

Maternal Eating Behavior and Problematic Eating Behaviors of Children Undergoing Weight Loss Treatment: A Cluster Analysis

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Abstract

Background: Research on the interplay between mothers' and children's eating behaviors is needed to better inform sensitive and tailored interventions for treatment-seeking children with overweight/obesity. The present study aimed to identify mothers' eating behavior phenotypes, investigating their associations with problematic eating behaviors of children undergoing weight loss treatment in two central hospitals.

Methods: This is a cross-sectional study evaluating 136 mother–child dyads (Mothers: age 39.58 ± 5.40 years; Children: $n = 75$ female; age 10.13 ± 1.37 years). Mothers' eating behavior (restraint, emotional, and uncontrolled eating) and depression/anxiety, and children's problematic eating attitudes/behaviors were assessed. A cluster analysis (K-means) was performed using mothers' eating behavior dimensions. Multivariate Analysis of Covariance investigated differences between clusters on mothers' and children's sociodemographic, anthropometric, psychological, and eating-related variables.

Results: Three clusters emerged: The *Disordered Eating* group ($n = 39$) of mothers with the highest scores on emotional eating and uncontrolled eating dimensions, the *Restraint Eating* group ($n = 48$), including mothers scoring high in cognitive restraint, and the *Low Disordered Eating* ($n = 49$) group where mothers scored low in all eating behavior dimensions. Children of mothers in the *Disordered Eating* cluster had significantly higher emotional overeating relative to children of mothers in the other two clusters.

Conclusions: Distinctive eating behavior profiles of mothers, instead of the presence of single eating behaviors, seem to be associated with specific problematic eating behaviors of children undergoing weight loss treatment. Prospective studies are essential to determine whether these profiles can predict differential weight change trajectories in pediatric obesity treatment.

Keywords: children; cluster analysis; pediatric obesity; problematic eating behaviors; mother

Introduction

According to recent data from the Childhood Obesity Surveillance Initiative 2019 (COSI), 29.6% of Portuguese children between 6 and 8 years of age have overweight or obesity.¹ Results from the Portuguese Generation XXI birth cohort study added critical information about the rising rates of obesity prevalence with age, from 10.6% at age 4 to 16.8% at age 10.² Despite the genetic vulnerability being a well-established risk factor contributing to the development of obesity, potentially modifiable

environmental and behavioral factors also play a key role to the onset and maintenance of overweight/obesity, which may inform treatment development and tailoring.^{3,4}

Recent evidence indicates that problematic eating behavior in adults and children can partly mediate the effect of genes on BMI.⁵ In fact, appetitive traits such as high food responsiveness and low satiety responsiveness have a robust genetic basis and together with food environment can influence the expression of problematic eating behaviors,⁶ that in turn are related to psychological distress^{7,8} and poor weight loss treatment prognosis in children and adults.^{9,10}

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Cognitive restraint, uncontrolled and emotional eating are eating behaviors related to weight management frequently targeted in interventions addressing childhood obesity.¹¹ Cognitive restraint describes the use of restricting eating strategies mostly due to individual's concern about weight control. The reliance on cognitive strategies to control eating (*e.g.*, eating small proportions, avoiding caloric foods) is usually linked to a subsequent loss of control over eating, high responsiveness to food palatability/social cues, and eating in the absence of hunger (uncontrolled eating).¹² Some studies have found uncontrolled eating to be associated with a higher BMI, less success in weight loss attempts, and binge eating behaviors/overeating due to psychological deprivation and subjective feelings of hunger.^{12,13} In addition, emotional eating characterizes a mood regulation strategy that includes eating to manage and reduce negative emotions/states (*e.g.*, anger, sadness, anxiety).¹⁴ Emotional eating is associated with unhealthy food choices, higher energy intake, increased levels of psychological distress and psychopathology.^{14,15}

Simultaneously, intergenerational studies have shown that transgenerational effects influence eating behaviors and attitudes, and that parents' own beliefs and eating behaviors are major determinants in the development of offspring problematic eating habits and behaviors.^{16–19} Therefore, parents are often targeted as change agents in pediatric weight management interventions²⁰ since literature consistently shows that children of parents who eat healthily are more likely to eat healthily as well.²¹ Parents, predominantly mothers, can act as role models of healthy/unhealthy eating patterns by controlling food availability and intake.^{22–24}

