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## Title

### Changes in parental feeding practices and preschoolers' food habits following a randomized controlled childhood obesity trial

Maria Somaraki <sup>a\*</sup>, Karin Eli <sup>b,c</sup>, Kimmo Sorjonen <sup>d</sup>, Anna Ek <sup>e</sup>, Pernilla Sandvik <sup>a</sup>, Paulina Nowicka <sup>a,e</sup>

## Affiliations

<sup>a</sup> Department of Food Studies, Nutrition and Dietetics, Uppsala University, Uppsala, Sweden; [maria.somaraki@ikv.uu.se](mailto:maria.somaraki@ikv.uu.se); [pernilla.sandvik@ikv.uu.se](mailto:pernilla.sandvik@ikv.uu.se); [paulina.nowicka@ikv.uu.se](mailto:paulina.nowicka@ikv.uu.se).

<sup>b</sup> Unit for Biocultural Variation and Obesity, School of Anthropology and Museum Ethnography, University of Oxford, Oxford, UK; [karin.eli@anthro.ox.ac.uk](mailto:karin.eli@anthro.ox.ac.uk).

<sup>c</sup> Social Science and Systems in Health, Division of Health Sciences, Warwick Medical School, University of Warwick, Warwick, England; [karin.eli@warwick.ac.uk](mailto:karin.eli@warwick.ac.uk).

<sup>d</sup> Division of Psychology, Department of Clinical Neuroscience, Karolinska Institutet, Solna, Sweden; [kimmo.sorjonen@ki.se](mailto:kimmo.sorjonen@ki.se).

<sup>e</sup> Division of Pediatrics, Department of Clinical Science, Intervention and Technology (CLINTEC), Karolinska Institutet, Stockholm, Sweden; [anna.ek@ki.se](mailto:anna.ek@ki.se); [paulina.nowicka@ki.se](mailto:paulina.nowicka@ki.se).

**\*Address correspondence to:** Maria Somaraki, Uppsala University, Department of Food Studies, Nutrition and Dietetics, Box 560, 751 22, Uppsala, Sweden; [maria.somaraki@ikv.uu.se](mailto:maria.somaraki@ikv.uu.se).

## **Abstract**

Childhood obesity treatment involving parents is most effective during the preschool age. However, the mechanisms of change are not known. The present study reports on secondary outcomes (changes in parental feeding practices and child food habits) of early obesity treatment. The More and Less study is a randomized controlled trial conducted in Stockholm County, Sweden. Children with obesity (n=174, mean BMI SDS 3.0, mean age 5 years, 56% girls) and their parents (60% with foreign background, 40% with a university degree) were randomized to: 1) standard treatment focusing on lifestyle recommendations (ST), 2) a parent support program with boosters (PGB), and 3) a parent support program without boosters (PGNB). The Child Feeding Questionnaire (CFQ) was used to measure parental feeding practices. Child food habits were assessed with a Food Frequency Questionnaire (FFQ). We calculated the monthly changes in CFQ practices and FFQ items based on four measurements. We did not find any significant between-group differences in parental feeding practices and child food habits over time. However, general linear models showed that changes in certain feeding practices predicted changes in child food habits. When ST was compared to the parent support groups, some associations moved in opposite directions. For example, increasing maternal restriction predicted increased consumption of cookies/buns in PGNB ( $b=2.3$ ,  $p<0.05$ ) and decreased consumption of cookies/buns in ST ( $b=-2.1$ ,  $p<0.05$ ). This is the first study to examine the effect of parental feeding practices on child food habits and weight status after obesity treatment among preschoolers. We found no evidence that changes in feeding practices or changes in child food habits mediated child weight loss. Future studies should consider other intermediary processes related to general parenting practices and parent-child interactions.

**Keywords:** Parental feeding practices, Child feeding questionnaire, Randomized controlled trial, Child eating, Family-based treatment

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3 **1 Manuscript**  
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5 **2 1. Introduction**  
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8 3 Successful interventions for early childhood obesity treatment typically involve parents and  
9  
10 4 integrate support in parenting skills with information on a healthy lifestyle (Golan, Kaufman,  
11  
12 5 & Shahar, 2006; Loveman, et al., 2015). These interventions seek to enhance the family  
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14 6 environment and thereby support changes in child behaviors indirectly (parent-child  
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16 7 interactions) and directly (child food intake and eating routines), with the aim of promoting  
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18 8 changes in child weight status. Few studies, however, have examined parental and child  
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20 9 behaviors as outcomes (Colquitt, et al., 2016; Duncanson, Shrewsbury, Collins, & Consortium,  
21  
22 10 2017; Loveman, et al., 2015). In addition, fathers have rarely been included in these studies  
23  
24 11 (Morgan, et al., 2017), despite the increasing involvement of fathers in cooking and feeding  
25  
26 12 (Neuman, Eli, & Nowicka, 2019). Thus, better insight into how family subsystems affect  
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28 13 behaviors that drive changes in child weight status may inform more effective and tailored  
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30 14 obesity interventions.  
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33  
34 15 In the present paper, we analyze secondary outcomes of the More and Less study (ML study),  
35  
36 16 a randomized controlled trial (RCT) assessing obesity interventions for preschool-age children  
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38 17 (Ek, et al., 2015). In the trial, the effect of three treatment conditions was evaluated: standard  
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40 18 treatment (ST), a parent support program with booster sessions (PGB), and a parent support  
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42 19 program without booster sessions (PGNB). The RCT's primary outcome results showed that  
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44 20 PGB was more effective in reducing child weight status over 12 months, compared to the other  
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46 21 conditions (Ek, et al., 2019). To understand what factors influenced the results, the present  
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48 22 paper evaluates changes in parental feeding practices and child food intake across the treatment  
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50 23 groups over 12 months. The parent support program focuses on parenting practices to change  
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52 24 child behaviors, therefore associations between changes in parental feeding practices and  
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62 25 changes in child food intake are also examined through separate analyses for mother-child and  
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64 26 father-child dyads.  
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### 67 *1.1 Parental feeding practices and the Child Feeding Questionnaire* 68

69  
70 28 Parental feeding practices are the specific strategies parents use during mealtime interactions  
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72 29 (Blissett, 2011; Ventura & Birch, 2008), and have consistently been associated with child  
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74 30 weight and eating behaviors (Birch, Fisher, & Davison, 2003; E. Jansen, Williams, Mallan,  
75  
76 31 Nicholson, & Daniels, 2018; Rollins, Savage, Fisher, & Birch, 2016). Parental feeding practices  
77  
78 32 are embedded in broader parenting styles that have also been associated with child weight status  
79  
80 33 (Collins, Duncanson, & Burrows, 2014; Hubbs-Tait, Kennedy, Page, Topham, & Harrist, 2008;  
81  
82 34 Niermann, Gerards, & Kremers, 2018; Sleddens, et al., 2014). The development of the Child  
83  
84 35 Feeding Questionnaire (CFQ) (Birch, et al., 2001) has facilitated a systematic examination of  
85  
86 36 controlling parental feeding practices among large samples from diverse contexts (Birch, et al.,  
87  
88 37 2003; Blissett & Bennett, 2013; Derks, et al., 2017; B. Y. Rollins, E. Loken, J. S. Savage, & L.  
89  
90 38 L. Birch, 2014; Wehrly, Bonilla, Perez, & Liew, 2014). In the CFQ, controlling parental feeding  
91  
92 39 practices are divided into three categories: restriction, pressure to eat and monitoring (Birch, et  
93  
94 40 al., 2001; Nowicka, Sorjonen, Pietrobelli, Flodmark, & Faith, 2014). Restriction and pressure  
95  
96 41 to eat represent two coercive forms of parental control during feeding interactions (Vaughn, et  
97  
98 42 al., 2016) which may override a child's innate signals of hunger and/or satiety (DiSantis,  
99  
100 43 Hodges, Johnson, & Fisher, 2011; Rollins, et al., 2016). On the other hand, monitoring is  
101  
102 44 conceptualized as a more favorable form of control whereby parents are aware of child food  
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104 45 intake (Birch, et al., 2001; Gubbels, et al., 2011; Vaughn, et al., 2016).  
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109 46 In most studies, restriction and pressure to eat have been associated with higher and lower child  
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111 47 weight status, respectively; for monitoring, however, the findings have been less consistent  
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113 48 (Shloim, Edelson, Martin, & Hetherington, 2015; Ventura & Birch, 2008). In addition, parental  
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115 49 feeding practices have been associated with child behaviors pertaining to food intake. Parental  
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120  
121 50 restriction of palatable and energy-dense foods relates to increased liking for and intake of these  
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123 51 foods (Brandi Y. Rollins, Eric Loken, Jennifer S. Savage, & Leann L. Birch, 2014), while  
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125 52 pressuring a child to eat particular foods relates to decreased liking for and intake of these foods,  
126  
127  
128 53 typically fruits and vegetables which are not readily accepted at younger ages (Galloway,  
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130 54 Fiorito, Lee, & Birch, 2005; Galloway, Fiorito, Francis, & Birch, 2006). The majority of  
131  
132 55 studies, however, have been cross-sectional and the direction of the relationships is not clear,  
133  
134 56 although bi-directional relationships seem to be most plausible (Derks, et al., 2017; E. Jansen,  
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136 57 et al., 2018; P. W. Jansen, et al., 2017).

