



## Mothers' eating style's influence on their feeding practices and on their children's appetite traits

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### Abstract

**Background:** Overweight and obesity in children and adolescents has become an important public health concern in the last decades. To study the way mothers and children's behavioral factors interact with each other, influencing eating and body weight, may provide information to be used in preventive and treatment strategies.

**Goals:** To study the association of mothers' eating style on their feeding behavior and on their children's eating behavior.

**Methods:** Cross-sectional observational study with a non-probabilistic sample of mother and child dyads (from three schools). Mothers' eating behavior (assessed with Dutch Eating Behavior Questionnaire scale; DEBQ) was classified and they were grouped into three eating styles: restrictive, emotional-external or neutral styles. Mothers' feeding restriction, pressure to eat and concern about child's weight were assessed (through the Child Feeding Questionnaire; CFQ). Finally, mothers classified their child's appetite behaviors (with the Children's Eating Behaviour Questionnaire; CEBQ).

**Results:** Overall, participated 279 mothers, aged between 23 and 59 years (Mean= 38.03 years, SD=5.09) and respective children (n=279), aged between 6 and 13 years (Mean= 9.43 years, SD= 1.35), 140 of those were females (50.2 %). Associations between mothers' eating style, their feeding behaviors and children's appetite traits showed that restrictive and emotional-external eating mothers had higher scores of CFQ and CEBQ items related with obesity, when compared to neutral eating style mothers. Mothers' feeding restriction and children's weight concern associated positively with children's food approach behaviors (enjoyment of food, food responsiveness, emotional over-eating), and negatively with food avoidance behaviors (satiety responsiveness and slowness in eating). On the contrary, pressure to eat associated positively with food avoidance behaviors and negatively with food approach behaviors. Mother's concern about child weight and feeding restriction were positively associated with CEBQ subscales that reflect food approach and negatively associated with subscales that reflect food avoidance. Pressure to eat had the symmetric associations.

**Discussion:** Results support the hypothesis of the transmission of eating behaviors that promote obesity from mothers to children, and have implications both for prevention and children and adolescents' obesity treatment. Therefore, mothers should be a part of the intervention when treating their children obesity.

**Keywords:** Children's appetite, Children's obesity, Eating behavior, Feeding, Mothers' eating style

## Introduction

In developed countries, we observe epidemic proportions of obesity, both in adults and children (Messiah, Lipshultz, & Natale, 2013; Organisation for Economic Co-operation and Development [OECD], 2014). Although there are genetic causes in some cases and an element of genetic susceptibility to the environment (Llewellyn & Fildes, 2017), in general, lifestyle and environmental factors are more important influences, namely, over-eating and lack of physical activity (Blundell, et al., 2017; Schoentgen, Lancelot, & Le Gall, 2017). Eating behavior has been identified as one of the most important factors in weight status (French, et al., 2012; van Strien, Herman, & Verheijden, 2014). Furthermore, children's attitudes and decisions regarding food and eating are shaped by their caretakers, in particular by their mothers' attitudes towards feeding (Ek et al., 2016; Scaglione, Salvioni, & Galimberti, 2008; Wansink, Hanhs, & Kaipainem, 2016).

Mothers' authoritarian feeding attitudes include two styles that, in opposite ways, are likely to provoke opposition from the child: (1) *feeding restriction*, which includes limiting access to high energy food, junk food and/or controlling the total amount of food; or (2) *pressure to eat*, which involves insisting that children have to eat, in particular healthy food, and demanding that they should eat everything that is on the plate, even if it is more than what the child wants (Birch, et al., 2001). High levels of parental control in child feeding are associated to worse adjustment of their offspring's intake in response to the energy density of food (Johnson & Birch, 1994). Pressure to eat may, paradoxically, have the opposite effect from the permissive approach: it may cause food avoidance and it is often associated with the child being underweight; whereas a restricted diet may lead the child to seek high-energy junk food outside home and thus gaining weight. Although feeding restriction may be already a consequence of the child being overweight and pressure to eat a result of his/her being underweight, recent research has found that feeding restriction or pressure to eat are determined to a greater extent by the mother's perceptions and subjective concerns

about the child's weight than by objective observations (Dinkevich, et al., 2015; Webber, Hill, Cooke, Carnell, & Wardle, 2010). This seems to be a bidirectional process, in which mothers influence their children's behaviors by their feeding practices, which are in turn influenced by their perception of children's weight and appetitive traits (Webber et al., 2010). However, a paper reported that restrictive feeding practices seem to be primarily a response of mothers, and not a cause, to their children's weight (Derks et al., 2017).

Mothers' own attitudes and behaviors related to food and eating are classified as eating behavior and eating style. The dimensions that describe eating style can be characterized as (van Strien, Frijters, Bergers, & Defares, 1986): (1) restrained eating, which refers to the intention to restrict food intake in order to prevent weight gain or to promote weight loss; (2) emotional eating, that refers to the disinhibition of appetite caused by stress or emotional factors; and (3) external eating, which regards the disinhibition of appetite due to the sight or odor of foods or by seeing other people eat. These factors are all associated with overeating and, therefore, can have a role in weight gain (Lluch, Herbeth, Méjean, & Siest, 2000; Reed et al., 2016). These dimensions probably have implications in the decisions taken when feeding others. Maternal eating control variables are associated not only with the quality of their diet, but also with the quality of their children's food choices, following a similar pattern (Contento, Zybert, & Williams, 2005). Moreover, mothers' disinhibition was associated to less healthy choices for themselves and their children (Contento, Zybert & Williams, 2005). Another research concluded that mothers who eat intuitively (primarily for physical reasons and trusting on their internal hunger and satiety cues) were more likely to allow their child to self-regulate eating (Tylka, Lumeng, & Eneli, 2015). In a recent investigation, authors found that socio-economically deprived families, where the mothers were heavier and had a more food-responsive eating, tended to provide a home environment of a higher risk of weight gain (Schrempft, van Jaarsveld, Fisher, Fildes, & Wardle, 2016). So, we can expect that the mothers' attitudes and decisions towards their eating may influence their behaviors and decisions regarding

their children eating. Mothers' feeding practices focus the children's attention on external stimuli about eating (i.e., eating in response to food clues) and decreases the child sensibility to internal processes that regulate appetite and satiety, thus contributing to deregulate their children's ingestion, which may lead to pediatric overweight (Birch, Fisher, & Davison, 2003). Moreover, overweight parents may establish an environment that promotes eating disinhibition and weight gain (Francis, Ventura, Marini, & Birch, 2007, Snoek, van Strien, Janssens, & Engels, 2009).

