performed with SPSS version 23.0.

Results

General characteristics of the mother-child dyads are shown in Table 9.1. The majority of mothers indicated to sometimes have used food to soothe their infant (53.0%), 22.7% 'often' and 24.3% 'never' used this feeding strategy. Women with a non-Dutch or low educational background used emotional feeding relatively more often ($p<0.001$, and $p=0.002$, respectively). The vast majority of infants were breast fed for some time (92.2%). At 6 months, a third of the infants were still breast fed, with only 1.2% of the infants receiving solely breast milk.

Table 9.2 shows the correlations between determinants, outcomes and mediators. Most of the correlations represented small effect sizes ($r<0.30$). The use of food to soothe an infant, body composition measures at ages 6 (BMIz) and 10 years (BMIz, FFMIz, FMIz), and emotional overeating at ages 4 and 10 years all correlated positively with each other. Food responsiveness was significantly correlated with body composition at all ages, but not with the use of food to soothe the infant. Therefore, this eating scale was not considered a potential mediating factor in further analyses.

Table 9.3 shows that the use of food to soothe was positively associated with BMI, FFMI and FMI z-scores at ages 6 and 10 years, while no significant relations were found with BMIz at ages 3 and 4 years. Particularly often use of food to soothe predicted a higher BMIz and higher FMIz in later childhood, after accounting for potential confounders

Table 9.1. General characteristics of the 3960 study participants[a]

Maternal characteristics	% or mean ± SD				
	Total study population (n=3960)[a]	By using food to soothe category			
		Never (n=961)	Sometimes (n=2099)	Often (n=900)	P-value[b]
Ethnicity (%)					<0.001
Dutch	61.6	27.4	53.5	19.1	
Western	8.9	22.3	52.3	25.4	
Non-western	29.5	18.8	52.0	29.2	
Educational level (%)					0.001
High	31.9	26.1	54.0	19.9	
Mid-high	24.3	24.6	54.8	20.6	
Mid-low	28.3	25.2	52.0	22.8	
Low	15.5	19.5	52.2	28.3	
Age in years	31.2 ± 4.7	31.4 ± 4.3	31.3 ± 4.6	30.8 ± 5.3	0.02
BMI (kg/m^2)	24.5 ± 4.3	24.7 ± 4.3	24.4 ± 4.2	24.5 ± 4.4	0.10
Psychopathology score[c]	0.25 ± 0.33	0.21 ± 0.28	0.24 ± 0.32	0.30 ± 0.40	<0.001
Child characteristics					
Gender (% boys)	49.3	48.3	48.8	51.7	0.27
BMI at 6 months	17.2 ± 1.40	17.2 ± 1.42	17.1 ± 1.37	17.3 ± 1.44	0.05
BMIz at 6 months	0.11 ± 1.00	0.12 ± 1.01	0.08 ± 0.99	0.18 ± 1.01	0.06
Ever breastfed (% yes)	92.2	90.4	92.2	94.3	0.007
Breastfeeding at 6 months (% yes)	33.6	23.5	34.4	42.8	<0.001
Exclusive breastfeeding at 6 months (% yes)	1.2	1.2	1.3	0.9	0.59

[a]Values are percentages for categorical variables and means ± SDs for continuous variables. Some variables had missing values: ethnicity (n=40), educational level (n=165), maternal BMI (n=299), psychopathology score (n=764), child BMI (BMIz) at 6 months (n=726) and breast feeding (n=1). Descriptive values of the imputed data was very similar.[b]P-value for heterogeneity: ANOVA for continuous variables, χ^2 for categorical variables.[c]Assessed with the Brief Symptom Inventory.[28, 29]

(e.g. B for FMI z-score at 10 years=0.11, 95% CI: 0.03, 0.20). The significant association between emotional feeding and FFMI z-score attenuated to statistical non-significance after adjustment for confounders.