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139 58 Parental feeding practices should also be considered in light of child appetitive traits. From an  
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141 59 early age, children with obesity have higher responsiveness to external food cues and lower  
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143 60 responsiveness to their internal satiety cues. Therefore, they present distinctive behavioral  
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145 61 profiles, which relate to increased food intake (Carnell & Wardle, 2008). Further, parents seem  
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147 62 more likely to adjust their feeding practices in response to child behaviors rather than to child  
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149 63 weight (e.g. pressure a child to eat if the child engages in picky eating behaviors, regardless of  
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151 64 weight) (Ek, et al., 2016; E. Jansen, et al., 2018), which may exacerbate obesity-related child  
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153 65 behaviors (Rodgers, et al., 2013). Thus, treatment efforts would benefit from addressing and  
154  
155 66 evaluating the role of parental feeding practices in samples of young children with obesity. In  
156  
157 67 these evaluations, separate analyses for mothers' and fathers' feeding practices are needed since  
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159 68 previous research suggests that fathers employ more coercive practices than mothers do (Pratt,  
160  
161 69 Hoffmann, Taylor, & Musher-Eizenman, 2017).

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165 70 Feeding practices also relate to structural, socio-cultural, socioeconomic and other contextual  
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167 71 factors (Blissett & Bennett, 2013; Cardel, et al., 2012; Nowicka, Sorjonen, et al., 2014; C. G.  
168  
169 72 Russell, et al., 2018). In our previous research, mothers born in a country other than Sweden  
170  
171 73 reported higher levels of controlling feeding practices (Nowicka, Sorjonen, et al., 2014;  
172  
173 74 Somaraki, et al., 2016). The present study includes a diverse sample in terms of parental foreign  
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180 75 background, to overcome research limitations posed by studying homogeneous samples  
181  
182 76 (Catherine Georgina Russell, et al., 2016).

### 185 77 ***1.2 Changes in parental feeding practices after obesity treatment***

188 78 A few studies reporting on childhood obesity interventions have assessed parental feeding  
189  
190 79 practices and found them to be modifiable (Burrows, Warren, & Collins, 2010; Epstein, Paluch,  
191  
192 80 Beecher, & Roemmich, 2008; Holland, et al., 2014; Mazzeo, et al., 2014; Stark, et al., 2014;  
193  
194 81 Steele, Jensen, Gayes, & Leibold, 2014). In particular, family-based treatment demonstrated  
195  
196 82 that modifications in parental feeding practices influence child dietary intake, which in turn  
197  
198 83 affects weight outcomes (Holland, et al., 2014). Previous research, however, has only included  
199  
200 84 families with older children; the one exception was a smaller study with children aged 2-5 years  
201  
202 85 old, which showed no changes in parental feeding practices after treatment (Stark, et al., 2014).

### 205 86 ***1.3 Child food intake in obesity treatment research***

208 87 In childhood obesity treatment, the child, the parents, and often all nuclear family members are  
209  
210 88 advised to decrease intake of energy dense foods and opt for healthier options (Altman &  
211  
212 89 Wilfley, 2015). Such changes in eating patterns are associated with reduced child weight status,  
213  
214 90 suggesting that parents play an important role in shaping healthy eating patterns and weight  
215  
216 91 trajectories (Best, et al., 2016; Hayes, et al., 2016; Robson, et al., 2019). Parent-focused  
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218 92 interventions specifically seek to enhance evidence-based parenting practices in order to shift  
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220 93 feeding dynamics towards healthier food intake. However, child food intake has not been  
221  
222 94 consistently assessed and reported in interventions for younger children (Duncanson, et al.,  
223  
224 95 2017).

### 228 96 ***1.4 Aim and hypotheses***

231 97 The present study reports on secondary outcomes of an RCT that evaluated a childhood obesity  
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233 98 intervention for families of preschoolers over a 12-month follow-up. Specifically, the study

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99 aims to investigate the role of parental feeding practices in child weight status and food intake  
100 according to the conceptual model proposed in Fig. 1.

101 The objectives of this study are:

- 102 1. To investigate changes in parental feeding practices and child food intake after early  
103 obesity treatment;
- 104 2. To examine the association between changes in parental feeding practices and changes  
105 in child food intake after early obesity treatment;
- 106 3. To examine the moderating effect of parental feeding practices at baseline on changes  
107 in child body mass index standard deviation scores (BMI SDS) after early obesity  
108 treatment.

109 Our hypotheses are informed by the results of the ML study (Ek, et al., 2015; Ek, et al., 2019).  
110 In ML, children whose parents participated in the PGB significantly decreased their BMI SDS  
111 after 12 months by 0.54 (95% CI -0.77 to -0.30) compared to children in the PGNB and in the  
112 ST groups (Ek, et al., 2019).

113 We hypothesize that parents enrolled in the PGB will experience a greater decrease in  
114 restriction and pressure to eat, along with a greater increase in monitoring, compared to  
115 parents enrolled in the other treatment conditions. Accordingly, we hypothesize that children  
116 in the PGB will consume obesogenic foods less often over time and increase their  
117 consumption frequency for healthier food options. In addition, we expect that changes in  
118 parental feeding practices will be associated with changes in child food intake over the  
119 follow-up period, in the PGB compared to the other groups. Moreover, we hypothesize that  
120 baseline levels of parental feeding practices will moderate treatment effects on child weight  
121 status over the 12-month follow-up, whereby receiving parenting training will most benefit



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122 parents with higher baseline levels of restriction/pressure to eat and lower levels of  
123 monitoring. Regarding separate analyses for mother-child and father-child dyads, we expect  
124 that they will yield similar results according to the hypotheses stated above. In addition, we  
125 expect that changes in both mothers' and fathers' feeding practices will be associated with  
126 changes in child food intake.

127 PLEASE INSERT FIGURE 1 HERE

128 **Figure 1.** A conceptual illustration of the expected interrelations between parental feeding  
129 practices, child food intake and child weight status after early obesity treatment focusing on  
130 parenting. Panel A (above). The hypothesized moderation effect of baseline feeding practices  
131 on child weight status (primary treatment outcome). Panel B (below). The hypothesized  
132 intermediary role of parental feeding practices and child food intake in treatment  
133 effectiveness. Dashed arrows leading to the primary outcome of the RCT are not examined in  
134 the present paper.