Although in several studies the eating behavior of the mothers was associated to children's eating, as far we know no one explored the relation between the mothers' eating style, their feeding practices and their perception of children's eating behavior.

The association between mothers' feeding behaviors and children's weight status (or children's eating behavior and weight status) is well established (Dinkevich et al., 2015; Ek, et al., 2016) and it's not the aim of this research. The purpose of this study is to explore the relation between mothers' and children's style and behavioral factors associated with weight gain. It is hypothesized that mothers' eating style profile will be associated with particular feeding practices, which will be associated with children's appetite traits.

## Material and methods

### Sample

This observational cross-sectional study included a non-probabilistic sample of children and corresponding mothers obtained in three schools in the area of Porto, Portugal. The board of three schools which hosted Nutrition Internship students were contacted and accepted to participate in this study. All children enrolled in the 1<sup>st</sup> to 8<sup>th</sup> grades were invited to participate, together with their respective mothers. Only children (and their mothers) without any identified chronic disease or learning disability were accepted.

In order to obtain sample size estimation, we performed a power analysis (Chow, Wang, & Shao, 2007). We considered a statistical power of .80. To observe, between groups, statistically significant differences of half of the pooled standard deviation, we would need a sample size of 253 individuals.

### Measures

The questionnaires we used are described next. They are all Lickert-type scales of 1 to 5 points, with psychometric characteristics already described for the addressed populations. The *Dutch Eating Behavior Questionnaire (DEBQ)* (van Strien et al., 1986), applied to the mothers, describes eating style and includes 33 items that are distributed along three dimensions, which are: '*eating restriction*', as the effort to eat less than desired, dieting to maintain or reduce weight; '*emotional eating*', as the appetite disinhibition and over-eating resulting from emotional causes and stress; and '*external eating*', referring to the sensibility to external influences related to food and the over-eating caused by seeing or smelling food or seeing other people eating. DEBQ was studied in a convenience sample of the Portuguese population (n= 191), where three factors were confirmed and had good internal consistency: *eating restriction*  $\alpha = .92$ , *emotional ingestion*  $\alpha = .94$  and *external ingestion*  $\alpha = .81$  (Viana & Sinde, 2003).

The *Child Feeding Questionnaire (CFQ)* (Birch et al., 2001) include 31 items that describe mothers' perception and concerns about their children's obesity and their feeding behaviors. CFQ was studied in a convenience sample of the Portuguese population (n = 292), where seven factors were confirmed and had Cronbach's alpha ranking from  $\alpha = .61$  to  $\alpha = .90$  (Viana et al., 2012). Only results of the following subscales were considered for our study: mothers' *perception of child's weight* ( $\alpha = .75$ ), mothers' *concern about child's weight* ( $\alpha = .87$ ), *feeding restriction* ( $\alpha = .80$ ), and *pressure to eat* ( $\alpha = .74$ ). In the case of the *feeding restriction* subscale, items 23 and 24 (assessing food reward), were excluded accordingly to confirmatory factor analysis results (Viana et al.,

2012). The *feeding restriction* subscale assesses mothers' efforts to ensure that their children eat less than they want and less high-energy food, such as sweets and snacks. *Pressure to eat* refers to the mothers' efforts to ensure that their children eat more and more healthy foods. These subscales were selected because they were correlated with weight status in previous studies (Viana, et al., 2012; Webber et al., 2010).

The *Children's Eating Behaviour Questionnaire (CEBQ)* (Wardle, Guthrie, Sanderson, & Rapoport, 2001), previously studied for the Portuguese population also in a convenience sample ( $n = 249$ ) (Viana & Sinde, 2008), is a 35-item measure instrument designed to assess mothers' perceptions of eight dimensions of children's appetite. The sub-scales *enjoyment of food* ( $\alpha = .89$ ) and *food responsiveness* ( $\alpha = .88$ ) represent a heightened interest in food and a more pronounced responsiveness to environmental food cues. The sub-scale *desire to drink* ( $\alpha = .82$ ) reflects an approach to desirable drinks (usually sweetened drinks). The sub-scales *slowness in eating* ( $\alpha = .88$ ) and *food fussiness* ( $\alpha = .73$ ) reflects a lack of enjoyment and interest in food and has been associated with underweight (Sledens, Kremers, & Thijs, 2008; Viana, Sinde, & Saxton, 2008). *Satiety responsiveness* ( $\alpha = .79$ ) reflects a more sensitive response to internal satiety and hunger cues, and thus a more efficient monitoring of energy intake that protects against over-consumption. *Emotional over-eating* ( $\alpha = .77$ ) and *emotional under-eating* ( $\alpha = .70$ ) represent emotionally reactive eating behaviors that would theoretically have opposing weight outcomes (Demir & Bektas, 2017).

### Procedure

Mothers were invited to answer all the three questionnaires at home and self-reported their weight and height; body mass index (BMI) ( $\text{kg}/\text{m}^2$ ) was calculated. The children's weight and height were measured with children in underclothes, individually and in a private room, at school during a gymnastic class by two trained students. Children's BMI ( $\text{kg}/\text{m}^2$ ) and then Z Score ( $z\text{BMI}$ ) were calculated in order to transform this categorical variable in continuous one, according to the World Health Organization criteria (Onis et al., 2007).