Additionally, mothers' restrictive, uncontrolled, and emotional eating behaviors have been associated with children's increased BMI *z* score^{12,25–28} and problematic eating behaviors. For example, maternal emotional eating is consistently associated with children's emotional eating.^{19,26} A recent study argued that emotional eating in children is a learned behavior from parental modeling rather than a result of genetic vulnerability.²⁹ Correspondingly, children's restraint eating behaviors can be predicted by their mothers' restrained eating.¹⁹ For instance, mothers' dieting behaviors seem to be associated with daughters' early dieting behavior (before 11 years old), regardless of mothers' weight status.³⁰

In addition to the associations found between mothers' uncontrolled eating and children's adiposity,²⁸ twin studies suggest that such similitude is likely due to the disinhibited eating heritability.³¹ Moreover, the relationship between mother and child eating disorders showed to be mediated by maternal anxiety and depression levels.³² In fact, mothers' higher levels of depressive symptomatology are also linked to increased children's emotional and restraint eating.³³

Taken together, these data highlight an interplay between mothers' and children's eating behaviors, but it does not account for the fact that the same individual may experience different degrees of varied problematic eating

behaviors/attitudes. To the best of our knowledge, no study has investigated eating behavior clusters of mothers of children undergoing ambulatory weight loss treatment and their associations with children's problematic eating behaviors. Such research would provide important clinical insights to better specify the role of parents in pediatric obesity treatment.^{34,35}

A cluster analysis exclusively based on psychopathology and problematic eating behaviors of children/adolescents with overweight seeking weight loss treatment suggested the existence of three groups: the dietary restraint/internalizing group, the internalizing, and the nonsymptomatic groups.³⁶ Nevertheless, there is no evidence about how these groups are related to specific maternal eating behavior profiles, and research on subtypes of maternal eating behaviors with this population is limited. Subtyping is particularly relevant in a context where mothers are considered key eating behavior role models and family-based behavioral interventions are considered the first-line treatment option.³⁷ Informing health care professionals and researchers about the distinguishing patterns of maternal eating behavior might help to optimize treatment as usual outcomes, also facilitating the development of personalized family-based interventions

The purpose of this study is to identify phenotypes based on eating behaviors (restraint eating, emotional and uncontrolled eating assessed by the Three-Factor Eating Questionnaire-Revised 21) of mothers of children with overweight and obesity who are undergoing outpatient weight control treatment. In addition, cluster differences in mothers' and children's sociodemographic, anthropometric, psychological, and problematic eating behaviors are explored to better inform tailored interventions for treatment-seeking children with overweight/obesity.

Methods

Recruitment and Procedures

This is a cross-sectional study assessing children undergoing weight loss treatment for overweight and obesity (along with their mothers) in two public and central hospitals in the north of Portugal. Participants included mother-child dyads who attended an appointment for pediatric nutrition in these hospitals and were assessed at different treatment points. Eligible participants were invited for the study during their appointment. All children included in this study had already started hospital outpatient treatment. The inclusion criteria for children's eligibility were age ranging between 8 and 12 years, BMI percentile equal to or greater than the 85th. Mothers needed to agree to participate in the study. Participants who were not able to read or presented development disorders, learning, and intellectual disabilities were excluded from the study.

Mother-child dyads who agreed to participate signed the informed consent form (children's signed informed assent). Subsequently, healthcare professionals collected the

anthropometric data of participating children and mothers. Finally, mothers and children responded to a set of self-report measures. Data collection took place from November 2015 to March 2018.

This study was implemented in accordance with the Declaration of Helsinki and approved by the University of Minho Ethics Committee for Research in Life and Health Sciences (SECVS142/2015) and by the Ethics Committees from the clinical centers involved (Centro Hospitalar do Porto [2015.192(164-DEFI/153-ES)]; Centro Hospitalar Universitário de São João [19/06/2015]).

Measures

Clinical sociodemographic questionnaire. This questionnaire was used to assess mothers' age, educational level, marital and occupational status, children's age, and gender.