136 **2. Methods**

137 **2.1 Study design**

138 The ML is a parallel open label RCT (NCT01792531) designed to evaluate the effects of two  
139 approaches (a parent support program with and without booster sessions and standard  
140 treatment) to treat obesity in preschoolers. A description of the study procedure and treatment  
141 groups has been published elsewhere (Ek, et al., 2015; Ek, et al., 2019), and a brief summary is  
142 provided below. The ML study was approved by the ethics committee in Stockholm, Sweden  
143 on November 16th 2011 (dnr: 2011/1329-31/4). All participating caregivers provided written  
144 informed consent.

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357 145 **2.2 Participant recruitment**  
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360 146 Families were eligible to participate based on the following criteria:  
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363 147 The child:

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365 148 1) was 4 to 6 years old at baseline;  
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368 149 2) was classified as having obesity according to international age- and sex-specific criteria  
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371 150 (Cole, Bellizzi, Flegal, & Dietz, 2000; Cole & Lobstein, 2012);  
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373  
374 151 3) did not have any known chronic or developmental conditions that could influence his/her  
375  
376 152 weight and height development;  
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378  
379 153 4) was not already in treatment for obesity.  
380

381 154 Additionally, parents' knowledge of Swedish needed to be sufficient to answer questionnaires  
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383 155 and participate in treatment.  
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385  
386 156 Families were mainly recruited from 68 child health care centers (primary care). In addition,  
387  
388 157 outpatient pediatric clinics (secondary care) and school health care offices in Stockholm  
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390 158 County, Sweden, contributed to recruitment.  
391

392  
393 159 After baseline measures, families were assigned (1:1:2) to one of three treatment groups (PGB,  
394  
395 160 PGNB, ST) using an electronic randomization program with permuted blocks. In the parent  
396  
397 161 support program, families and research group members remained blinded to group allocation  
398  
399 162 into booster and non-booster sessions until the ending of the parent group sessions. The study  
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401 163 statistician maintained the randomization sequence. Data were collected between May 2012  
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403 164 and October 2017.  
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406 165 **2.3 Sample size**  
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416 166 Power calculations were based on the primary outcome, child BMI SDS (Kleber, et al., 2009),  
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418 167 adjusting for a dropout rate of 21% (Ek, et al., 2015; West, Sanders, Cleghorn, & Davies, 2010).  
419  
420 168 Seventy-five children were estimated to be needed in each of the treatment approaches (parent  
421  
422 169 support program and standard treatment) in order to identify a difference in BMI SDS between  
423  
424  
425 170 the groups at 12 months post-baseline.

#### 426 427 171 ***2.4 Standard treatment***

428  
429  
430 172 The ST group received the usual care offered in outpatient pediatric clinics, based on the action  
431  
432 173 plan for childhood obesity in Stockholm County (SLL, 2016). Individual families were offered  
433  
434 174 5.5 visits on average over one year (Ek, et al., 2019). The treatment sessions focused on lifestyle  
435  
436 175 modifications with respect to eating and activity habits. During the first visit families met with  
437  
438 176 a pediatrician. In follow-up visits, families usually met with a pediatric nurse. If required, some  
439  
440 177 families were also referred to a dietician, psychologist, physiotherapist or occupational  
441  
442 178 therapist.

#### 443 444 445 179 ***2.5 Parent support program (with and without booster sessions)***

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447  
448 180 The ML parent support program includes 10 group sessions (1.5 hours/week); each session  
449  
450 181 integrates a parenting component along with a lifestyle component (Ek, et al., 2015). The  
451  
452 182 treatment focuses on strengthening skills that help parents support and sustain a healthy lifestyle  
453  
454 183 and respond to child behaviors in an effective way. The lifestyle content addresses healthy food  
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456 184 choices that each family can incorporate into daily practice. Through the program's focus on  
457  
458 185 parenting skills, parents are prompted to implement responsive feeding – characterized by low  
459  
460 186 levels of coercive control and high levels of structure – which has been associated with positive  
461  
462 187 weight outcomes (Rollins, et al., 2016). Either alone or with their partners, mothers were more  
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464 188 likely to attend the group sessions than fathers were (58% vs. 42%). All attendees were  
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475 189 encouraged to share relevant information with their co-parent or co-caregiver. A participant  
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477 190 manual facilitated this process.  
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480 191 Following the parent support program, families randomized to booster sessions received  
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482 192 individual support through 30-minute phone calls from the research team every 4 to 6 weeks  
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484 193 for up to 12 months post-baseline. The booster sessions revolved around encouraging parents  
485  
486 194 to maintain healthy habits and empowering them to face additional challenges that might have  
487  
488 195 emerged. During these phone calls, booster session facilitators referenced the content of the  
489  
490 196 treatment program and the group sessions.  
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## 493 197 ***2.6 Measurements***

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496 198 All measures were administered at baseline, 3, 6 and 12 months post-baseline. Both mothers  
497  
498 199 and fathers reported on their feeding practices, while one parent (mother or father) reported on  
499  
500 200 child food intake. Mothers and fathers were defined as caregivers who identified as the child's  
501  
502 201 biological parent and who reported, through a questionnaire, that they were female or male,  
503  
504 202 respectively. None of the children in the sample were adopted or in the sole care of caregivers  
505  
506 203 other than their biological parents.  
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### 511 512 205 ***2.6.1 Parental feeding practices***

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514  
515 206 We used the CFQ to examine key obesity-related feeding practices employed by parents  
516  
517 207 (mothers and fathers) (Birch, et al., 2001; Nowicka, Sorjonen, et al., 2014). The CFQ consists  
518  
519 208 of 3 subscales - restriction, pressure to eat and monitoring (Shloim, et al., 2015; Ventura &  
520  
521 209 Birch, 2008). Restriction (Cronbach's alpha for mothers 0.7, for fathers 0.8) consists of 6 items  
522  
523 210 (e.g. "I have to be sure that my child does not eat too many high-fat foods"), and pressure to eat  
524  
525 211 (Cronbach's alpha for mothers 0.5; for fathers 0.5) consists of 4 items (e.g. "My child should  
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527 212 always eat all of the food on her plate"), with responses ranging from 1 (disagree) to 5 (agree).  
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213 Monitoring (Cronbach’s alpha for mothers 0.8; for fathers 0.9) consists of 3 items (e.g. “How  
214 much do you keep track of the sweets (candy, ice-cream cake, pies, pastries) that your child  
215 eats?”) with responses ranging from 1 (never) to 5 (always). The “reward items” for restriction  
216 were excluded in the Swedish sample after a validation of the questionnaire (Nowicka,  
217 Sorjonen, et al., 2014). The total score for each feeding practice is the mean score of its  
218 component items. Higher mean scores indicate greater endorsement of the respective practice.

219 **2.6.2 Child food intake**

220 A Food Frequency Questionnaire (FFQ) assessed child food intake relevant to obesity treatment  
221 (Ek, et al., 2015). The FFQ was part of a more extensive questionnaire about background  
222 characteristics of the child (e.g. child’s birth date, siblings) along with current information about  
223 the child’s health (e.g. health conditions and lifestyle). At each time point, one parent reported  
224 on the child’s usual food intake. The FFQ assessed the consumption frequency of 10 food items  
225 (fresh fruits, vegetables, pizza/hamburger, fish, ice-cream, cookies/buns, soft drinks, juice,  
226 sweets & chocolate, chips & snacks), with the response categories ranging from once per month  
227 or less to four times per day or more (13 response options in total). Frequency equivalents were  
228 calculated for monthly consumption. The food items listed in the FFQ have been used in several  
229 international studies (Byrne, et al., 2019; Golley, et al., 2017). In the Swedish context, the items  
230 have been included in a national survey administered by the National Food Agency  
231 (Livsmedelsverket) to monitor population trends (Enghardt Barbieri, Pearson, & Becker, 2006).  
232 In addition, the items have been validated using food diaries in a nation-wide obesity prevention  
233 study in young children (Doring, et al., 2014).