### Statistical analysis

IBM SPSS 20.0 was used for the statistical analysis. Values of  $p$  below .05 were considered statistically significant. Normality was assessed by analyzing skewness and kurtosis. All continuous variables followed a distribution close to the normal. Cluster analysis (K-Means Cluster) of DEBQ scores was used in order to group mothers by different eating styles using the three DEBQ dimensions. Results were classified as high when the mean was close or higher than the first standard deviation score obtained in a Portuguese study (Viana & Sinde, 2003). ANOVA, including multiple comparisons test with Bonferroni's correction, was selected for comparative analysis for all CFQ and CEBQ variables. A Multivariate General Linear Model (Christensen, 2002) was used to verify the associations of a set of five subscales from CEBQ with a set of covariates, the three subscales from CFQ. We selected only the subscales from CEBQ and from CFQ that showed statistical differences in comparative analysis with the three clusters of the mother's eating style.

### Ethical issues

The study was presented to each school board that authorized the procedure.

Following Declaration of Helsinki, informed consent was asked to mothers and only those that gave their written agreement and acceptance for their own and their children participation in the research were included in the study.

Besides due authorizations, no ethical committee has been consulted for the study.

## Results

### Sample demographic characteristics

Subjects were 357 mothers. We excluded 78 (21,9%) individuals because they didn't provide complete data, leaving 279 mothers that were between 23 and 59 years old (Mean = 38.03 years, SD = 5.09). Their

children were between 6 and 13 years old (Mean = 9.43 years, SD = 1.35), 140 of those females (50.2%), attending school from 1st to 8<sup>th</sup>: 1<sup>o</sup> and 2<sup>o</sup> grade n= 22 (7.9%), 3<sup>o</sup> grade n=64 (22.9%), 4<sup>o</sup> grade n=116 (41.6%) and 5 to 8<sup>o</sup> grade N=77 (27.6%). Mothers and children's demographic characteristics are included in Table 2.

### Mother's eating style

Mothers were first divided into clusters according to their eating style. Three groups were found: one group were mothers who had a high mean score in the *eating restriction* subscale; another group consisted of those whose mean scores of both *emotional eating* and *external eating* were high; and the last group, classified as *neutral*, were mothers whose results on all the subscales were relatively low (Table 1).

### Comparison of variables by mother's eating style

Mothers and children's demographic characteristics classified by the mothers' three eating style clusters are presented in Table 2. Although differences were significant in mothers' *education* distributed by eating styles, Bonferroni's correction revealed that only the differences between the pair *neutral style* and *emotional and external eating* were significant ( $p < .05$ ). Differences in mothers' BMI and children's zBMI were also significant. In both cases, BMI indicators were lower in the groups of mothers with *neutral eating style*. Concerning mothers' BMI, the Bonferroni's correction showed that differences were significant in the pair *neutral eating style* and *eating restriction style* and the pair *neutral eating style* and *emotional and external eating* ( $p < .001$  in both pairs). Regarding

children's zBMI, differences were significant for the pair *neutral style* and *restrictive eating* ( $p < .001$ ), and for the pair *neutral style* and *emotional-external eating* ( $p < .005$ ).

### Comparative analysis of mother's feeding practices and perceptions of children's eating behavior by mothers' eating style

In Table 3, the results of comparative analysis of the CFQ and CEBQ sub-scales by the three clusters of mothers' eating style are presented. About CFQ results, differences were only significant for three sub-scales. Nevertheless, Bonferroni's correction identified that there are differences between clusters of *neutral eating style* and *restrictive eating* for *Concern about child's weight* ( $p < .001$ ), for *feeding restriction* ( $p < .05$ ) and for *pressure to eat* ( $p < .05$ ). Concerning CEBQ sub-scales, differences among mothers' eating styles clusters were found for *enjoyment of food*, *food responsiveness*, *emotional over-eating*, *satiety responsiveness* and *slowness in eating*. Bonferroni's correction showed that there were significant differences in the results between *emotional/external eating* mothers and *neutral eating* mothers for sub-scales *enjoyment of food* ( $p < .05$ ), *food responsiveness* ( $p < .001$ ), and *emotional over-eating* ( $p < .002$ ). We also found differences between the clusters *restrictive* and *neutral* in sub-scales *food responsiveness* ( $p < .05$ ) and *satiety responsiveness* ( $p < .001$ ); and regarding *restrictive eating* and *emotional-external eating* for sub-scale *emotional over-eating* ( $p < .05$ ). In *slowness in eating* sub-scale, differences were statistically significant between *neutral* and *restrictive* mothers ( $p < .05$ ) and a tendency to a difference between *neutral* and *emotional-external eating* mothers ( $p = .050$ ).

**Table 1.** Cluster analysis of mother's results in the Dutch Eating Behavior Questionnaire (DEBQ) subscales, Mean (SD), and comparative analysis (ANOVA)

	Cluster 1 Restrictive Eating (n = 113 ; 40.5%)	Cluster 2 Emotional/External eating (n = 61 ; 21.9%)	Cluster 3 Neutral eating (n = 105 ; 37.6%)		
	Mean (SD)	Mean (SD)	Mean (SD)	F	p
Restriction	2.92 (0.48)	2.53 (0.57)	1.52 (0.39)	251.16	< .001
Emotional Eating	1.63 (0.41)	3.15 (0.65)	1.37 (0.48)	234.35	< .001
External Eating	2.35 (0.45)	3.06 (0.57)	2.37 (0.42)	53.83	< .001

**Table 2.** Sample characteristics, mothers' and children' Mean (SD) by mothers' eating style, and comparative analysis (ANOVA)