Anthropometric data of mothers and children. Children and mothers' height were measured using a portable stadiometer (Seca® 206 model; Postfach, Germany) to the nearest 1 mm. Children's body weight and body fat percentage were measured by a digital balance scale (Tanita® Body Composition Analyzer, TBF 300 model; Tanita Corp., Arlington Heights, IL, USA) set to the nearest 0.01 kg. Children's waist circumference was measured in centimeters with a portable measuring tape using Cameron's Method. BMI *z* scores for age and sex were calculated using World Health Organization (WHO) Anthroplus software 3.2.2 version³⁸ and BMI percentiles were defined using the National Center for Health and Statistics (NCHS) growth curves. Mothers' weight was measured by a portable balance scale (Seca® model 220; SECA Corp., Hamburg, Germany, 2008) to the nearest 0.01 kg. Mothers' weight status was classified according to WHO BMI cutoffs.³⁹

Mother Self-Report Measures

Three-Factor Eating Questionnaire-Revised 21 (TFEQ-R21).^{40,41} This is a 21-item instrument to assess eating behaviors subdivided into three domains: cognitive restraint, uncontrolled eating, and emotional eating. All first 20 items are answered on a four-point Likert scale (1=*completely true*; 4=*completely false*) and the last item is answered on an eight-point numerical rating scale. Raw scores were transformed into a 0–100 scale. Higher scores in each domain are indicative of greater cognitive restraint, uncontrolled eating, and emotional eating. Cronbach's α for this sample were 0.74, 0.87, and 0.91 for cognitive restraint, uncontrolled eating, and emotional eating, respectively (McDonald's ω for this sample: Cognitive Restraint=0.75; Uncontrolled Eating=0.87; Emotional Eating=0.91).

Depression Anxiety Stress Scales.^{42,43} This instrument is composed of 21 items equally divided for three subscales: depression, anxiety, and stress. The responses are given on a four-point Likert scale (0=*I strongly disagree*; 3=*I totally agree*). For the purpose of the present study, only depression

and anxiety subscales were used. The final score of each subscale ranges from 0 to 100 points, with higher scores indicating more negative affective states (McDonald's ω for this sample: Depression Scale=0.88; Anxiety Scale=0.59).

Mother Reports of Child Behaviors

Children's Eating Behavior Questionnaire.^{44,45} This is a 35-item questionnaire completed by parents about their children's eating styles. All items are rated using a Likert scale of five points (1=*never*; 5=*always*) with higher scores indicating poorer functioning in the domain assessed. In accordance with the aims of the study only the emotional overeating scale was used (four items) (McDonald's ω for this sample=0.89).

Child Self-Report Measures

Children's Eating Attitudes Test.^{46,47} Children's Eating Attitudes Test (ChEAT) assesses problematic eating attitudes and behaviors through 26 items answered on a 6-point Likert scale (1=*never*; 6=*always*). For the purpose of this study, only the total score was used (McDonald's ω for this sample=0.91). Higher scores indicate the presence of problematic eating attitudes and behaviors (specifically Fear of Getting Fat, Restrictive and Purging Behaviors, Food Preoccupation, and Social Pressure to Eat).

Statistical Analyses

The IBM® SPSS® Statistics 22.0 (SPSS, Inc., Chicago, IL) was used for data analyses. Descriptive statistics examined demographic and anthropometric characteristics. McDonald's ω was calculated using JASP version 0.12.2 (JASP Team University of Amsterdam, Amsterdam, The Netherlands) to all self-report measures as an estimate of scale reliability.

Mothers' Eating Behavior Clusters

A cluster analysis was performed with the Three-Factor Eating Questionnaire-R21 dimensions (Emotional Eating; Cognitive Restraint; and Uncontrolled Eating) to identify phenotypes based on mothers' eating behavior. The cluster analysis followed a two-step approach based on the previously computed factor scores to identify subgroups within the data. First, a hierarchical cluster analysis using Ward's method generated a dendrogram for estimation of the probable number of clusters. This estimate was pre-specified in a K-means cluster analysis, which was used as the principal clustering technique. The final decision on the number of clusters considered several approaches being supported by the analysis of the Akaike's Information Criterion (AIC) plot and by the Silhouette Method, which was used as an indicator of cluster consistency. The silhouette values range from -1 to +1, a high value indicates that the object is well matched to its own cluster and poorly matched to the neighboring cluster. To test the stability of the clusters, a replication analysis within two randomly selected subsets from the original sample ($n=68$ and $n=96$) was conducted to assess how robust the clusters are

at capturing the structure of the data. A cluster was considered as high in a given eating behavior dimension when the mean was higher than the first standard deviation score obtained in the Portuguese validation study of the Three-Factor Eating Questionnaire-R21. Three-Factor Eating Questionnaire-R21 mean and standard deviation values for the Portuguese population were: Emotional Eating ($M=11.46$, $SD=4.48$); Cognitive Restraint ($M=13.26$, $SD=3.95$); Uncontrolled Eating ($M=18.45$, $SD=4.96$).⁴⁰

