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► **To cite this version:**

Claire Guivarch, Aminata Hallimat Cissé, Marie-Aline Charles, Barbara Heude, Blandine de Lauzon-Guillain. Parental feeding practices as potential moderating or mediating factors in the associations between children's early and later growth. *International Journal of Obesity*, 2023, 47, pp.190-196. 10.1038/s41366-023-01255-y . hal-04176175

HAL Id: hal-04176175

<https://hal.inrae.fr/hal-04176175>

Submitted on 2 Aug 2023

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1 **TITLE**

2 Parental feeding practices as potential moderating or mediating factors in the associations
3 between children's early and later growth

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14 **COMPETING INTEREST STATEMENT**

15 The authors declare that they have nothing to disclose.

16 **SOURCES OF SUPPORT**

17 The EDEN study is supported by Fondation pour la Recherche Médicale (FRM), French
18 Ministry of Research: Federative Research Institutes and Cohort Program, INSERM Human
19 Nutrition National Research Program, and Diabetes National Research Program (through a
20 collaboration with the French Association of Diabetic Patients [AFD]), French Ministry of
21 Health, French Agency for Environment Security (AFSSET), French National Institute for
22 Population Health Surveillance (InVS), Paris- Sud University, French National Institute for
23 Health Education (INPES), Nestlé, Mutuelle Générale de l'Education Nationale (MGEN),
24 French-speaking Association for the Study of Diabetes and Metabolism (ALFEDIAM),

- 25 National Agency for Research (ANR non- thematic programme), and National Institute for
26 Research in Public Health (IRESP: TGIR 2008 cohort in health programme).
- 27 **RUNNING TITLE**
- 28 Parental feeding practices and children's growth

29 **ABSTRACT**

30 **Background:** Given inconsistent results in the literature, our objective was to examine the
31 role of early parental feeding practices in children's growth.

32 **Methods:** Analyses were based on 1245 children from the EDEN mother-child cohort.
33 Parental feeding practices were assessed at the 2-year follow-up by using the Comprehensive
34 Feeding Practices Questionnaire. International Obesity Task Force BMI z-scores were derived
35 from weight and height assessed at 2, 4, 6 and 8 years. Associations between parental feeding
36 practices and child BMI z-scores at 4, 6 and 8 years were assessed by multivariable linear
37 regressions, notably adjusted for 2-year BMI z-score. Analyses were stratified by child sex
38 when relevant. Moreover, interaction and mediation analyses were respectively performed to
39 assess whether parental feeding practices could moderate or mediate the associations between
40 early and later growth.

41 **Results:** For a given BMI z-score at 2 years, parental restriction for weight at 2 years was
42 positively associated with child BMI z-scores from 4 to 8 years (at 8 years: β [95% CI] = 0.09
43 [0.01; 0.16]). Among boys only, high use of food as a reward was positively associated with
44 later BMI z-scores (at 8 years: β [95% CI] = 0.15 [0.03; 0.27]). Parental feeding practices
45 were not moderating factors in the associations between early and later growth. Parental
46 restriction for weight was a mediating factor in the associations between 2-year BMI z-score
47 and BMI z-scores up to 8 years (mediation: 2.69% [0.27%; 5.11%] of the total effect at 8
48 years).

49 **Conclusions:** Restriction for weight reasons, often used by parents in response to the child's
50 high appetite in infancy, appears to lie on the pathway between early and later BMI, but not
51 restriction for health, suggesting that parental way of restricting the child's food intake
52 matters.

53 **KEYWORDS**

54 Parental feeding practices; growth; BMI; birth cohort; mediation

55 INTRODUCTION

56 Childhood overweight and obesity affects 39 million children under the age of 5 years
57 worldwide (1) and is associated with short- and long-term adverse outcomes, such as
58 adulthood obesity, cardiovascular diseases and psychosocial difficulties (1, 2). According to
59 the concept of the developmental origins of health and disease, the first 1000 days of life (i.e.,
60 from conception to age 2 years) constitute an opportunity window to prevent overweight and
61 obesity (3). It is notably suggested that the factors related to eating behaviors may be easier to
62 modify during their development in the first years of life than later in life (3).

63 Early eating behaviors and eating habits have been found to be associated with eating
64 behaviors and food intake later in childhood or in adolescence (4-6). The previous literature
65 showed that child early appetite or eating behaviors could be associated with later BMI:
66 appetite, enjoyment of food, emotional overeating and food responsiveness in early life have
67 been found to be positively associated with BMI later in childhood, whereas slowness in
68 eating and satiety responsiveness have been found to be negatively related to BMI later in
69 childhood (7-9). However, early BMI has also been found to be positively or negatively
70 associated with the same aspects of later child eating behavior (9-12).