	Restrictive eating (n = 113)	Emotional/External eating (n = 61)	Neutral eating (n = 105)	Total (n = 279)		
<b>Mothers</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>F</b>	<b>p</b>
Age (23-59 y)	38.00 (5.21)	38.22 (5.20)	37.95 (4.95)	38.03 (5.10)	0.56	0.95
Education (school years)	8.69 (3.64) <sup>ab</sup>	9.72 (4.41) <sup>a</sup>	8.05 (3.45) <sup>b</sup>	8.67 (3.78)	3.62	< .05
BMI	27.56 (5.40) <sup>a</sup>	28.59 (5.55) <sup>a</sup>	23.57 (3.48) <sup>b</sup>	26.33 (5.25)	18.10	< .001
<b>Children</b>						
Male	n = 60	n = 28	n = 51	n = 139		
Female	n = 53	n = 33	n = 54	n = 140		
	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>F</b>	<b>p</b>
Age (6-13 y)	9.56 (1.41)	9.39 (1.14)	9.32 (1.39)	9.43 (1.35)	0.85	0.43
Education (school years)	4.08 (1.36)	3.93 (0.98)	3.80 (1.19)	3.94 (1.22)	1.45	0.24
zBMI	1.07 (1.01) <sup>a</sup>	0.98 (1.01) <sup>a</sup>	0.41 (1.17) <sup>b</sup>	0.80 (1.11)	11.24	< .001

Different letter in superscript (<sup>a</sup> and <sup>b</sup>) means statistically significant differences between pairs (Bonferroni's correction). BMI (mothers' Body Mass Index); zBMI (distribution of Z score for children's Body Mass Index).

**Table 3.** Comparative analysis (ANOVA) of mean scores for Child Feeding Questionnaire (CFQ) and Children's Eating Behaviour Questionnaire (CEBQ) subscales by mothers' eating style groups

	Restrictive eating	Emotional/External eating	Neutral eating		
<b>CFQ</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>F</b>	<b>p</b>
Perceived child weight	3.09 (0.38)	3.05 (0.34)	2.99 (0.39)	2.14	.120
Concern about child weight	3.87 (1.27) <sup>a</sup>	3.58 (1.31) <sup>ab</sup>	3.03 (1.45) <sup>b</sup>	10.62	< .001
Feeding restriction	3.94 (0.88) <sup>a</sup>	3.93 (0.81) <sup>ab</sup>	3.63 (1.02) <sup>b</sup>	4.16	< .020
Pressure to eat	3.34 (1.13) <sup>b</sup>	3.32 (1.15) <sup>ab</sup>	3.71 (1.00) <sup>a</sup>	4.03	< .020
<b>CEBQ</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>F</b>	<b>P</b>
Enjoyment of food	3.21 (0.82) <sup>a</sup>	3.27 (0.82) <sup>a</sup>	2.90 (0.92) <sup>b</sup>	4.93	< .005
Food response	2.29 (1.02) <sup>a</sup>	2.54 (1.01) <sup>a</sup>	1.92 (0.86) <sup>b</sup>	8.76	< .001
Emotional overeating	1.99 (0.80) <sup>b</sup>	2.32 (0.77) <sup>a</sup>	1.88 (0.85) <sup>b</sup>	5.83	< .005
Desire to drink	2.33 (0.95)	2.53 (0.91)	2.44 (1.08)	0.80	.450
Satiety responsiveness	2.41 (0.64) <sup>b</sup>	2.61 (0.69) <sup>ab</sup>	2.80 (0.85) <sup>a</sup>	7.80	< .002
Emotional under eating	2.35 (0.79)	2.52 (0.76)	2.52 (0.79)	1.55	.210
Slowness in eating	2.53 (0.79) <sup>b</sup>	2.49 (0.87) <sup>b</sup>	2.88 (0.99) <sup>a</sup>	5.48	< .005
Food fussiness	2.86 (0.73)	2.87 (0.72)	2.93 (0.83)	0.22	.800

Different letter in superscript (<sup>a</sup> and <sup>b</sup>) means statistically significant differences between pairs (Bonferroni's Correction).

**Association of mothers' feeding practices and perceptions of children's eating behavior**

Table 4 shows the results of the Multivariate General Linear Model (GLM) analysis regarding the associations between CFQ sub-scales with the CEBQ sub-scales that presented pairwise significant differences in Table 3. We can verify that *concern about child weight* and *feeding restriction* were positively associated to CEBQ sub-scales that reflect food approach

(*food responsiveness, enjoyment of food and emotional over-eating*), and negatively associated with *satiety responsiveness* and *slowness in eating*. *Pressure to eat* was negatively associated to sub-scales that reflect food approach and positively to *satiety responsiveness* and *slowness in eating*, sub-scales that reflect food avoidance. These results have emerged after controlling for mothers' level of education.

**Table 4.** Multivariate General Linear Model of associations between Children's Eating Behaviour Questionnaire (CEBQ) subscales and Child Feeding Questionnaire (CFQ) weight concern and feeding practices, controlling for mothers' education

CEBQ	CFQ		
	Concern about child weight	Feeding restriction	Pressure to eat
	$\beta$ / t (p)	$\beta$ / t (p)	$\beta$ / t (p)
Enjoyment of food	0.239/ 6.39 (< .001)	0.111/ 2.03 (< .05)	-0.180/-4.26 (< .001)
Food Response	0.201/ 4.79 (< .001)	0.225/3.69 (< .001)	-0.266/-5.63 (< .001)
Emotional overeating	0.107/ 2.76 (< .01)	0.122/ 2.16 (< .05)	-0.176/-4.01 (< .001)
Satiety responsiveness	-0.159/-4.74 (< .001)	-0.060/-1.23 (0.22)	0.196/ 5.03 (< .001)
Slowness in eating	-0.058/-3.02 (< .005)	-0.058/-0.96 (0.34)	0.228/4.83 (< .001)

$\beta$ ) Regression index; t) Student distribution of  $\beta$ /Standard deviation

## Discussion

We aimed to study the relation between mothers' and children's eating style and behavioral factors associated with weight gain. A convenience sample of mothers answered the Dutch eating Behavior Questionnaire to assess their eating style, the Child Feeding Questionnaire, evaluating their perceptions and concerns about their children and the children's Eating Behaviour Questionnaire that provided mother's perception of children's appetite.