Results of the regression analyses with the use of food to soothe and emotional overeating are shown in Table 9.4. More frequent use of food to soothe an infant was associated with higher levels of children's emotional overeating at ages 4 and 10 years, compared to children whose parents never used food to soothe. These associations attenuated slightly after accounting for potential confounders (e.g. at 10 years, B attenuated from 0.26 [95%CI 0.15, 0.36] to 0.23 [95% CI: 0.13, 0.34]), but remained statistically significant.

Table 9.2. Correlations between the use of food to soothe, child BMI and eating behavior in 3960 children of the general population[a]

		Pearson correlation coefficients						
	Mean ± SD	Use of food to soothe at 6 months	BMI z-score				FFMI z-score 10 years M=−0.10 (SD=0.92)	FMI z-score 10 years M=−0.02 (SD=0.95)
			3 years M=0.11 (SD=0.96)	4 years M=0.08 (SD=0.97)	6 years M=0.21 (SD=0.88)	10 years M=0.19 (SD=1.0)		
Use food to soothe at 6 months			0.03	0.01	0.04*	0.06*	0.04*	0.07**
Child eating behavior								
At 4 years								
Emotional Overeating	5.8 ± 2.4	0.05*	0.05*	0.03	0.06*	0.06*	0.11	0.07**
Food Responsiveness	8.9 ± 3.4	0.01	0.25**	0.23**	0.21**	0.15**	0.15**	0.12**
At 10 years								
Emotional Overeating	6.0 ± 2.7	0.09*	0.10**	0.09**	0.14**	0.16**	0.11**	0.17**
Food Responsiveness	9.2 ± 3.9	0.04	0.25**	0.23**	0.35**	0.37**	0.27**	0.36**

[a] Values are means ± SDs and Pearson correlation coefficients. FFMI: Fat free mass index. FMI: Fat mass index. * p-value <0.05, ** <0.001.

Table 9.3. Association of the use of food to soothe with body composition in 3960 children of the general population[a]

Use of food to soothe at 6 months	B (95%CI) for body composition z-scores at different ages					
	BMI z-score at 3 years (n=2819)[b]	BMI z-score at 4 years (n=2464)[b]	BMI z-score at 6 years (n=3416)[b]	BMI z-score at 10 years (n=3075)[b]	Fat free mass index z-score at 10 years (n=3028)[b]	Fat mass index z-score at 10 years (n=3028)[b]
Model 1: Unadjusted						
Never	Reference	Reference	Reference	Reference	Reference	Reference
Sometimes	0.01 (−0.08, 0.09)	−0.02 (−0.11, 0.08)	0.00 (−0.07, 0.07)	−0.00 (−0.09, 0.08)	−0.03 (−0.11, 0.05)	0.01 (−0.07, 0.09)
Often	0.09 (−0.01, 0.20)	0.03 (−0.08, 0.14)	0.12 (0.03, 0.20)*	0.18 (0.08, 0.29)*	0.11 (0.01, 0.21)*	0.18 (0.09, 0.28)*
P for trend	*0.087*	*0.61*	*0.010*	*0.001*	*0.043*	*<0.001*
Model 2: Adjusted[c]						
Never			Reference	Reference	Reference	Reference
Sometimes			0.02 (−0.04, 0.08)	0.02 (−0.06, 0.10)	0.01 (−0.08, 0.08)	0.02 (−0.05, 0.09)
Often			0.08 (0.01, 0.17)*	0.13 (0.03, 0.22)*	0.09 (−0.01, 0.18)	0.11 (0.03, 0.20)*
P for trend			*0.065*	*0.011*	*0.079*	*0.014*

*p-value <0.05

[a] Values are regression coefficients (95% CI).

[b] N varied per analysis due to different number of missing BMI assessments per time point.

[c] Adjusted for maternal education, ethnicity, age, BMI and psychopathology score, and child gender, BMI at 6 months and breast feeding.