71 Parents play a key role in the development of their child's eating behaviors and eating
72 habits, especially in the first years of life, by being role models (13, 14) and by deciding the
73 type of foods and the portion size offered to the child as well as the feeding time (15).
74 Parental feeding practices are strategies (actions or behaviors) parents adopt to influence their
75 child's food intake or eating behavior (16-18). Several studies assessed the associations
76 between these feeding practices and children's growth, summarized in literature reviews that
77 mainly focused on coercive parental feeding practices (i.e., restriction for health, restriction
78 for weight or pressure to eat) (19). The conclusions of these literature reviews are inconsistent
79 (12, 18, 20-24). Nevertheless, the recent systematic review and meta-analysis of Ruzicka et al.

80 (based on 31 cross-sectional studies, 13 longitudinal studies and 7 randomized control trials)
81 found a positive association between parental restriction and child weight and a negative
82 association between parental pressure to eat and child weight and concluded that more
83 longitudinal studies are required to examine the direction of this association (25).

84 Overall, recent literature reviews concluded that more longitudinal studies are required
85 to assess the complex associations between parental feeding practices and childhood BMI,
86 notably by accounting for the child's eating behavior (21, 23, 25). As parental feeding
87 practices are modifiable, to develop strategies to prevent childhood obesity, it would be of
88 great importance to examine whether parental feeding practices could be considered as
89 potential lever to modulate early growth (moderating factor), by attenuation or reinforcement
90 of the associations between early and later growth, or whether they could lie on the pathway
91 between early and later growth (mediating factor). In this context, the first objective of this
92 prospective study was to assess the associations between parental feeding practices in
93 toddlerhood and children's BMI up to 8 years. The second objective was to examine whether
94 parental feeding practices may be considered as moderating or mediating factors in the
95 associations between early and later child BMI.

96 **MATERIAL AND METHODS**

97 **Study population**

98 The EDEN mother-child study is a French prospective cohort that investigates the prenatal
99 and postnatal determinants of child growth, development and health (26). A total of 2002
100 pregnant women before 24 weeks of amenorrhea were recruited in two university hospitals
101 (Nancy and Poitiers) from 2003 to 2006. Exclusion criteria were multiple pregnancies, known
102 diabetes before pregnancy, French illiteracy and planning to move outside the region in the
103 next 3 years. Written consent was obtained from both parents. The study was approved by the
104 ethics committee of the university hospital of Kremlin- Bicêtre (ID 0270 of December 12,

105 2002) and data files were declared to the National Committee for Processed Data and
106 Freedom (CNIL, ID 902267 of December 12, 2002).

107 **Child growth**

108 The child's weight and length/height were measured at each clinical examination (at birth, 1,
109 3 and 5 years) (26). Moreover, at each follow-up (at 4, 8 and 12 months, 2, 3, 4, 5 and 8
110 years), parents reported weight and length/height data, collected in the child's health booklet
111 (26). In order to study children's anthropometric measurements exactly at the same age,
112 individual growth curves for weight and length/height were computed by using the Jentsch-
113 Bayley growth curve model, as described previously (26, 27). To account for the increase in
114 BMI variability with child's age, the data from the individual growth curves were used to
115 calculate the child's BMI z-scores at ages 2, 4, 6 and 8 years, using the International Obesity
116 Task Force references (28).

117 **Parental feeding practices**

118 Parental feeding practices were assessed at the 2-year follow-up (i.e., when the child was 2
119 years old) with the French version (29) of the Comprehensive Feeding Practices
120 Questionnaire (30). In the present analysis, five scales of the questionnaire were used:
121 restriction for health (4 items; in the EDEN mother-child cohort: Cronbach $\alpha = 0.79$),
122 restriction for weight (4 items; Cronbach $\alpha = 0.67$), pressure to eat (3 items; Cronbach $\alpha =$
123 0.59), using food as a reward (Rewards, 3 items; Cronbach $\alpha = 0.45$) and using food to
124 regulate the child's emotions (Emotion regulation, 3 items; Cronbach $\alpha = 0.66$). Each item is
125 associated with a score from 1 (never or disagree) to 5 (always or agree). Item scores are
126 averaged within each scale. Scores of coercive parental feeding practices (i.e., restriction for
127 health, restriction for weight and pressure to eat) were considered as continuous variables.
128 Because of the skewed distribution of scores, parental feeding practices of using food as a
129 reward or to regulate the child's emotions were considered as binary variables, according to

130 the median in our sample. “Low use” of a specific parental feeding practice was defined by a
131 score below the median and “high use” by a score equal to or above the median.