### Influence of mothers' eating style in mothers' and children' weight status

In this paper we analyzed jointly three components of eating behavior, restriction, emotional eating and external eating, since these characteristics are present together in all individuals, though at different levels. From the cluster analysis, mothers were separated into three groups of eating style. In one of these groups, *eating restriction* was prevailing, in another *emotional eating* and *external eating* were higher, and in the last, the *neutral* style cluster, results were lower for all three dimensions. Mothers' and children's demographic characteristics showed homogeneity across the three different clusters, except in the case of the mother's education, which is lower in the cluster of mothers with neutral eating style. We can put the hypothesis that less educated mothers, because less exposed to information, practiced an intuitive or more adequate eating pattern. Intuitive eating meaning that they have a flexible eating style characterized

by trusting in and mainly following physiological hunger and satiety cues to determine when, what, and how much to eat (Tylka, 2006). Further studies would be needed to confirm this hypothesis in similar samples. The differences of mothers' BMI between the three groups were expected. *Restriction*, *emotional eating* and *external eating* are associated with disinhibited eating and are behavioral causes of weight gain (Anschutz, van Strien, & van De Ven, 2009; Bryant, King, & Blundell, 2008; Stroebe, 2008; van Strien, Herman, & Verheijden, 2009). Children of *restrictive eating* mothers and *emotional-external eating* mothers had higher zBMI than children from *neutral* eating mothers. These results suggest that the mothers' eating style and children's eating patterns are associated. Once it is less likely that the children's weight and eating pattern determine mother's eating style, a possible explanation is that the less adequate the mothers' eating behavior is, the more they may contribute to a familiar obesogenic environment, probably through their child-feeding behavior (Joyce & Zimmer-Gembeck, 2009; Ventura & Birch, 2008; Wardle, Sanderson, Guthrie, Rapoport, & Plomin, 2002). According to this, it is likely that parents' eating behavior mediates similarities between parents and children's weight status.

### Mothers' eating style and feeding practices

Children from mothers that pressure them to eat present, probably, a lower weight (Faith & Kerns, 2005; Ventura & Birch, 2008; Wardle et al., 2002). Our study revealed that perception of child's overweight, concern about child weight and feeding restriction were

higher in mothers with a restrictive eating style when compared to mothers with a neutral style. Children from restrictive eating mothers had higher weight status.

### Mothers' eating style and perception of children's appetite

We verified that *food responsiveness* and *emotional over-eating* were higher in children from mothers' *emotional-external* style. This association suggests that mother's emotional eating disinhibition may be reflected in children's external and emotional eating disinhibition. *Satiety responsiveness* was higher in children of mothers with a *neutral* eating style comparatively with *restrictive eating* style mothers. *Slowness in eating* was higher in children from *neutral eating* mothers comparatively to children from *restrictive eating* and *emotional-external* mothers. *Eating restrictive* mothers seem to promote more feeding restriction, which may have a negative impact on children's self-regulation of intake. *Satiety responsiveness* reflects the capability of self-regulation of the ingestion in relation to the needs (Wardle et al., 2001). *Satiety responsiveness* protects from over-eating and, therefore, from overweight. This appetitive trait implies a better response to internal satiety and hunger cues. It is therefore an adapted process in response to food favoring weight control (dos Passos, Gigante, & Maciel, 2015; Sánchez, Weisstaub, Santos, Corvalán, & Uauy, 2016). The same for *slowness in eating*. Higher results in this trait have been associated with lower BMI status, suggesting that this factor has a protective role against weight gain and an effect in satiety regulation (Faith, Scanlon, Birch, Francis, & Sherry, 2004; Webber, Hill, Saxton, Jaarsveld, & Wardle, 2009).

### Mothers' feeding practices and perception of children's appetite

The general linear model analysis showed that children with higher *enjoyment of food* and higher *Emotional over-eating* were those whose mothers were more *concerned with children's overweight*, exerted more *restrictive feeding* and less *pressure to eat*. Children with higher *satiety responsiveness* and higher

*slowness in eating* had mothers less concerned with their weight and that exerted higher *pressure to eat*. Children's external and emotional eating disinhibition increased as *concerns about children's weight* increased, while intake self-regulation and slowness in eating decreased, confirming that mother's *concern with children's weight* was an important moderator of the association between mother's feeding practices and weight in children (Webber et al., 2010). Also, feeding restriction is positively associated to external eating in children. The heavier the children's weight status the larger the feeding restriction. Feeding restriction was identified as an influence in overweight, being this associations well documented (Joyce & Zimmer-Gembeck, 2009; Ventura & Birch, 2008; Webber et al., 2009). And strictly controlled feeding was related to eating disinhibition, emotional over-eating and overweight (Joyce & Zimmer-Gembeck, 2009; Snoek, Engels, Janssen, & van Strien, 2007; Tylka et al., 2015). On the other hand, in another study (Brown, Ogden, Vogeles, & Gibson, 2008) healthier diet was associated with covert control, and pressure to eat was related to less healthy eating. In the same study, pressure to eat was associated with less external and emotional eating, better eating self-regulation and slowness in eating, which contradicts some conclusions from other studies (even considering that the observed conditions were not the same). In girls of 4 to 6 years it was found that pressure to eat disturbed the interpretation of the signs of satiety and hunger reflecting in more external eating (Carper, Orlet, & Birch, 2000). Regarding pressure to eat perception by adolescents, it was verified that it had a disturbing effect in the ability of energy self-regulation (van Strien & Bazelier, 2007). Contradicting this, and partially agreeing with the conclusion of our study, other researchers (Carnell, Benson, Driggin, & Kolbe, 2014; Webber, Cooke, Hill, & Wardle, 2010) found positive associations between *pressure to eat*, *satiety responsiveness* and *slowness in eating*, and between *feeding restriction* and *food responsiveness*. In the same way, it was verified that *pressure to eat* was associated with *satiety responsiveness* and *feeding restriction* with *food responsiveness*. In other works, *pressure to eat* has been associated with a lower weight status (Tylka et al., 2015; Faith et al., 2004; Carnell & Wardle, 2007). In general, these results suggest that mothers' eating



style are associated with children's eating behavior, and support the hypotheses of mothers to children transmission of behavioral factors that prompt obesity (Wardle et al., 2002; Carnell & Wardle, 2007; Munsch et al., 2007; Tiggemann & Lowes, 2002).