Table 9.4. Association of the use of food to soothe with emotional overeating in 3960 children of the general population[a]

Use of food to soothe at 6 months	B (95%CI) for emotional overeating z-scores	
	4 years (n=3217)	10 years (n=2838)
Model 1: Unadjusted		
Never	Reference	Reference
Sometimes	0.09 (0.01, 0.17)*	0.09 (−0.00, 0.17)
Often	0.15 (0.05, 0.25)*	0.26 (0.15, 0.36)**
P for trend	*0.003*	*<0.001*
Model 2: Adjusted[b]		
Never	Reference	Reference
Sometimes	0.08 (−0.01, 0.16)	0.09 (0.01, 0.18)*
Often	0.10 (0.01, 0.20)*	0.23 (0.13, 0.34)**
P for trend	*0.038*	*<0.001*

* p-value <0.05, ** <0.001.

[a] Values are regression coefficients (95% CI).

[b] Adjusted for maternal education, ethnicity, age, BMI and psychopathology score, and child gender, BMI at 6 months and breast feeding.

In mediation analyses (presented in Figure 9.1), a significant indirect effect of the use of food to soothe an infant on child BMI z-score via emotional eating was found (e.g. indirect effect on child BMIz at 10 years: B=0.04, 95% CI: 0.02, 0.06). Besides, a direct effect of frequent use of food to soothe on children's BMI z-score was also observed (e.g. direct effect on child BMIz at 10 years: B=0.14, 95% CI: 0.04, 0.24).

DISCUSSION

Children, who were soothed by their parents with food and drinks in infancy, displayed more obesogenic eating behaviors and an unhealthier body composition when they were ten years old. In particular, these children had a higher mean BMI and a greater accumulation of fat mass. Although the mean increase in BMI z-score of 0.13 due to emotional feeding (often vs never, corresponding with 0.40 BMI points, 95% CI: 0.15, 0.64) may appear small, this is very comparable to the protective effect of breast feeding, which is estimated to reduce BMI z-score in childhood by 0.18.[32] Thus, our findings suggest that the use of food to soothe might contribute to the development of obesity.

Our findings provide support for the hypothesis that the practice of offering food for non-nutrient purposes influences weight development of children. The adverse effect of the use of food to soothe a distressed infant or child on weight development was

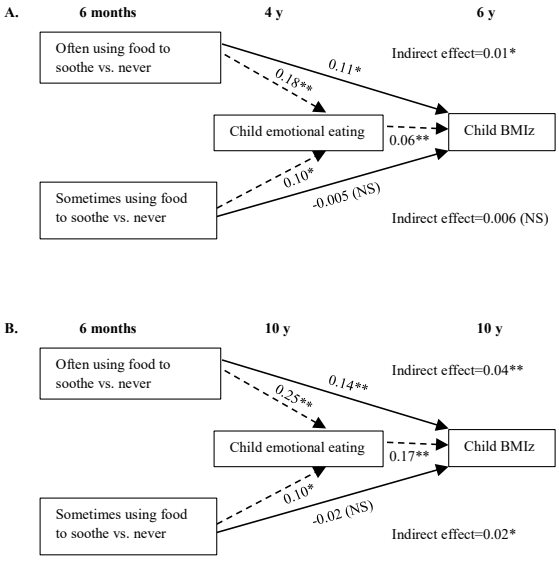

Figure 9.1. Mediation analyses representing the direct effect of the use of food to soothe in infancy on (Panel A) BMI at age 6 y and the indirect effect via emotional eating at 4 y, and on (Panel B) BMI at age 10 y and the indirect effect via emotional eating at 10. Values represent regression coefficients derived from Mplus 7.2. Figure 1A: n=3416, Figure 1B: n=3075. Adjusted for maternal education, ethnicity, age, BMI, psychopathology score, and child gender, BMI at 6 months and breast feeding.
* p-value <0.05, ** <0.001.