132 **Other variables**

133 The baseline questionnaire administered during pregnancy or at birth was used to collect
134 information on parental characteristics, including maternal age at delivery (in years),
135 primiparity (yes/no), maternal education level (< high school diploma, high school diploma,
136 and 2-year and \geq 5-year university degree), household income (in €/month: \leq €1500, €1501 to
137 €2300, €2301 to €3000 and $>$ 3000€), maternal smoking status during pregnancy (yes/no) and
138 parental BMI. Maternal BMI was classified into 4 categories (underweight: $<$ 18.5 kg/m²,
139 normal BMI: \geq 18.5 to $<$ 25 kg/m², overweight: \geq 25 to $<$ 30 kg/m² and obese: \geq 30 kg/m²).
140 Paternal BMI was studied in 3 categories because of the low number of underweight fathers
141 (underweight or normal BMI: $<$ 25 kg/m², overweight: \geq 25 to $<$ 30 kg/m² and obese: \geq 30
142 kg/m²).

143 Data on child characteristics were collected at birth and during the first year of life and
144 included sex, birth weight (in kg), preterm birth (yes/no) and any breastfeeding duration ($<$ 1
145 month, 1 to $<$ 4 months and \geq 4 months). Moreover, maternal perception of the child’s
146 appetite was assessed with one item at 4, 8, 12 and 24 months. A 4-to-24-month appetite
147 indicator in 3 categories (low, intermediate and high appetite) was then developed, as
148 previously described (31).

149 **Sample selection**

150 Of the 2002 recruited women, 76 were excluded because they left the study before or at the
151 time of delivery; 24 because of miscarriage, intrauterine death, or discontinuation of
152 pregnancy for medical reasons and 9 because they delivered outside the study hospitals. Data
153 on birthweight were available for 1899 newborns. Individuals with missing data for at least

154 one parental feeding practice (n=492), child growth (n=6) and potential confounders (n=156)
155 were excluded, which led to a complete-case sample of 1245 (Figure 1).

156 **Statistical analyses**

157 Comparisons between excluded and included participants were assessed by chi-squared tests
158 for categorical variables and Student *t* tests for continuous variables.

159 Associations between 2-year parental feeding practices and BMI z-scores at 4, 6 and 8
160 years were investigated with multivariable linear regression models. One model was run per
161 parental feeding practice (exposure variable) and per child BMI z-score (outcome, i.e., at each
162 age). Potential confounders were identified from the literature and selected according to the
163 directed acyclic graph method (32): study center, parental characteristics (primiparity,
164 maternal age at delivery, maternal education level, household income, maternal smoking
165 status during pregnancy, parental BMI) and child's characteristics (sex, preterm birth, any
166 breastfeeding duration, 4-to-24-month appetite and 2-year BMI z-score). In preliminary
167 analyses, child sex significantly modified the associations between parental use of food as a
168 reward and later child growth (i.e., $p_{\text{interaction}} \leq 0.10$). Then, these analyses were stratified by
169 child sex.

170 Moderation occurs when the association between the exposure and the outcome differs
171 depending on the level of a third variable, called moderating factor (33). In the current study,
172 moderation analyses were used in order to examine whether parental feeding practices could
173 be considered as potential lever to modulate early growth, by attenuation or reinforcement of
174 the associations between early and later child growth. To assess whether parental feeding
175 practices could be moderating factor in the associations between the exposure (i.e., 2-year
176 BMI z-score) and the outcome (i.e., BMI z-score at 4, 6 or 8 years), an interaction term (2-
177 year BMI z-score * parental feeding practice) was added in each multivariable linear
178 regression model. One model was performed per potential moderating factor and per outcome

179 (i.e., at each age). All models were adjusted for study center, primiparity, maternal age at
180 delivery, maternal education level, household income, maternal smoking status during
181 pregnancy, parental BMI, child sex, preterm birth, any breastfeeding duration and 4-to-24-
182 month appetite. When the $p_{\text{interaction}}$ was ≤ 0.10 , analyses were stratified by parental feeding
183 practices.

184 Mediation occurs when a third variable lies on the causal pathway between the
185 exposure and the outcome (33). In the current study, mediation analyses were used to study if
186 parental feeding practices could lie on the pathway between early and later growth. To study
187 whether parental feeding practices could be mediating factors in the associations between
188 child 2-year BMI z-score and later child BMI z-scores at 4, 6 and 8 years, mediation analyses
189 using the counterfactual framework were performed (CAUSALMED procedure, SAS
190 statistical software) (34, 35). This method was used because it allows for mediation analyses
191 of a continuous or binary mediating factor or exposure, continuous outcome and categorical
192 or continuous covariables. Covariables included in the mediation models were the same as the
193 adjustment factors included in moderation analyses. Supplemental analyses were performed
194 by adding an interaction term between the exposure and the potential mediating factor, as
195 suggested previously (36). Because this interaction term did not modify the results (data not
196 shown), we present the mediation analyses without this interaction term.