### Limitations and strengths of the study

This research has some limitations. The fact that this is a convenience sample makes the generalization of results difficult. Another limitation of this study is that the data are cross-sectional and so it is impossible to draw conclusions about the direction of the associations. The data about children's eating behavior were based on mothers' reports in the CEBQ, so it is possible that they may misinterpret their children's behavior. Despite these limitations, this study has as a strong point the observation of mothers' feeding behaviors and perceptions of children's eating behaviors depending of the mother's eating styles clusters. Another strength is the use of well-established instruments, and considering together three dimensions of the mother's eating behavior, namely: restriction, emotional eating and external eating.

### Conclusions

In this study, mothers' *restrictive* and *emotional-external* eating styles were associated with higher obesogenic feeding behavior and perception of children's appetite traits than *neutral* eating style mothers. Mothers' *feeding restriction* and children's *weight concern* were associated with perception of food approach children's behaviors, while *pressure to eat* was associated with perception of food avoidance children's behaviors. In prevention and treatment of child and youth obesity, it is important to focus on such aspects of familiar environment as those related to mothers' feeding behaviors and concerns. Mothers should thus be included in the intervention process; especially in order to raise self-awareness of their eating style, its implications in child-feeding behavior and, therefore, in their children's eating behavior and weight variations.

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### Authorship

VV and AG designed the research; VV wrote the first draft and was principally involved in data interpretation; BO made the statistical analysis; PA, MG and DS conducted data collecting and registration. All authors contributed with draft revision and approved the final manuscript.

### Declaration of conflicting interests

We declare that there is no conflict of interest.

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### References

- Anschutz, D., van Strien, T., & van De Ven, M. (2009). Eating styles and energy intake in young women. *Appetite*, *53*, 119-122. <https://doi.org/10.1016/j.appet.2009.03.016>.
- Birch, L., Fisher, J., & Davison, K. (2003). Learning to overeat: Maternal use of restrictive feeding practices promotes girls' eating in the absence of hunger. *American Journal of Clinical Nutrition*, *78*, 215-220. <https://doi.org/10.1006/ajcn.2001.0398>.
- Birch, L., Fisher, J., Grimm-Thomas, K., Markey, C., Sawyer, R., & Johnson, S. (2001). Confirmatory factor analysis of the Child Feeding Questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. *Appetite*, *36*, 201-210. <https://doi.org/10.1006/ajcn.2001.0398>.
- Blundell, J., Baker, J., Boyland, E., Blaak, E., Charzewska, J., He-nauw, S., Frühbeck, G., Gonzalez-Gross, M., Hebebrand, J., Holm, L., Kriaucioniene, V., Lissner, L., Oppert, J-M, Schindle, K., Silva, A., & Woodward, E. (2017). Variations in the prevalence of obesity among European countries, and a