not reported in longitudinal population-based studies before.[17,20] Only one small study in the U.S. (n=135) showed that emotional feeding predicted weight gain from 6 to 18 months.[10] Our results add substantially to this study by showing that the use of food to soothe predicted a higher child BMI z-score and particularly the accumulation of body fat over a ten-year period, independently of initial body weight. The current study also suggests that parents' use of food to soothe in infancy is associated with later emotional eating. This supports previous work reporting similar associations in cross-sectional[21,22] or longitudinal studies with a one-year follow up only.[17]

Different explanations for the reported association between the use of food to soothe distressed infants and body composition in childhood are conceivable. First, we showed that children's tendencies to emotional eating mediated the feeding – body composition association. This finding could be interpreted as evidence for the hypothesis[12] that being fed as a way to provide comfort and consolation may specifically teach children to associate food with emotions and to cope with negative emotions by eating, even at times when they are not hungry. We showed that the use of food to soothe was related with emotional eating at ages 4 and 10 years, while the association with body composition was only evidenced in late and not in early childhood. This suggests that the effects of using food

to soothe on child weight via emotional eating may not become evident until children have more free access to food. Free access makes it possible to act upon the inclination to eat and snack in response to distress. This hypothesis is supported by work showing that emotional eating is a risk factor for excessive weight gain in school-aged children from about age 6 years onwards,[27,33] but not at younger ages.[19,34] Alternatively, subtle differences in BMI due to feeding practices may first be masked by individual differences in timing of the adiposity rebound, and only become apparent after this transition period (>5-6 years).[35]

An alternative explanation for the reported feeding – body composition association is that parents who use food to soothe their infants may years later also be more indulgent to give their children something to eat or snack. In line with this reasoning, we acknowledge the possibility that the feeding – body composition relation is explained by other factors not included in the analyses. Possibly, families using food in non-nutrient ways may also be families with unhealthier lifestyle habits or a less affluent background. Although the analyses were adjusted for several possible confounding factors, residual confounding cannot be ruled out.

Reverse causality is another mechanism that must be considered. Previously, we showed that parents tend to use specific feeding practices in response to child weight or eating behavior.[36] Plausibly, parents of food-oriented or reward sensitive children may realize that offering food is an efficient way to quickly soothe their child's distress. By adjusting the analyses for initial weight, we attempted to rule out the direction of effect that heavy children with a large appetite were more likely to be exposed to emotional feeding. However, only a randomized controlled trial can definitely confirm the current findings and demonstrate direction of causation.

The current study is strengthened by its large sample size of mother-child dyads and the use of objective measurements of body composition. Furthermore, we relied on a prospective design using data collected in multiple assessment waves, making it possible to infer on the longer-term effects of a specific feeding practice. Limitations of our study include

our relatively healthy, affluent sample, due to selective participation[37] and loss to follow-up, which was more substantial in those of lower socio-economic and ethnic minority backgrounds. Moreover, our sample showed a lower rate of exclusive breastfeeding at 6 months postpartum as compared to a large representative sample of Dutch mothers in the same period.[38] Another limitation is the reliance on mother reports of emotional feeding and children's emotional eating. Mothers may have provided socially desirable or biased reports on her own parenting strategies and her child's eating behavior. However, findings for emotional overeating and child BMI – which was objectively measured – were rather similar. Moreover, the validity of the CEBQ has been proven with a variety of observations of actual eating behaviors.[26] The assessment of emotional feeding was

also limited by its single item assessment. Although a single item can be effectively used to capture a global construct, a multi-item questionnaire could have assessed situational aspects of feeding and the relevant emotional states of children in more detail. Furthermore, we only assessed emotional feeding at a single time point in infancy, when milk and perhaps fruit and vegetable puree are the main components of a child's diet. It is unclear whether emotional feeding practices in these circumstances remain the same or change as children grow older, thus limiting more general conclusions on parental feeding practices across childhood.