197 The main analyses were conducted on the complete-case sample. In sensitivity
198 analyses, missing data on adjustment factors were handled by using the hot deck method,
199 which replaces each missing value with an observed data of respondents sharing the same
200 characteristics (37). Analyses were conducted with SAS v9.4 (SAS Institute, Cary, NC,
201 USA). The code book and analytic code will be made available upon request.

202 **RESULTS**

203 As compared with excluded children (n=757), included children (n=1245) were more
204 frequently born to mothers who were older (30 vs 29 years, $p < 0.0001$), primiparous (48% vs
205 39%, $p = 0.0003$), with higher education level (37% vs 23% with at least a 5-year university
206 degree, $p < 0.0001$), with higher household income (31% vs 20% with $> 3000\text{€}/\text{month}$, $p <$
207 0.0001), and with lower BMI before pregnancy (23.1 vs 23.5 kg/m^2 , $p = 0.05$) and who less
208 frequently smoked during pregnancy (21% vs 36%, $p < 0.0001$). As compared with excluded
209 children, included children were breastfed longer (36% vs 25% breastfed for at least 4
210 months, $p < 0.0001$). Included participants were similar to excluded ones regarding paternal
211 BMI, child sex, birth weight and preterm birth. Characteristics of included participants are in
212 Table 1.

213 **Associations between parental feeding practices and child growth**

214 Even after accounting for 2-year BMI z-score, parental restriction for weight was positively
215 associated with child BMI z-scores between 4 and 8 years (Table 2). Among boys only,
216 parental use of food as a reward was positively associated with child BMI z-scores between 4
217 and 8 years (Table 3). Parental restriction for health, pressure to eat and use of food to
218 regulate the child's emotions were not related to child BMI z-scores between 4 and 8 years
219 (Table 2).

220 Similar results were found after the hot deck imputation, except for parental restriction
221 for health, which was positively associated with child BMI z-scores at 6 and 8 years (Tables 2
222 and 3).

223 **Moderation and mediation analyses**

224 Parental feeding practices were not moderating factors in the associations between child early
225 and later BMI z-scores (all $p_{\text{interaction}} > 0.10$).

226 Parental restriction for weight was a mediating factor in the associations between early
227 and later BMI z-scores (Table 4). The effect of parental restriction for weight on BMI z-score
228 is providing by the natural indirect effect (Table 4). The percentage of the association
229 explained by restriction for weight ranged from 0.78% [0.03%; 1.52%] at 4 years to 2.69%
230 [0.27%; 5.11%] at 8 years (Table 4). Similar results were found after hot deck imputation
231 (Table 4). Among boys, parental use of food as a reward was not a mediating factor in the
232 associations between early and later BMI z-scores (Table S1).

233 **DISCUSSION**

234 In this prospective study, parental restriction for weight and high use of food as a reward
235 (among boys) at 2 years were positively associated with child BMI z-scores up 8 years.
236 Parental feeding practices were not moderating factors in the association between early and
237 later BMI z-scores. Moreover, parental restriction for weight lied on the pathway between 2-
238 year BMI z-score and BMI z-scores between 4 and 8 years.

239 Several studies assessed the associations between parental restrictive feeding practices
240 and children's later BMI, providing inconsistent findings. Of note, most studies examining
241 parental restrictive practices used the Child Feeding Questionnaire (38), with global score on
242 parental restriction, whereas the Comprehensive Feeding Practices Questionnaire (30), used in
243 the present study, distinguishes between parental restriction for health reasons or to prevent
244 weight issues. This discrepancy may limit some comparisons. A recent systematic review and
245 meta-analysis highlighted a weak but significant association between restrictive feeding
246 practice and child weight and considered that more longitudinal studies are needed to
247 conclude on the direction of the association (25). Indeed, this meta-analysis was mainly based
248 on cross-sectional studies, and findings were less consistent in other narrative or systematic
249 reviews including more longitudinal studies (21, 22). In a systematic review including only
250 prospective studies, restrictive feeding practices were not considered related to later growth

251 parameters (23). In the current study, parental restriction for weight was positively related to
252 later BMI up to 8 years in all analyses, and the positive association with restriction for health
253 was found only at 6 and 8 years after hot deck imputation. Further prospective studies are
254 needed to confirm these results.

255 Results concerning the association between parental pressure to eat and child BMI are
256 inconsistent in the literature (22). Most literature reviews concluded a negative association
257 (18, 20, 21, 25). Nevertheless, in line with the results of the current study, a literature review
258 and a recent study concluded that parental pressure to eat was not associated with children's
259 BMI (23, 39). More prospective studies are needed to explore this issue.