234 **2.6.3 Child BMI SDS**

235 Child height and weight were measured by trained health care professionals. Height was  
236 measured to the nearest 0.1 cm using a fixed stadiometer and weight was measured to the

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593 237 nearest 0.1 kg in underwear. BMI was calculated based on weight and height. The primary  
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595 238 outcome of the RCT, BMI SDS, was computed based on age- and sex-specific reference data  
596  
597 239 (Cole & Lobstein, 2012).  
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## 600 240 **2.7 Statistical analysis**

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603 241 Background characteristics were compared across the three treatment groups (PGB, PGNB, ST)  
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605 242 at baseline using one-way ANOVA (for continuous variables) and chi-squared test (for  
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607 243 categorical variables). Moreover, baseline characteristics were compared across mothers and  
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609 244 fathers using paired samples t-test (for continuous variables) and McNemar's test (for  
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611 245 categorical variables). Mean change per month (for maternal/paternal feeding practices -  
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613 246 restriction, pressure to eat and monitoring, child food intake and child BMI SDS) was computed  
614  
615 247 for each individual child/parent (Pfister, Schwarz, Carson, & Jancyzk, 2013). In linear  
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617 248 regression models, all measurements of each variable (dependent variable) for the individual  
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619 249 child/parent were regressed on an independent time variable (0, 3, 6, and 12 months). The  
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621 250 extracted mean change per month in each variable was utilized to carry out standard  
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623 251 significance tests and statistical procedures. Mean changes were not calculated for individuals  
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625 252 who had missing data at two measurement points, and these individuals are not included in the  
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627 253 analyses. Moreover, individuals who had invariable measurements at all measurements points  
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629 254 were assigned the value zero and were included in the analytical sample.  
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633 255 One-way ANOVAs were used to compare the mean change of maternal and paternal feeding  
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635 256 practices across treatment groups (objective 1), and one-sample t-tests were used to compare  
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637 257 the mean change within each treatment group against zero change. Moreover, paired samples  
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639 258 t-tests were employed to compare the mean change between maternal and paternal feeding  
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641 259 practices. General linear models were used to explore the effect of change in parental feeding  
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643 260 practices (independent variable) on change in child food intake (dependent variable) (objective  
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645 261 2). The models included a 'treatment group x change in feeding practices' interaction term to  
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652 262 evaluate differences between groups. The analyses were separate for mother-child and father-  
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654 263 child dyads. When the interaction was found significant, we proceeded to explore the  
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656 264 associations of changes in parental feeding practices with changes in child eating patterns in  
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658 265 each treatment group separately. If no significant interaction was found, the associations were  
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661 266 explored using the total sample.

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663 267 Moreover, the moderating effect (objective 3) of baseline feeding practices on changes in child  
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665 268 BMI SDS was examined using general linear models. Change in BMI SDS was the dependent  
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668 269 variable and we added the interaction term ‘treatment group x baseline feeding practices’. The  
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670 270 analyses were separate for mother-child and father-child dyads.

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673 271 The significance levels for all analyses were set at 0.05. The software package IBM SPSS  
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675 272 Statistics 24 was used for all statistical analyses.

### 676 677 273 *2.7.1 Missing data*

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680 274 We used an intention-to-treat (ITT) approach, as far as missing data allowed, and listwise  
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682 275 deletion was applied. Thus, we analyzed the available data without imputing the unknown  
683  
684 276 values.

## 685 686 687 277 **3. Results**

688  
689 278 No significant differences in baseline characteristics were found across the treatment conditions  
690  
691 279 (Table 1). On average, children were 5.2 years old and had a BMI SDS of 3.0 at baseline. Their  
692  
693 280 mothers and fathers reported higher restriction (3.8 and 3.5) and monitoring (4.0 and 3.8)  
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695 281 compared to pressure to eat (2.1 and 2.3) at baseline, respectively. As compared to mothers,  
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697 282 fathers reported lower levels of restriction (3.5 vs. 3.8) and monitoring (3.8 vs. 4.0). However,  
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699 283 at baseline neither maternal nor paternal feeding practices differed across treatment groups.  
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701 284 Foreign background and education level did not differ between mothers and fathers.

702  
703  
704  
705 285 Table 1. Characteristics of the study sample at baseline

	N	Total sample	Parent program		Standard treatment
		N=174	With boosters n=44	Without boosters n=43	n=87
		no.(%) or mean (SD)	no.(%) or mean (SD)		no.(%) or mean (SD)
<b>Child</b>					
Girl	174	98 (56.3)	19 (43.2)	23 (53.5)	56 (64.4)
Living with both parents	143	113 (79)	25 (78.1)	31 (81.6)	57 (78.1)
First born	147	72 (49)	15 (41.7)	21 (51.2)	36 (51.4)
Age at baseline	174	5.2 (0.78)	5.2 (0.83)	5.2 (0.86)	5.3 (0.71)
BMI SDS at baseline	174	2.97 (0.61)	2.99 (0.55)	3.01 (0.69)	2.91 (0.59)
<b>Mother</b>					
Age	139	36.6 (5.5)	38 (5.1)	36 (5.4)	36 (5.7)
BMI	141	28.1 (5.7)	28.2 (6)	29.1 (6.5)	27.6 (5.1)
Foreign background	145	89 (61.4)	21 (63.6)	21 (56.8)	47 (62.7)
University degree	143	58 (40.6)	14 (42.4)	15 (41.7)	29 (39.2)
<b>Father</b>					
Age	124	39.8 (7.1)	43 (7.9)	39 (7.4)	39 (6.3)
BMI	126	29.4 (4.4)	29.1 (4.20)	30.02 (4.59)	29.34 (4.46)
Foreign background	130	75 (57.7)	17 (54.8)	21 (63.6)	37 (56.1)
University degree	128	49 (38.3)	11 (36.7)	12 (37.5)	26 (39.4)

### 3.1 Changes in parental feeding practices

Table 2 shows the mean changes in mothers' and fathers' feeding practices over time. We found no difference between or within treatment groups. Moreover, no significant differences were found between mothers and fathers in mean change in feeding practices in the total sample.

Table 2. Baseline parental feeding practices and mean monthly changes after a randomized controlled childhood obesity trial

CFQ Child Feeding Questionnaire	n	Parent group with boosters (PGB)		Parent group without booster (PGBN)		Standard treatment (ST)		p-value*
		Baseline <sup>‡</sup>	Mean monthly change <sup>‡</sup>	Baseline <sup>‡</sup>	Mean monthly change <sup>‡</sup>	Baseline <sup>‡</sup>	Mean monthly change <sup>‡</sup>	
<i>Maternal Feeding Practices<sup>a</sup></i>								
Restriction	123	3.8 (0.9)	0.02	3.8 (0.8)	0.01	3.8 (0.7)	0.01	0.69
Pressure to eat	121	2.2 (0.8)	-0.01	2.0 (0.9)	-0.03	2.0 (0.9)	-0.03	0.61
Monitoring	126	4.0 (0.6)	0.02	4.0 (0.8)	0.01	4.1 (0.9)	0.03	0.77
<i>Paternal Feeding Practices<sup>a</sup></i>								
Restriction	110	3.5 (0.8)	0.01	3.4 (0.8)	-0.003	3.5 (0.9)	0.01	0.80
Pressure to eat	113	2.2 (0.8)	0.01	2.4 (0.8)	0.01	2.3 (0.8)	-0.02	0.53
Monitoring	112	3.7 (0.6)	0.02	3.5 (1.0)	0.02	3.9 (0.8)	-0.002	0.14

<sup>‡</sup> Mean monthly changes were computed for each parent in the study based on measurements at all four time points (baseline, 3, 6 and 12 months)

\*p-values for comparisons of changes in feeding practices across treatment groups; one-way ANOVA

<sup>‡</sup> maternal/paternal feeding practices at baseline did not differ across treatment groups (p>0.05); one-way ANOVA

<sup>a</sup> no significant within-group mean monthly changes (p>0.05); one sample t-test with test value set to zero



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**3.2 Changes in child eating patterns**

Changes in reported intake of food items did not differ between the children in the different treatment conditions (Table 3). Some within-group changes, however, were found to be significant. The average monthly consumption of cookies/buns decreased over time among children in two treatment groups (PGBN: by 0.2,  $p < 0.05$ , and ST: by 0.2,  $p < 0.05$ ). Moreover, children in ST decreased their reported consumption of sweets and chocolate (by 0.2 per month,  $p < 0.05$ ).