- consideration of possible causes. *Obesity Facts*, 10, 25-37. <http://dx.doi.org/10.1159/000455952>.
- Brown, K., Ogden, J., Vogele, C., & Gibson, E. (2008). The role of parental control practices in explaining children's diet and BMI. *Appetite*, 50, 252-259. <http://dx.doi.org/10.1016/j.appet.2007.07.010>.
- Bryant, E.J., King, N.A., & Blundell, J.E. (2008). Disinhibition: Its effects on appetite and weight regulation. *Obesity Reviews*, 9, 409-419. <http://dx.doi.org/10.1111/j.1467-789X.2007.00426.x>.
- Carnell, S., Benson, L., Driggin, E., & Kolbe, L. (2014). Parent feeding behavior and child appetite: Associations depend on feeding style. *International Journal of Eating Disorders*, 47, 705-709. <http://dx.doi.org/10.1002/eat.22324>.
- Carnell, S. & Wardle, J. (2007). Associations between multiple measures of parental feeding and children's adiposity in United Kingdom preschoolers. *Obesity*, 15, 137-144. <https://doi.org/10.1038/oby.2007.513>.
- Carper, J., Orlet, F., & Birch, L.L. (2000). Young Girls' Emerging Dietary Restraint and Disinhibition Are Related to Parental Control in Child Feeding. *Appetite*, 35, 121-129. <http://dx.doi.org/10.1006/appe.2000.0343>.
- Chow, S-C., Wang, H., & Shao, J. (2007). *Sample Size Calculations in Clinical Research, 2nd Ed.*. New York. Chapman & Hall / CRC Biostatistics Series. <http://doi.org/10.1201/9781584889830>.
- Christensen, R. (2002). *Plane Answers to Complex Questions: The Theory of Linear Models*, 3th. ed. New York: Springer.
- Contento, I., Zybert, P., & Williams, S. (2005). Relationship of cognitive restraint of eating and disinhibition to the quality of food choices of Latina women and their young children. *Preventive Medicine*, 40, 326-336. <http://dx.doi.org/10.1016/j.pymed.2004.06.008>.
- Demir, D. & Bektas, M. (2017). The effect of children's eating behaviors and parental feeding style on childhood obesity. *Eating Behaviors*, 26, 137-142. <http://dx.doi.org/10.1016/j.eatbeh.2017.03.004>.
- Derks, I., Tiemeier, H., Sijbrands, E., Nicholson, J., Voortman, T., Verhulst, F., Jaddoe, V., Jansen, P. (2017). Testing the direction of effects between child body composition and restrictive feeding practices: results from a population-based cohort. *American Journal of Clinical Nutrition*, 106: 783-90. <http://dx.doi.org/10.3945/ajcn.117.156448>.
- Dinkevich, E., Leid, L., Pryor, K., Wei, Y., Huberman, H., & Carnell, S. (2015). Mothers' Feeding Behaviors in Infancy: Do They Predict Child Weight Trajectories? *Obesity*, 23, 2470-2476. <http://doi.org/10.1002/oby.21320>.
- dos Passos, D., Gigante, D., & Maciel, F. (2015). Children's eating behavior: comparison between normal and overweight children from a school in Pelotas, Rio Grande do Sul, Brazil. *Revista Paulista de Pediatria*, 33, 42-49. <http://dx.doi.org/10.1016/j.rpped.2014.11.007>.
- Ek, A., Sorjonen, K., Eli, K., Lindberg, L., Nyman, J., Marcus, C., & Nowicka, P. (2016). Associations between Parental Concerns about Preschoolers' Weight and Eating and Parental Feeding Practices: Results from Analyses of the Child Eating Behavior Questionnaire, the Child Feeding Questionnaire, and the Lifestyle Behavior Checklist. *PLoS One*, 11(1), e0147257. <http://dx.doi.org/10.1371/journal.pone.0147257>.
- Faith, M., & Kerns, J. (2005). Infant and child feeding practices and childhood overweight: the role of restriction. *Maternal Child Nutrition*, 1, 164-168. <https://doi.org/10.1111/j.17408709.2005.00024.x>
- Faith, M., Scanlon, K., Birch, L., Francis, L., & Sherry, B. (2004). Parent-child feeding strategies and their relationships to child eating and weight status. *Obesity Research*, 12, 1711-1722. <http://DOI:10.1038/oby.2004.212>.
- Francis, L., Ventura, A., Marini, M., & Birch, L. (2007). Parent overweight predicts daughters' increase in BMI and disinhibited overeating from 5 to 13 years. *Obesity*, 15, 1544-1553. <https://dx.doi.org/10.1038/oby.2007.183>.
- French, S., Epstein, L., Jeffery, J., Blundell, J., & Wardle, J. (2012). Eating behavior dimensions. Associations with energy intake and body weight: a review. *Appetite*, 59, 541-549. <https://doi.org/10.1016/j.appet.2012.07.001>.
- Johnson, S., & Birch, L.L. (1994). Parent's and children's adiposity and eating style. *Pediatrics*, 94, 653-661.
- Joyce, J., & Zimmer-Gembeck, M. (2009). Parent feeding restriction and child weight. The mediating role of child disinhibited eating and the moderating role of the parenting context. *Appetite*, 52, 726-734. <http://dx.doi.org/10.1016/j.appet.2009.03.015>.
- Llewellyn, C., & Fildes, A. (2017). Behavioural Susceptibility Theory: Professor Jane Wardle and the Role of Appetite in Genetic Risk Of Obesity. *Current Obesity Report*, 6, 38-45. <http://dx.doi.org/10.1007/s13679-017-0247-x>.
- Lluch, A., Herbeth, B., Méjean, L., & Siest, G. (2000). Dietary intakes, eating style and overweight in the Stanislas Family Study. *International Journal of Obesity*, 24, 1493-1499. <http://doi:10.1038/sj.ijo.0801425>.
- Messiah, S. E., Lipshultz, S. E., Natale, R. A., & Miller, T. L. (2013). The imperative to prevent and treat childhood obesity: why the world cannot afford to wait. *Clinical Obesity*, 3, 163-171. <http://dx.doi.org/10.1111/cob.12033>.
- Munsch, S., Hasenboehler, K., Michael, T., Meyer, A., Roth, B., Biedert, E., & Margraf, J. (2007). Restrained eating in overweight children; Does eating style run in families? *International Journal of Pediatric Obesity*, 2, 97-103. <http://doi.org/10.1080/17477160701369191>.
- OECD (2014). *Obesity Update 2014*. Organization for Economic Co-operation and Development. <http://www.oecd.org/els/health-systems/Obesity-Update-2014.pdf>
- Onis, M., Onyango, A., Borghi, E., Siyam, A., Nishida, C., & Siekmann, J. (2007). Development of a WHO growth reference for school-aged children and adolescents. *Obesity Research*, 85, 660-667. <http://doi:10.2471/BLT.07.043497>.
- Reed, J., Yates, B., Houfek, J., Pullen, C., Briner, W., & Schmid, K. (2016). Eating Self-Regulation in Overweight and Obese Adults: A Concept Analysis. *Nursing Forum*, 51. <http://doi:10.1111/nuf.12125>.
- Sánchez, U., Weisstaub, G., Santos, J., Corvalán, C., & Uauy, R. (2016). GOCS cohort: children's eating behaviour scores and BMI. *European Journal of Clinical Nutrition*, 70, 925-928. <http://doi.org/10.1038/ejcn.2016.18>.
- Scaglioni, S., Salvioni, M., & Galimberti, C. (2008). Influence of parental attitudes in the development of children eating behaviour. *British Journal of Nutrition*, 99, Suppl.1, S22-S25. <https://doi.org/10.1017/S0007114508892471>.
- Schoentgen, B., Lancelot, C., & Le Gall, D. (2017). Comportement alimentaire de l'enfant et de l'adolescent souffrant d'obésité: intérêt d'un couplage des approches neurobiologique et neuropsychologique (Eating behavior in pediatric obesity: Of the advantages of combining the neurobiological and neuropsychological approaches). *Archives de Pédiatrie*, 24, 273-279. <https://doi.org/10.1016/j.arcped.2016.12.004>.