260 Concerning parental use of food for non-nutritional purposes, in a recent review,
261 parental use of food as a reward was positively associated with children's later BMI, with no
262 association found for parental use of food to regulate the child's emotions (23). In line with
263 these results, we did not find any association between parental use of food to regulate the
264 child's emotions but rather a positive association between parental use of food as a reward
265 and later BMI, among boys only. Further studies are needed to confirm this result and to
266 investigate the mechanisms that could explain the potential moderating effect of child sex.

267 If some studies examined whether children's eating behaviors could lie on the pathway
268 between parental feeding practices and child BMI (40), to our knowledge, no study has
269 examined whether parental feeding practices could lie on the pathway between early and later
270 BMI. Because parental feeding practices are modifiable factors that could be targeted by
271 strategies to prevent childhood obesity, it seems important to understand their potential role in
272 this association. In the current study, parental feeding practices were not moderating factors in
273 the associations between early and later BMI. In others words, favoring a given feeding
274 practice does not appear to be a promising lever to inflect the BMI curve. Moreover, parental
275 restriction for weight lied on the pathway between early and later child BMI. Overall, our

276 results suggest that parental restriction for weight does not seem effective in limiting later
277 child BMI and could even be counterproductive, and should therefore be avoided by parents
278 to limit childhood obesity. These findings are contradictory to what was found in adult
279 populations, in which cognitive restraint seems to attenuate the association between genetic
280 susceptibility to obesity and BMI (41). For children, parents seem to use these restrictive
281 feeding practices to deal with their child's high appetite in toddlerhood (31). Differences
282 regarding potential impact of restriction on BMI among children and adults could be
283 explained in part by adults choosing to restrict their own food intake, whereas young children
284 do not decide for themselves. Interestingly, contrary to restriction for weight, restriction for
285 health was not a mediating factor in the associations between early and later child BMI. This
286 difference could partly be explained by what distinguishes these restrictive feeding practices.
287 Indeed, restriction for health (i.e., parental control of the child's food intake with the purpose
288 of limiting less healthy foods and sweets (30)) could refer to the restriction of foods with high
289 levels of salt, sugar or fat, whereas restriction for weight (i.e., parental control of the child's
290 food intake with the purpose of decreasing or maintaining the child's weight (30)) could refer
291 to the restriction of food quantities consumed by the child, in order to limit child's later BMI.
292 These results suggest that parental restriction per se could not be problematic, but parental
293 way of doing it. Moreover, as it is suggested in the literature that parental restriction could be
294 perceived or not by the child (overt vs covert restriction) (42), distinguishing the nature of the
295 parental restriction in the associations between parental feeding practices and growth will be
296 of great interest. Future studies are warranted to investigate how to advise parents whose
297 children are perceived as having a high appetite in toddlerhood to prevent the risk of
298 childhood obesity.

299 Most previous studies investigating associations between parental feeding practices
300 and child growth focused on controlling feeding practices, so further studies focusing on
301 parental responsive feeding practices are needed.

302 In the present study, parental feeding practices were reported by parents, which could
303 imply a social desirability bias (43). To limit this bias, parental feeding practices were
304 assessed by using a validated questionnaire (30) applicable in a French sample (29). The
305 internal consistency of parental feeding practices was acceptable, except for the scale of
306 parental use of food as a reward, which had a low Cronbach α , thus limiting the interpretation
307 of the results concerning this feeding practice. However, our results concerning this feeding
308 practice seem to be consistent with those of the literature (23), thereby suggesting the
309 reliability of the present findings. Families included in the EDEN mother–child cohort have a
310 higher socio-economic position than the French population (26); hence, these findings should
311 be confirmed in more vulnerable families.

312 This study highlights that restriction for weight, often used by parents to deal with
313 children’s high appetite in infancy, may lie on the pathway between early and later BMI.
314 Future longitudinal studies are needed to identify which parental feeding practices, notably
315 responsive feeding practices, could attenuate the association between early and BMI later in
316 childhood in order to target them in childhood obesity prevention strategies.

317 **ACKNOWLEDGEMENTS**

318 The authors thank the EDEN mother–child cohort study group, whose members are I. Annesi-
319 Maesano, J.Y. Bernard, M.A. Charles, P. Dargent-Molina, B. de Lauzon-Guillain, P.
320 Ducimetière, M. de Agostini, B. Foliguet, A. Forhan, X. Fritel, A. Germa, V. Goua, R.
321 Hankard, B. Heude, M. Kaminski, B. Larroque, N. Lelong, J. Lepeule, G. Magnin,
322 L. Marchand, C. Nabet, F. Pierre, R. Slama, M.J. Saurel-Cubizolles, M. Schweitzer, and O.
323 Thiebaugeorges.