Table 3. Baseline child food intake and monthly changes after a randomized controlled childhood obesity trial

FFQ Food Frequency Questionnaire (per month)	n	Parent group with boosters (PGB)		Parent group without booster (PGBN)		Standard treatment (ST)		p-value *
		Baseline <sup>‡</sup>	Mean monthly change <sup>‡</sup>	Baseline <sup>‡</sup>	Mean monthly change <sup>‡</sup>	Baseline <sup>‡</sup>	Mean monthly change <sup>‡</sup>	
Fruit	128	45 (34)	-0.5	57 (24)	-1.4	48 (28)	0.004	0.40
Vegetables	128	40 (29)	-0.2	49 (26)	-0.3	50 (30)	-0.3	0.97
Pizza & hamburgers	128	2.1 (1.6)	0.02	2.4 (1.6)	-0.05	2.1 (1.5)	-0.01	0.38
Fish	129	6.2 (4.3)	0.3	8.6 (9.8)	-0.3	7.7 (10)	-0.2	0.15
Ice-cream	129	5 (7)	-0.1	3.6 (2.3)	0.1	4.1 (3.9)	-0.1	0.20
Cookies/buns	128	4.2 (3.1)	-0.1	5.5 (3.5)	-0.2 <sup>a</sup>	5.1 (5.6)	-0.2 <sup>a</sup>	0.78
Soft drinks	127	5.8 (5.1)	-0.2	4.3 (3.5)	-0.03	6.7 (12.5)	-0.5	0.32
Juice	126	11.6 (22.3)	-0.3	8.4 (9.9)	-0.2	7.7 (10.7)	-0.2	0.93
Sweets & chocolate	128	4.5 (2.5)	-0.05	4.7 (1.8)	-0.01	5.3 (5.2)	-0.2 <sup>a</sup>	0.10
Snacks	128	3.5 (2.2)	-0.02	3.6 (3.1)	-0.1	3.4 (4)	-0.1	0.80

<sup>‡</sup> Mean monthly changes were computed for each parent in the study based on measurements at all four time points (baseline, 3, 6 and 12 months)

\*p-values for between-group comparisons of mean changes in child food intake; one-way ANOVA

<sup>‡</sup> child food intake at baseline did not differ across treatment groups ( $p > 0.05$ ); one-way ANOVA

<sup>a</sup> significant within-group mean monthly changes ( $p < 0.05$ ); one sample t-test with test value set to zero

307 **3.3 Associations between changes in parental feeding practices and changes in child eating**  
 308 **patterns over 12 months of follow-up**

309 For the total sample, increased monthly consumption of cookies/buns was associated with  
 310 increasing maternal pressure to eat ( $b=1.1, p<0.05$ ) and decreased monthly consumption of  
 311 sweets and chocolate was associated with increasing maternal monitoring ( $b=-1.4, p<0.05$ ). The  
 312 associations between changes in parental feeding practices and changes in the monthly  
 313 consumption of certain foods diverged between treatment groups (Table 4). In ST, mothers’  
 314 and fathers’ increased restriction was associated with a decrease in child intake of pizza and  
 315 hamburgers per month ( $b=-1.4, p<0.001$  and  $b=-1.1, p<0.001$ , respectively); the same pattern  
 316 was shown for mothers’ increased monitoring ( $b=-1.1, p<0.001$ ). By contrast, increased levels  
 317 of mothers’ restriction in PGNB were associated with increased monthly intake of pizza and  
 318 hamburgers ( $b=0.7, p<0.05$ ), and cookies/buns ( $b=2.3, p<0.05$ ). Increased levels of restriction  
 319 among both mothers and fathers in ST were associated with a decrease in the child’s monthly  
 320 intake of ice-cream ( $b=-3.6, p<0.001$  and  $b=-3.3, p<0.001$ , respectively).  
 321 Moreover, increasing maternal pressure to eat was associated with increased ice-cream  
 322 consumption in PGB ( $b=1.3, p<0.05$ ) and decreased ice-cream consumption in PGNB ( $b=-3.1,$   
 323  $p<0.001$ ). Interestingly, increased maternal restriction and pressure to eat were associated with  
 324 increased monthly consumption of fruits and vegetables in PGNB only.

325 Table 4. Associations between mean changes in parental feeding practices with mean changes  
 326 in child food intake

	MOTHERS			FATHERS		
	Restriction ‡	Pressure to eat ‡	Monitoring‡	Restriction ‡	Pressure to eat ‡	Monitoring ‡
<b>Fruits ‡</b>	× PGNB: $b=20.4^*$	× PGNB: $b=25.1^*$	ns	ns	ns	ns
<b>Vegetables ‡</b>	ns	× PGNB: $b=12.1^*$	ns	ns	ns	ns
<b>Pizza &amp; hamburgers ‡</b>	× PGNB: $b=0.7^*$ ST: $b=-1.4^*$	$b=0.5^*$	× ST: $b=-1.1^*$	× PGNB: $b=0.6^*$ ST: $b=-1.1^*$	× PGNB: $b=-0.4^*$	ns
<b>Fish ‡</b>	ns	ns	ns	n.s	ns	× PGNB: $b=6.7^*$
<b>Icecream ‡</b>	× ST: $b=-3.6^*$	× PGB: $b=1.3^*$ PGNB: $b=-3.1^*$	× ST: $b=-1.8^*$	× ST: $b=-3.3^*$	ns	ns

<b>Cookies/buns ‡</b>	× PGNB: b=2.3* ST: b=-2.1*	b=1.1*	ns	ns	ns	ns
<b>Sweet drink ‡</b>	ns	ns	ns	ns	ns	ns
<b>Juice ‡</b>	ns	ns	ns	ns	ns	ns
<b>Sweets &amp; chocolate ‡</b>	ns	ns	b=-1.4*	ns	ns	ns
<b>Snacks ‡</b>	ns	× PGNB: b=2.1*	ns	ns	ns	ns

PGB: Parent group with boosters; PGNB: Parent group without boosters; ST: Standard treatment

‡ Mean monthly changes were computed based on all four measurements (baseline, 3, 6 and 12 months) for each family in the study

× Food items for which divergent associations were found between treatment groups (significant interaction between treatment group and changes in feeding practices); otherwise associations were examined in the total sample

\*p<0.05; ns: not statistically significant, null association

Mean monthly change for individuals with the same measurements over time were assigned the value zero.

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### 328 3.4 Moderating effects of parental feeding practices on changes in child BMI SDS

329 Changes in parental feeding practices did not differ across treatment groups. Further, parental  
 330 feeding practices at baseline did not moderate the treatment effect on changes in child BMI  
 331 SDS between treatment groups (Table 5).