- Schrempft, S., van Jaarsveld, C., Fisher, A., Fildes, A., Wardle, J. (2016). Maternal characteristics associated with the obesogenic quality of the home environment in early childhood. *Appetite, 107*, 392-397. <http://doi.org/10.1016/j.appet.2016.08.108>.
- Sleddens, E., Kremers, S., Thijs, C. (2008). The Children's Eating Behaviour Questionnaire: factorial validity and association with Body Mass Index in Dutch children aged 6-7. *International Journal of Behavioral Nutrition and Physical Activity, 5*:49. doi:10.1186/1479-5868-5-49
- Snoek, H., Engels, R., Janssen, J., & van Strien, T. (2007). Parental behaviour and adolescents' emotional eating. *Appetite, 49*, 223-230. <http://doi.org/10.1016/j.appet.2007.02.004>.
- Snoek, H., van Strien, T., Janssens, J., & Engels, R. (2009). Longitudinal relationships between father', mothers', and adolescents' restrained eating. *Appetite, 52*, 461-468. <http://doi.org/10.1016/j.appet.2008.12.009>.
- Stroebe, W. (2008). Restrained eating and the breakdown of self-regulation. In *Dieting, overweight, and obesity Self-regulation in a food-rich environment*, pp. 115-139 [W. Stroebe, Editor]. Washington, DC: American Psychological Association.
- Tiggemann, M. & Lowes, J. (2002). Predictors of maternal control over children's eating behaviour. *Appetite, 39*, 1-7. <http://doi.org/10.1006/appe.2002.0487>.
- Tylka, T. L. (2006). Development and psychometric evaluation of a measure of intuitive eating. *Journal of Counseling Psychology, 53*, 226-240. <http://dx.doi.org/10.1037/0022-0167.53.2.226>.
- Tylka, T., Lumeng, J., & Eneli, I. (2015). Maternal intuitive eating as a moderator of the association between concern about child weight and restrictive child feeding. *Appetite, 95*, 158-165. <http://dx.doi.org/10.1016/j.appet.2015.06.023>.
- van Strien, T., & Bazelier, F. (2007). Perceived parental control of food intake is related to external, restrained and emotional eating in 7-12- year-old boys and girls. *Appetite, 49*, 618-625. <http://dx.doi.org/10.1016/j.appet.2007.03.227>.
- van Strien, T., Frijters, J., Bergers, G., & Defares, P. (1986). Dutch Eating Behaviour Questionnaire for assessment of restraint, emotional and external eating behaviour. *International Journal of Eating Disorders, 5*, 295-315. [http://dx.doi.org/10.1002/1098-108X\(198602\)5:2<295::AID-EAT2260050209>3.0](http://dx.doi.org/10.1002/1098-108X(198602)5:2<295::AID-EAT2260050209>3.0).
- van Strien, T., Herman, C., & Verheijden, M. (2009). Eating style, overeating, and overweight in a representative Dutch sample. Does external eating play a role? *Appetite, 52*, 380-387. <http://dx.doi.org/10.1016/j.appet.2008.11.010>.
- van Strien, T., Herman, C., & Verheijden, M. (2014). Dietary restraint and body mass change. A 3-year follow up study in a representative Dutch sample. *Appetite, 76*, 44-49. <http://dx.doi.org/10.1016/j.appet.2014.01.015>.
- Ventura, A., & Birch, L.L. (2008). Does parenting affect children's eating and weight status? *International Journal of Behavioral Nutrition and Physical Activity, 17*, 5:15. <http://dx.doi.org/10.1186/1479-5868-5-15>.
- Viana, V., Franco, T., Morais, C., Almeida, P., Silva, D., & Guerra, A. (2012). Controlo Alimentar Materno e Estado Ponderal: Resultados do Questionário Alimentar para Crianças (Mother's feeding control and weight status: Results of the Child Feeding Questionnaire). *Psicologia, Saúde & Doenças, 13*, 298-310.
- Viana, V., & Sinde, S. (2003). Estilo alimentar: Adaptação e validação do Questionário Holandês do Comportamento Alimentar (Eating style: adaptation and validation of the Dutch Eating Behaviour Questionnaire). *Psicologia, Teoria, Investigação e Prática, 8*, 59-71.
- Viana, V. & Sinde, S. (2008). Comportamento alimentar em crianças: Estudo de validação de um questionário numa amostra portuguesa (CEBQ) (Eating behavior in Children: A validation study of a questionnaire in a Portuguese sample). *Análise Psicológica, 1*(26), 111-120.
- Viana, V., Sinde, S., & Saxton, J. (2008). Children's Eating Behaviour Questionnaire: Associations with BMI in Portuguese Children. *British Journal of Nutrition, 100*, 445-450. <http://dx.doi.org/10.1017/S0007114508894391>.
- Wansink, B., Hanks, A., & Kaipainem, K. (2016). Slim by Design: Kitchen Counter Correlates of Obesity. *Health Education & Behaviour, 43*, 552-558, <http://dx.doi.org/10.1177/1090198115610571>.
- Wardle, J., Guthrie, C., Sanderson, S., & Rapoport, L. (2001). Development of the Children's Eating Behaviour Questionnaire. *Journal of Child Psychology and Psychiatry, 42*, 963-970. <https://doi.org/10.1111/1469-7610.00792>.
- Wardle, J., Sanderson, S., Guthrie, C., Rapoport, L., & Plomin, R. (2002). Parental feeding style and the intergenerational transmission of obesity risk. *Obesity Research, 10*, 453-462. <http://doi.org/10.1038/oby.2002.63>.
- Webber, L., Cooke, L., Hill, C., & Wardle, J. (2010). Associations between Children's Appetitive Traits and Maternal Feeding Practices. *Journal of the American Dietetic Association, 110*, 1718-1722. <http://dx.doi.org/10.1016/j.jada.2010.08.007>.
- Webber, L., Hill, C., Cooke, L., Carnell, S., & Wardle, J. (2010). Associations between child weight and maternal feeding styles are mediated by maternal perceptions and concerns. *European Journal of Clinical Nutrition, 64*, 259-265. <http://dx.doi.org/10.1038/ejcn.2009.146>.
- Webber, L., Hill, C., Saxton, J., Jaarsveld, C., & Wardle, J. (2009). Eating Behaviour and Weight in Children. *International Journal of Obesity, 33*, 21-28. <http://dx.doi.org/10.1038/ijo.2008.219>.