324 **AUTHOR CONTRIBUTIONS**

325 CG and BLG designed the research, analysed the data and wrote the manuscript. AHC
326 analysed the data. BH and MAC oversaw the EDEN study. BH and MAC were responsible
327 for data collection in EDEN. BLG had full access to all the data in the study and takes
328 responsibility for the integrity of the data and the accuracy of the data analysis. All authors
329 reviewed drafts, provided critical feedback, read and approved the final manuscript, were
330 responsible for the final content of the paper and agreed to be accountable for all aspects of
331 the work.

332 **COMPETING INTEREST STATEMENT**

333 The authors declare that they have nothing to disclose.

334 **DATA AVAILABILITY STATEMENT**

335 The data underlying the findings cannot be made freely available for ethical and legal
336 restrictions imposed because this study includes a substantial number of variables that
337 together could be used to re-identify the participants based on a few key characteristics and
338 then be used to access other personal data. Therefore, the French ethics authority strictly
339 forbids making these data freely available. However, they can be obtained upon request from
340 the EDEN principal investigator. Readers may contact barbara.heude@inserm.fr to request

341 the data. The code book and analytic code will be made available upon request pending
342 application and approval.

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458

459 **FIGURE LEGEND**

460 Figure 1. Flow of participants in the study

461 TABLES

462 Table 1. Characteristics of the study population (n=1245)

	% (n) or Mean (SD) or Median (Q1-Q3)	Missing value % (n) ^a
Parental characteristics		
Center		0
Poitiers	47.6% (593)	
Nancy	52.4% (652)	
Maternal age at delivery (year)	29.9 (4.7)	0
Primiparous	47.6% (592)	0.1% (2)
Maternal education level		0.5% (7)
< High school diploma	22.1% (275)	
High school diploma	17.7% (220)	
2 years university degree	23.8% (296)	
≥ 5 years university degree	36.5% (454)	
Household income (€/month)		0.6% (9)
≤ 1500	11.1% (138)	
1501-2300	29.7% (370)	
2301-3000	28.4% (354)	
> 3000	30.8% (383)	
Smoker during pregnancy	21.3% (265)	2.2% (31)
Maternal BMI before pregnancy (kg/m ²)	23.1 (4.3)	1.9% (27)
Paternal BMI before pregnancy (kg/m ²)	25.0 (3.5)	7.0% (98)
Parental feeding practices (1-5 scores)		
Restriction for health	3.4 (1.0)	0
Restriction for weight	1.7 (0.6)	0
Pressure to eat	2.3 (0.8)	0
Food as a reward	1.3 (1.0 - 1.7)	0
Emotional feeding	1.3 (1.0 - 1.7)	0
Child characteristics		
Boys	52.0% (647)	0
Birth weight (kg)	3.3 (0.5)	0
Preterm birth (< 37 gestational weeks)	5.4% (67)	0
Any breastfeeding duration (month)		0.1% (1)
< 1	32.9% (410)	
1 to < 4	31.5% (392)	
≥ 4	35.6% (443)	
4-to-24-month appetite		0
Low	10.8% (135)	
Intermediate	78.3% (975)	
High	10.8% (135)	
IOTF BMI z-scores		
At 2 years	-0.4 (0.9)	0
At 4 years	-0.1 (0.9)	0
At 6 years	0.3 (0.9)	0
At 8 years	0.2 (0.9)	0

463 IOTF: International Obesity Task Force.

464 ^a These missing values were imputed using the hot deck method (37), and were used in

465 supplemental analyses (after hot deck imputation, N=1401).

466 **Table 2. Associations between parental feeding practices and child BMI z-scores (main sample)**