332 Table 5. Effects of baseline levels of parental feeding practices on changes in child BMI SDS

	Parental feeding practices at baseline	MOTHERS			FATHERS		
		n	Child BMI SDS mean monthly change ‡	p-value	n	Child BMI SDS mean monthly change ‡	p-value
PGB	Restriction	25	0.013	0.11 <sup>a</sup>	23	0.006	0.50 <sup>a</sup>
	Pressure to eat	24	0.004	0.64 <sup>a</sup>	25	0.009	0.28 <sup>a</sup>
	Monitoring	25	0.020	0.07 <sup>a</sup>	25	0.007	0.53 <sup>a</sup>
PGNB	Restriction	31	-0.002 (0.013-0.015) <sup>*</sup>	0.17 <sup>b</sup>	27	-0.007 (0.006-0.013) <sup>*</sup>	0.29 <sup>b</sup>
	Pressure to eat	31	0.01 (0.004+0.006) <sup>*</sup>	0.60 <sup>b</sup>	28	0.003 (0.009-0.006) <sup>*</sup>	0.62 <sup>b</sup>
	Monitoring	32	0.001 (0.020-0.019) <sup>*</sup>	0.17 <sup>b</sup>	28	-0.002 (0.007-0.009) <sup>*</sup>	0.50 <sup>b</sup>
ST	Restriction	57	-0.01 (0.013-0.022) <sup>*</sup>	0.03 <sup>b</sup>	54	0.001 (0.006-0.005) <sup>*</sup>	0.62 <sup>b</sup>
	Pressure to eat	56	-0.01 (0.004-0.014) <sup>*</sup>	0.18 <sup>b</sup>	54	-0.001 (0.009-0.010) <sup>*</sup>	0.33 <sup>b</sup>
	Monitoring	59	0.003 (0.020-0.017) <sup>*</sup>	0.16 <sup>b</sup>	53	0.005 (0.007-0.003) <sup>*</sup>	0.84 <sup>b</sup>

‡ Mean monthly changes were computed for each parent in the study based on measurements at all four time points (baseline, 3, 6 and 12 months)

PGB: Parent group with boosters; PGNB: Parent group without boosters; ST: Standard

Reference group: Parent group with boosters (PGB)

<sup>a</sup>significance level for the coefficient in the reference group

<sup>\*</sup> the coefficient in the parent group with boosters and standard treatment as the output of the function in parenthesis

<sup>b</sup>significance level for the difference in coefficients compared to the reference group

Treatment group interactions with mothers' feeding practices at baseline: 1) restriction ( $p=0.08$ ), 2) pressure to eat ( $p=0.07$ ), 3) monitoring ( $p=0.32$ )

Treatment group interactions with fathers' feeding practices at baseline: 1) restriction ( $p=0.57$ ), 2) pressure to eat ( $p=0.61$ ), 3) monitoring ( $p=0.70$ )

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948 335 **4. Discussion**  
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951 336 This is among the few studies to examine changes in parental feeding practices and changes in  
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953 337 child food intake in the context of obesity treatment for preschoolers. We analyzed secondary  
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955 338 outcomes from the ML study, in which a parent support program with boosters (PGB) was  
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957 339 shown to be more effective than the program without boosters (PGNB) as well as standard  
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959 340 treatment (ST) in decreasing child weight status. Contrary to our hypotheses, we found that  
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961 341 PGB was no more effective in changing parental feeding practices or child food intake than  
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963 342 PGNB or ST. Associations between changes in parental feeding practices and changes in child  
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965 343 food intake were identified mainly in PGNB and ST. Moreover, we did not find that different  
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967 344 levels of parental feeding practices at baseline moderated treatment effectiveness.

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971 345 We conducted this study to understand whether the greater decrease in child weight status in  
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973 346 the PGB group (Ek, et al., 2019) could be explained by changes in parental feeding practices.  
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975 347 To our disappointment, our hypothesis was not confirmed. Previous studies like ours have  
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977 348 provided mixed evidence (Okely, et al., 2010; Stark, et al., 2014). A pilot US study comparing  
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979 349 family-based behavioral obesity treatment with home visits and pediatrician counseling found  
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981 350 greater decrease in child weight after family-based behavioral treatment, although changes in  
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983 351 parental feeding practices did not differ between the groups (Stark, et al., 2014). However, in  
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985 352 the Australian study HICKUPS, participants in a parent group intervention arm with a focus on  
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987 353 diet decreased their restriction more than parents whose intervention did not include the diet  
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989 354 component; the former group was also more successful in decreasing child weight status  
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991 355 (Burrows, et al., 2010; Okely, et al., 2010). The differences between these groups regarding  
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993 356 feeding practices were driven by changes in the two reward items of the CFQ restriction scale  
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995 357 (Burrows, et al., 2010). These items describe counterproductive parental behaviors related to  
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997 358 offering food in exchange for good behavior (Vaughn, et al., 2016). In Swedish society, using  
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1006 359 food to reward children is generally considered inappropriate, and in the Swedish validation of  
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1008 360 the CFQ the reward items had to be excluded due to social desirability issues as seen by high  
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1010 361 ceiling effect (Nowicka, Sorjonen, et al., 2014). Hence, although the CFQ has been widely used  
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1013 362 by researchers to measure parental feeding practices in the past two decades (Shloim, et al.,  
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1015 363 2015; Ventura & Birch, 2008), methodological issues related to the feeding practices the CFQ  
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1017 364 assesses might explain the lack of group differences in our study. In a recent summary of  
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1019 365 measurements of parental feeding, Vaughn, et al. (2016) list a wide range of parental feeding  
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1021 366 strategies involving structure and control. Not all the parental strategies listed are represented  
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1023 367 in the CFQ, and it is possible that changes in parental feeding practices that we did not measure  
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1025 368 could explain our results.

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1028 369 The greater reduction in child weight status in PGB was also not explained by changes in  
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1030 370 reported child food intake. In fact, children within PGNB and ST reportedly reduced their  
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1032 371 consumption frequency of cookies and buns by half compared to baseline. Although assessment  
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1034 372 of child food intake has not been prioritized in trials for obesity treatment (Duncanson, et al.,  
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1036 373 2017), previous research has demonstrated a greater decrease in calorie-dense foods and caloric  
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1038 374 intake, and a greater increase in dietary quality after intensive family-based treatment,  
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1040 375 compared to counseling (Robson, et al., 2019). As the authors note, this change in eating  
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1042 376 patterns also mirrors a greater decrease in child weight status in family-based treatment  
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1044 377 (Robson, et al., 2019; Stark, et al., 2018), such that a lower energy intake may explain the  
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1046 378 treatment effect (Kuhl, et al., 2014). In the present study, we found that child food intake  
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1048 379 relevant to obesity treatment was within recommended levels in all groups already at baseline.  
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1050 380 Thus, other aspects of food intake, such as portion sizes and energy intake, may have changed  
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1052 381 during the intervention, which might explain the greater child weight loss in PGB. However,  
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1054 382 more time-consuming methods, such as 24 h-recalls or food recall diaries, would have been  
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1056 383 required to extract this information. We chose not to use them, as it would have resulted in  
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384 greater participant burden. Likewise, we did not measure physical activity using objective  
385 measurements such as accelerometers, and therefore could not assess if children’s physical  
386 activity affected their energy balance.

387 We found that certain feeding practices were associated with child food intake. Increased  
388 parental monitoring and restriction were associated with decreased consumption of energy-  
389 dense foods in the total sample and ST. Although a reduction in energy-dense foods can be  
390 expected with increased monitoring (Haszard, Skidmore, Williams, & Taylor, 2015; Rollins, et  
391 al., 2016), it is a surprising finding considering the coercive nature of restriction, which previous  
392 research has suggested might be counterproductive in relation to child eating behaviors (Fisher  
393 & Birch, 1999; Rollins, et al., 2016). The similar associations for increased monitoring and  
394 restriction may indicate that parents who reported restriction and parents who reported  
395 monitoring were referring to similar kinds of control. Recent studies on feeding practices have  
396 focused on disentangling the effects of overt control (child can detect parental control, e.g.  
397 “How often are you firm about what your child should eat”) and covert control (child cannot  
398 detect parental control, e.g. “Avoid buying sweets and crisps and bringing them into the  
399 house?”) (Boots, Tiggemann, & Corsini, 2018; Nowicka, Flodmark, Hales, & Faith, 2014;  
400 Ogden, Reynolds, & Smith, 2006). Whereas overt control may lead to unfavorable outcomes  
401 over time, covert control is associated with more favorable weight and food intake outcomes  
402 (Ogden, et al., 2006; Rodenburg, Kremers, Oenema, & van de Mheen, 2014), such that a more  
403 nuanced understanding of parental restriction is needed (Vaughn, et al., 2016). The CFQ items  
404 assessing restriction, however, may not make the distinction clear. Of note, a Swedish study of  
405 nearly 900 mothers of preschoolers (Nowicka, Sorjonen, et al., 2014) showed that covert control  
406 was moderately correlated with restriction (as measured through the CFQ). This shows that, in  
407 Sweden, parents may interpret the CFQ restriction items as capturing covert controlling  
408 behaviors related to structure and limit setting (Rollins, et al., 2016). Taken together, these

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409 findings highlight the challenges for operationalizing relevant constructs in parental feeding  
410 research. The field has accumulated a theory-based pool of items that are developmentally  
411 appropriate and easy to administer; however, novel ways to analyze existing data that account  
412 for certain limitations may be needed. Item Response Theory (IRT) might be one alternative  
413 which can facilitate analyses of empirical data while refining our existing conceptualization of  
414 feeding practices so that they can be better operationalized (Gordon, 2015).