In conclusion, this longitudinal population-based study is the first, to our knowledge, to suggest that the use of food to soothe in infancy contributes to unhealthy weight development throughout childhood. However, given our assessment of emotional feeding using a single item at only one time point in infancy, we emphasize the need for replication of our findings in future longitudinal studies, preferably with precise, repeated assessments of feeding practices, as well as experimental studies. Such studies can better demonstrate (direction of) causation. However, the burden of the overweight epidemic urges us to translate findings – even if representing small effects – into clinical practice.[1] Thus, we recommend health professionals involved in the care of young parents, like midwives and professionals at baby-well clinics, to inform parents about adequate strategies to soothe distressed infants, such as distraction and comforting through talking, singing, walking and rocking. These strategies are positive in any case and such advice needs only a minimal time effort if given along with the standard recommendations about breast feeding. Once the negative effects of emotional feeding are confirmed by future studies, health care professionals should then be advised to guide parents to use emotional feeding strategies to a limited extend only.

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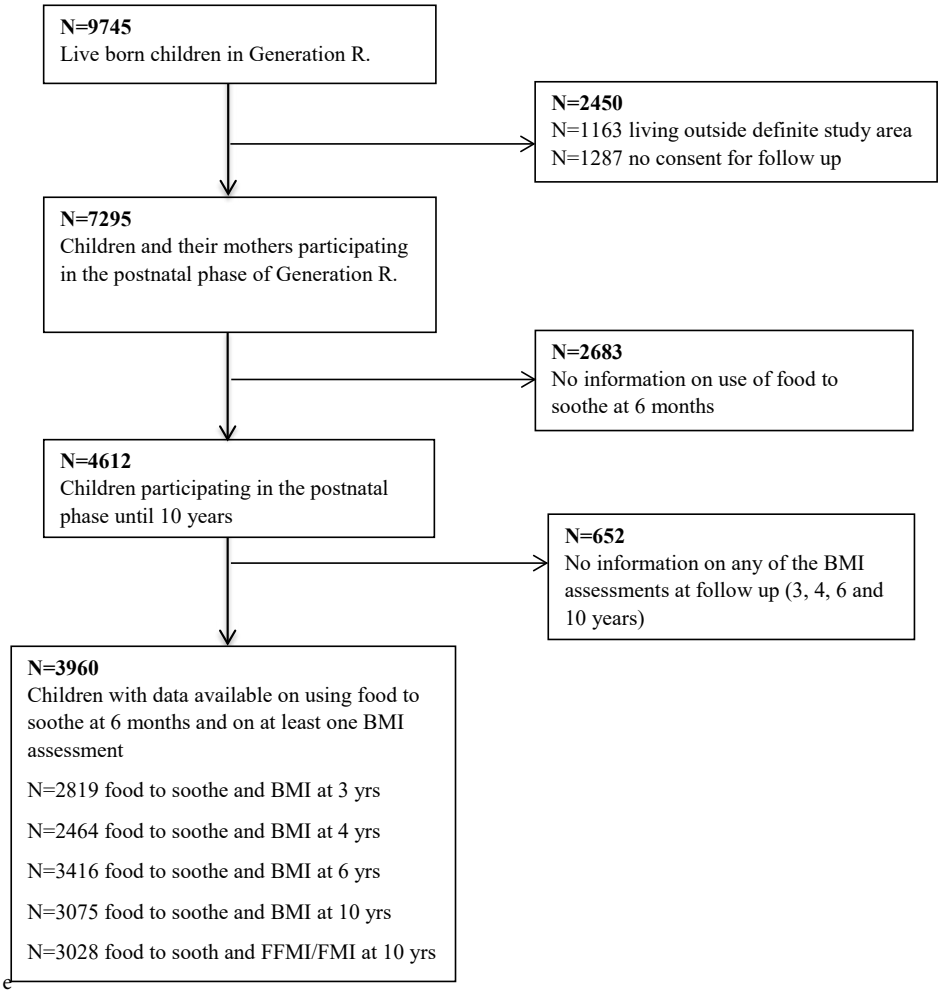
SUPPLEMENT



Supplementary Figure 9.1. Flowchart of the study sample