	4-year BMI z-score		6-year BMI z-score		8-year BMI z-score	
	β [95% CI]	p	β [95% CI]	p	β [95% CI]	p
Unadjusted analyses (N=1245)						
Restriction for health (1-5 score)	0.05 [0.00; 0.10]	0.05	0.06 [0.01; 0.10]	0.02	0.06 [0.01; 0.11]	0.01
Restriction for weight (1-5 score)	0.33 [0.25; 0.41]	<0.0001	0.27 [0.19; 0.35]	<0.0001	0.23 [0.15; 0.31]	<0.0001
Pressure to eat (1-5 score)	-0.10 [-0.16; -0.04]	0.001	-0.08 [-0.14; -0.02]	0.01	-0.07 [-0.13; -0.01]	0.03
High emotional feeding ^a	0.08 [-0.02; 0.19]	0.1	0.08 [-0.02; 0.17]	0.1	0.07 [-0.03; 0.17]	0.2
Adjusted analyses (N=1245)^b						
Restriction for health (1-5 score)	0.01 [-0.02; 0.03]	0.7	0.02 [-0.01; 0.06]	0.2	0.04 [0.00; 0.08]	0.08
Restriction for weight (1-5 score)	0.05 [0.00; 0.09]	0.03	0.07 [0.01; 0.14]	0.02	0.09 [0.01; 0.16]	0.02
Pressure to eat (1-5 score)	0.00 [-0.03; 0.03]	0.9	0.00 [-0.04; 0.05]	1	0.00 [-0.05; 0.05]	1
High emotional feeding ^a	0.01 [-0.04; 0.06]	0.7	0.02 [-0.06; 0.09]	0.6	0.02 [-0.06; 0.11]	0.6
Adjusted analyses, after imputation (N=1401)^b						
Restriction for health (1-5 score)	0.01 [-0.01; 0.04]	0.2	0.04 [0.00; 0.07]	0.04	0.05 [0.01; 0.09]	0.01
Restriction for weight (1-5 score)	0.05 [0.01; 0.09]	0.01	0.08 [0.02; 0.14]	0.008	0.10 [0.03; 0.17]	0.008
Pressure to eat (1-5 score)	0.00 [-0.03; 0.03]	1	0.00 [-0.04; 0.04]	1	0.00 [-0.06; 0.05]	0.8
High emotional feeding ^a	0.02 [-0.03; 0.07]	0.4	0.03 [-0.04; 0.10]	0.4	0.03 [-0.05; 0.11]	0.5

467 ^a High parental emotional feeding is defined by a score equal to or above the median.

468 ^b Linear regression models adjusted for study center, maternal age at delivery, primiparity, maternal education level, household income, maternal
 469 smoking status during pregnancy, parental BMI, child sex, preterm birth, any breastfeeding duration, 4-to-24-month appetite and 2-year BMI z-
 470 score.

471 One model was performed for each parental feeding practice and at each age.

472 **Table 3. Associations between parental use of food as a reward and child BMI z-scores, by child sex**

Exposure: high use of food as a reward ^a	4-year BMI z-score		6-year BMI z-score		8-year BMI z-score	
	β [95% CI]	p	β [95% CI]	p	β [95% CI]	p
Boys						
Unadjusted analyses (N=1245)	0.01 [-0.14; 0.16]	0.9	0.06 [-0.07; 0.20]	0.4	0.08 [-0.06; 0.22]	0.2
Adjusted analyses (N=1245) ^b	0.09 [0.02; 0.17]	0.01	0.14 [0.03; 0.25]	0.01	0.15 [0.03; 0.27]	0.01
Adjusted analyses, after imputation (N=1401) ^b	0.08 [0.01; 0.15]	0.03	0.12 [0.02; 0.22]	0.02	0.14 [0.02; 0.26]	0.02
Girls						
Unadjusted analyses (N=1245)	0.09 [-0.05; 0.23]	0.2	0.09 [-0.04; 0.23]	0.2	0.10 [-0.04; 0.24]	0.2
Adjusted analyses (N=1245) ^b	-0.04 [-0.11; 0.04]	0.3	-0.03 [-0.13; 0.08]	0.6	0.00 [-0.13; 0.12]	0.9
Adjusted analyses, after imputation (N=1401) ^b	-0.02 [-0.09; 0.05]	0.6	0.00 [-0.10; 0.10]	1	0.02 [-0.10; 0.14]	0.8

473 ^a High parental use of food as a reward is defined by a score equal to or above the median.

474 ^b Linear regression models adjusted for study center, maternal age at delivery, primiparity, maternal education level, household income, maternal
 475 smoking status during pregnancy, parental BMI, preterm birth, any breastfeeding duration, 4-to-24-month appetite and 2-year BMI z-score.

476 One model was performed for each parental feeding practice and at each age.

477 **Table 4. Mediation analyses of parental restriction for weight in the associations between 2-year BMI and later BMI**