415 Despite such challenges, the different patterns of associations across treatment groups provide  
416 insights into how parent-reported measures may change through different treatment approaches.  
417 This is highlighted by the contrasting patterns of associations of increased restriction in PGNB  
418 (increased consumption of pizza and hamburgers) and ST (decreased consumption of pizza and  
419 hamburgers). The findings for ST align with a proposed model by which parental restriction  
420 and monitoring of obesogenic foods relate to children's decreased consumption of these foods.  
421 Because ST was less effective in improving child weight status, such associations may only  
422 reflect increased knowledge on matters of nutrition and socially desirable responses,  
423 considering the focus of ST on lifestyle modification and the provision of information about  
424 *what* would be healthy/unhealthy to consume/not consume.

425 The associations for PGNB may reflect *how* parent-child dynamics shift after a parenting  
426 program not solely focused on food and nutrition. In PGNB, increased restriction and pressure  
427 to eat were associated with both increased consumption of healthy foods (fruits and vegetables)  
428 and increased consumption of energy-dense foods (pizza and hamburgers and cookies and  
429 buns). Parents who attended the program (without receiving booster sessions) may have become  
430 more attuned to what their children ate (child food intake), adjusting their feeding practices  
431 accordingly. As children grow older they tend to become more food responsive, and thereby  
432 increase their obesogenic food intake. At the same time, children appear to become pickier with  
433 food, possibly following a normal developmental trajectory. It is possible that in PGNB, parents

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434 reporting increasing restriction (or monitoring) along with increasing pressure to eat (which  
435 may focus on ‘healthier’ food items, like vegetables) were responding to developmental  
436 changes in children’s appetites (Ashcroft, Semmler, Carnell, van Jaarsveld, & Wardle, 2008;  
437 Ek, et al., 2016). Data from the ML study indicated that, following the parenting program,  
438 children with high levels of picky eating at baseline reduced their weight status over 12 months  
439 to a lower degree than non-picky eaters (Sandvik, et al., 2019). Thus, introducing an assessment  
440 of child characteristics, such as appetite traits, at baseline, might help to tailor treatment to  
441 families’ needs. Taken together, the findings suggest that tailored treatment approaches may be  
442 more suitable to address high consumption of certain energy-dense foods and/or the low  
443 consumption of healthier foods. These findings are unexpected in light of the null associations  
444 found in PGB, which is contrary to our hypotheses. Greater child weight loss in this group  
445 cannot be explained by the associations between changes in parental feeding practices and  
446 changes in child food intake presented in this paper. Such null findings in PGB reflect that  
447 parental feeding practices, child weight status, and child food intake were not correlated at the  
448 different time points (data not shown). It is possible that general parenting strategies, which  
449 reflect the sustained focus on general parenting in PGB, and/or aspects of dietary intake not  
450 measured in the study, e.g. portion sizes, may explain the effectiveness of the PGB.  
451 Alternatively, parents in PGB who were actively involved for the entire follow-up period  
452 became increasingly aware of their parenting practices and their child’s behavior, which may  
453 have resulted in null associations between those over time.

454 Regarding the third study objective, our hypothesis was not confirmed and parental feeding  
455 practices at baseline did not influence the effect of treatment on child weight status in either  
456 mother-child or father-child dyads. In contrast, a study by Epstein, et al. (2008) found that  
457 higher restriction at baseline predicted more favorable child weight outcomes for the treatment  
458 group that focused on replacing energy-dense foods with healthier alternatives, compared to



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459 treatment that only focused on reducing energy-dense foods. This may be because parents who  
460 exerted more control over child feeding at baseline continued to apply the same practices during  
461 treatment. As a result, they were able to implement positive changes in child food intake, as  
462 directed by the intervention, to influence child weight status. While the intervention described  
463 by Epstein et al. (2008) exclusively focused on dietary changes without addressing parenting,  
464 in the ML study, we have focused on evidence-based parenting practices, such as how to use  
465 effective limit setting strategies and how to handle a power struggle with one’s child. Since  
466 parental feeding practices did not differentially change over time across treatment groups, we  
467 could not provide evidence that they mediated treatment effects. However, the children’s weight  
468 status in the ML study may have been influenced by how general parenting strategies, including  
469 parental feeding practices, changed over time (mediating effect) rather than by baseline levels  
470 of parental feeding practices (moderating effect).

471 ***4.1 Future studies***

472 Although PGB was more successful in decreasing child weight status (Ek, et al., 2019), in the  
473 present study we found that changes in feeding practices did not differentially predict changes  
474 in child food intake in PGB. Examining potential changes in more general parenting skills may  
475 shed light on the greater decreases in child weight in this group. Because feeding practices have  
476 considerable stability over time, general parenting might not influence parental feeding  
477 practices in a measurable way (Duncanson, Burrows, & Collins, 2016; Powell, Farrow, Meyer,  
478 & Haycraft, 2018), and might instead moderate the effects of feeding practices on child eating  
479 patterns (Rodenburg, Kremers, Oenema, & van de Mheen, 2012; Sleddens, et al., 2014). Thus,  
480 we believe that factors related to co-parenting and the combined effects of maternal and paternal  
481 feeding practices (Pratt, et al., 2017; Tan, Domoff, Pesch, Lumeng, & Miller, 2019), as the child  
482 perceives them, warrant further investigation. In the ML study, we developed and validated an  
483 instrument to assess parenting practices and skills (unpublished data), which has the potential

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484 to provide clearer answers on how the intervention worked. Our group will address this in a  
485 future analysis.

486 ***4.2 Strengths and limitations***

487 The main strength in our study is its diverse sample (Foster, Farragher, Parker, & Sosa, 2015).  
488 Sixty percent of mothers and fathers were of non-Swedish background; this allows for higher  
489 generalizability of the study across migrant groups, and better reflects demographic changes in  
490 Sweden and in Europe more widely. Another strength of the study is the prior validation of the  
491 CFQ in Sweden (Nowicka, Sorjonen, et al., 2014). In addition, we included a FFQ to assess  
492 child food habits, which are rarely evaluated in obesity interventions (Duncanson, et al., 2017).  
493 Placing equal focus on both mothers and fathers is also a strength. Previous research has focused  
494 on maternal feeding practices and not much is known about the effect of paternal feeding  
495 practices (Khandpur, Blaine, Fisher, & Davison, 2014; Morgan, et al., 2017). In the changing  
496 family environment, both parents/caregivers and members of the extended family need to be  
497 addressed (Eli, Howell, Fisher, & Nowicka, 2016; Niermann, et al., 2018). Our analysis, which  
498 includes mother-child and father-child dyads, is an important step in acknowledging  
499 subsystems within the family. Fathers along with mothers were involved in the parenting  
500 program, although attendance varied. This may explain why mothers responded to the  
501 questionnaires to a greater degree. No data on which caregivers attended ST are available.