	4-year BMI z-score		6-year BMI z-score		8-year BMI z-score	
	β [95% CI]	p	β [95% CI]	p	β [95% CI]	p
Exposure: 2-year BMI z-score, complete-case analyses (N=1245)						
Total effect	0.86 [0.83; 0.89]	<0.0001	0.59 [0.55; 0.64]	<0.0001	0.44 [0.39; 0.49]	<0.0001
Natural direct effect	0.85 [0.82; 0.88]	<0.0001	0.58 [0.54; 0.63]	<0.0001	0.42 [0.37; 0.48]	<0.0001
Natural indirect effect	0.01 [0.00; 0.01]	0.04	0.01 [0.00; 0.02]	0.03	0.01 [0.00; 0.02]	0.03
Percentage mediated by restriction for weight	0.78 [0.03; 1.52]	0.04	1.69 [0.17; 3.21]	0.03	2.69 [0.27; 5.11]	0.03
Exposure: 2-year BMI z-score, imputed analyses (N=1401)						
Total effect	0.86 [0.83; 0.89]	<0.0001	0.59 [0.55; 0.63]	<0.0001	0.43 [0.38; 0.48]	<0.0001
Natural direct effect	0.85 [0.82; 0.88]	<0.0001	0.58 [0.54; 0.62]	<0.0001	0.42 [0.37; 0.47]	<0.0001
Natural indirect effect	0.01 [0.00; 0.01]	0.02	0.01 [0.00; 0.02]	0.01	0.01 [0.00; 0.02]	0.01
Percentage mediated by restriction for weight	0.88 [0.14; 1.61]	0.02	1.96 [0.43; 3.50]	0.01	3.14 [0.68; 5.59]	0.01

478 Mediation analyses adjusted for study centre, maternal age at delivery, primiparity, maternal education level, household income, maternal

479 smoking status during pregnancy, parental BMI, child sex, preterm birth, any breastfeeding duration and 4-to-24-month appetite.

480 One mediation analysis was performed at each age.

SUPPLEMENTAL MATERIAL

Table S1. Mediation analyses of parental use of food as a reward in the associations between 2-year BMI and later BMI, among boys only

	4-year BMI z-score		6-year BMI z-score		8-year BMI z-score	
	β [95% CI]	p	β [95% CI]	p	β [95% CI]	p
Exposure: 2-year BMI z-score, complete-case analyses (N=647)						
Total effect	0.88 [0.84; 0.93]	<0.0001	0.61 [0.55; 0.67]	<0.0001	0.43 [0.37; 0.50]	<0.0001
Natural direct effect	0.88 [0.84; 0.93]	<0.0001	0.61 [0.55; 0.67]	<0.0001	0.44 [0.37; 0.50]	<0.0001
Natural indirect effect	0.00 [-0.01; 0.00]	0.7	0.00 [-0.01; 0.01]	0.7	0.00 [-0.01; 0.01]	0.7
Percentage mediated by use of food as a reward	-0.11 [-0.62; 0.40]	0.7	-0.23 [-1.32; 0.85]	0.7	-0.36 [-2.02; 1.31]	0.7
Exposure: 2-year BMI z-score, imputed analyses (N=729)						
Total effect	0.88 [0.84; 0.92]	<0.0001	0.60 [0.54; 0.66]	<0.0001	0.43 [0.36; 0.50]	<0.0001
Natural direct effect	0.88 [0.84; 0.92]	<0.0001	0.61 [0.55; 0.66]	<0.0001	0.43 [0.36; 0.50]	<0.0001
Natural indirect effect	0.00 [-0.01; 0.00]	0.5	0.00 [-0.01; 0.00]	0.5	0.00 [-0.01; 0.00]	0.5
Percentage mediated by use of food as a reward	-0.14 [-0.56; 0.28]	0.5	-0.32 [-1.26; 0.61]	0.5	-0.53 [-2.06; 1.01]	0.5

Mediation analyses adjusted for study centre, maternal age at delivery, primiparity, maternal education level, household income, maternal smoking status during pregnancy, parental BMI, preterm birth, any breastfeeding duration and 4-to-24-month appetite.

One mediation analysis was performed at each age.

Parental feeding practices as potential moderating or mediating factors in the associations between children’s early and later growth. Guivarch C., Cissé A.H., Charles MA., Heude B., de Lauzon-Guillain B. Supplemental Material.

Table S2. STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-8
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5-8
		<i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls	
		<i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed	NA
		<i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-9
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	7-8 Figure 1
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8-9
		(b) Describe any methods used to examine subgroups and interactions	8-9
		(c) Explain how missing data were addressed	9

Parental feeding practices as potential moderating or mediating factors in the associations between children’s early and later growth. Guivarch C., Cissé A.H., Charles MA., Heude B., de Lauzon-Guillain B. Supplemental Material.

		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed	
		<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed	
		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	8-9
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Figure 1
		(b) Give reasons for non-participation at each stage	7-8 Figure 1
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9-10 Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Table 1
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	Table 1
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-11 Tables 2, 3, 4
		(b) Report category boundaries when continuous variables were categorized	6-7
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-11 Suppl. table 1
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11-14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other	11-14

Parental feeding practices as potential moderating or mediating factors in the associations between children's early and later growth. Guivarch C., Cissé A.H., Charles MA., Heude B., de Lauzon-Guillain B. Supplemental Material.

		relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	13-14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	1-2

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.