502 The main limitation of the analysis is that power was calculated for the primary outcome of the  
503 RCT, change in child BMI SDS, and not for parental feeding practices (Ek, et al., 2015).  
504 Another limitation is missing data, which was more pronounced in fathers, for whom 61 and  
505 89 questionnaires (35% and 51% of total sample) were missing at baseline and at 12 months  
506 post-baseline, respectively. Consequently, analyses for mother-child dyads are based on a larger  
507 sample, which may explain why some associations were found for mothers but not fathers. An  
508 alternative explanation is that mothers predominantly filled out the child background

questionnaire, which included the FFQ. Mothers also assumed greater responsibility for child eating/drinking. Hence, the observed associations may reflect maternal perceptions of parent-child dynamics in feeding. Moreover, mothers and fathers with a foreign background and no university degree were twice more likely not to respond to the questionnaires. However, the rate of missing data did not differ across treatment groups. We used a listwise approach, which has further reduced statistical power. Moreover, questionnaire data were self-reported and thus social desirability bias cannot be ruled out (Farrow, Blissett, & Haycraft, 2011). Low reliability for maternal/paternal pressure to eat presents additional methodological limitations, which may relate to the non-specificity of food items in the questions about pressure to eat in the CFQ.

### **4.3 Conclusion**

This is among the few studies to examine the effect of parental feeding practices on child food intake and weight status after obesity treatment among preschoolers. Neither changes in feeding practices nor changes in child eating patterns could explain why the parent group with boosters was more effective in reducing children's weight status in the ML study. Because intermediary processes involving parenting practices and parent-child interactions may be important, future studies should examine whether general parenting practices moderate the effect of feeding practices on child weight status. Moreover, from a methodological point of view, our results suggest that instruments that include more nuanced categories for feeding practices should be considered in future research.

### **Abbreviations**

CFQ: Child Feeding Questionnaire; FFQ: Food Frequency Questionnaire; BMI SDS: Body Mass Index; SD: standard deviation; RCT: Randomized Controlled Trial; ML: the More and Less study

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**Authors' contributions**

PN conceived the study, designed the statistical approach together with MS and supervised the coordination of the study and manuscript process. MS performed the statistical analyses with guidance from KS and drafted the initial manuscript. KS and KE interpreted data and edited the manuscript. AE and PS made a substantial contribution to conception and design, data collection and to interpretation of data. All authors contributed to reviewing and approving the final manuscript.

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**Declarations of interest**

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None

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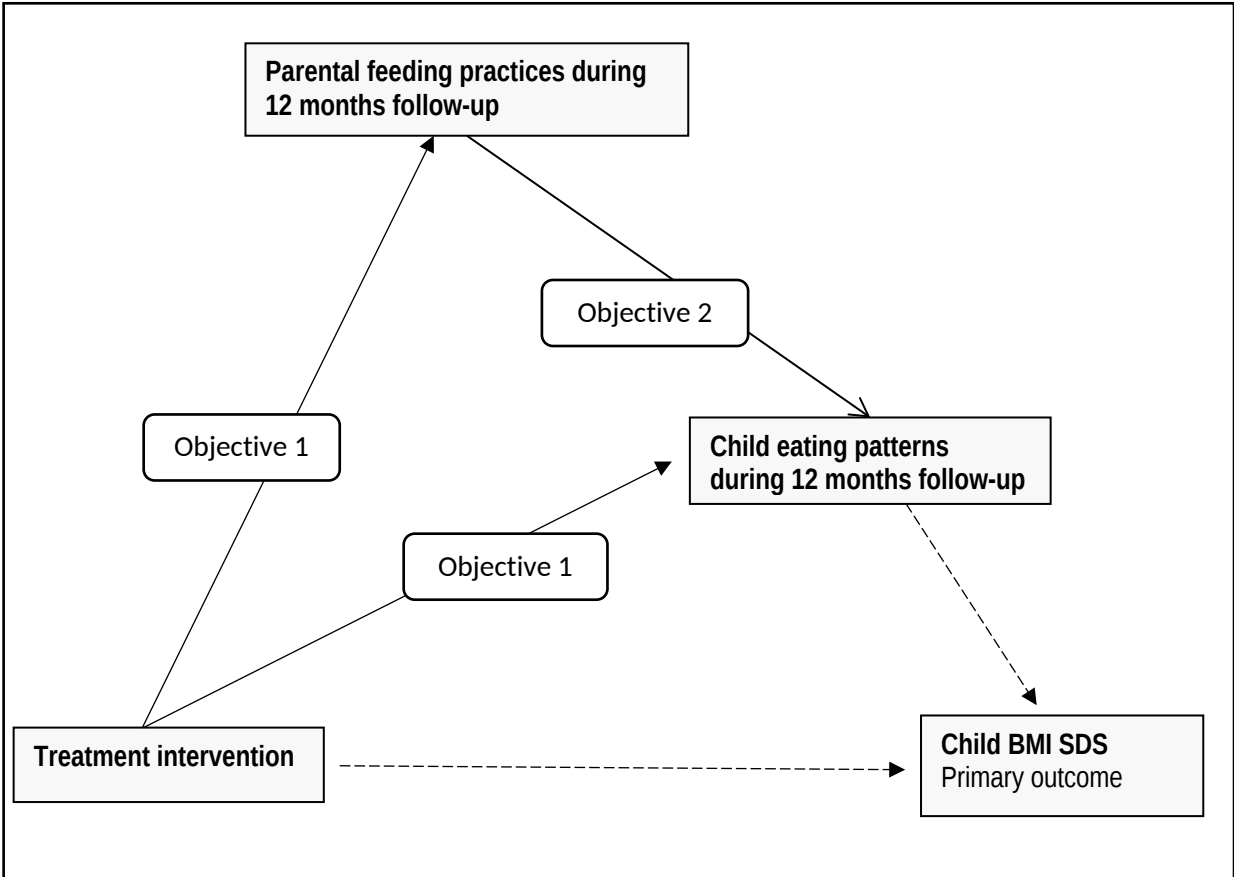
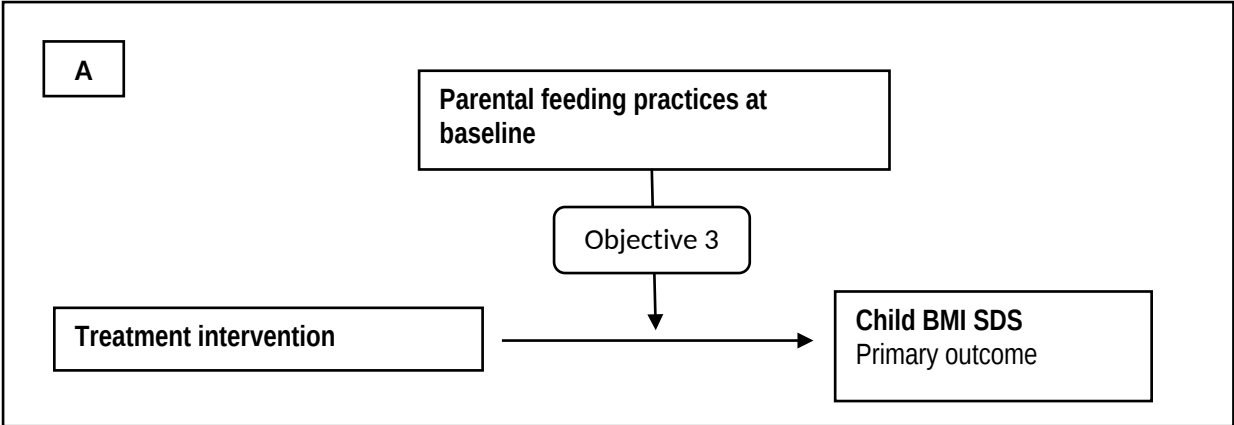
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## **Ethical statement**

The More and Less study (ML study) described in the attached manuscript was approved by the ethics committee in Stockholm, Sweden on November 16th 2011 (dnr: 2011/1329-31/4).

All participating caregivers provided written informed consent on behalf of their children.