Differences between Clusters on Mothers' and Children's Anthropometric, Sociodemographic, and Eating-Related Variables

Univariate tests [one-way analysis of variance; ANOVA (with Tukey's HSD *post hoc* tests), Chi-square Test, and Kruskal-Wallis Tests] were used to determine differences between the clusters regarding mothers' and children's anthropometric, sociodemographic, and eating-related variables. Finally, two multivariate analyses of covariance (MANCOVAs) followed by pairwise univariate contrasts (one-way ANOVA with Tukey's HSD *post hoc* tests) corrected for multiple comparisons were conducted to investigate cluster differences on (1) mothers' psychological distress (Depressive Symptomatology and Anxiety levels—DASS-21) controlling for mothers' BMI; and (2) separately, on children's problematic eating behaviors (Emotional Overeating—Children's Eating Behavior Questionnaire [CEBQ], and problematic Eating Attitudes/Behaviors—ChEAT total score) controlling for mothers' depressive symptomatology. Mean z scores were used in Figure 2 to describe Emotional Overeating—CEBQ and ChEAT total scores per cluster. Partial eta squared (η^2) was calculated with 0.01 indicating small, 0.06 indicating medium, and 0.13 indicating large effect size.⁴⁸ p Values <0.05 were considered significant.

Results

Participants

A total of 136 mother-child dyads participated in this study. The mean age of the children assessed was 10.13 ($SD=1.37$) years, 75 were females (55.1%), and the majority were attending middle school ($n=84$, 62.2%). Children's body fat and waist circumference were 34.75% ($SD=6.05$) and 89 cm ($SD=10.33$) on average, respectively. The majority of the children had obesity ($n=113$, 87.6%) and their mean BMI z score was 2.77 ($SD=0.71$).

The age of mothers ranged between 24 and 52 years old ($M=39.58$, $SD=5.40$). The majority completed middle school ($n=65$, 46.7%), had a full-time job ($n=75$, 57.4%), and were married or cohabited with the child's biological father ($n=101$, 73.9%). Mothers' mean BMI was 29.64 kg/m² ($SD=5.78$), 41.7% ($n=55$) had overweight, 40.9% ($n=54$) obesity, and 17.4% ($n=23$) presented normal weight (according to WHO cutoffs³⁹).

Clusters of Mothers' Eating Behaviors

A three-cluster solution based on the mother's eating behavior (cognitive restraint, emotional eating, and uncontrolled eating, as assessed by TFEQ-R21) was the most suitable to the data. The silhouette mean value was 0.35, $SD=0.16$ (Min. -0.02 ; Max. 0.58). The positive mean value indicates good cluster consistency of the cluster solution. Table 1 displays the mean scores of the TFEQ-R21 dimensions for the three clusters. Figure 1 depicts the scores on each eating behavior dimension of mothers per cluster.

Cluster 1 included 28.68% of the sample ($n=39$) and was labeled the "Disordered Eating" cluster. This cluster was characterized by mothers with the highest scores on emotional eating and uncontrolled eating dimensions, as well as high levels of cognitive restraint.

Cluster 2 represented 35.29% of the sample ($n=48$) and corresponded to the "Restraint Eating" cluster. Mothers in this cluster scored the highest scores on cognitive restraint, compared with the other two clusters, but had low scores on emotional eating and uncontrolled eating.

Cluster 3 represented 36.03% of the sample ($n=49$) and was labeled the "Low Disordered Eating" cluster. Overall, this cluster included mothers with the lowest scores on all dimensions of the TFEQ-R21.

Differences between Clusters on Mothers' Sociodemographic, Anthropometric, and Psychological Distress

Table 2 presents the differences between the three groups on the self-report measures responded by mothers about themselves. No significant differences were found between the three clusters regarding mothers' age, educational level, marital status, or occupational status. Statistically significant differences were found on one-way ANOVA with Tukey's HSD *post hoc* tests between the three clusters regarding the mothers' BMI [$F(2, 129)=6.15$, $p=0.003$] with the *Disordered eating* cluster showing higher mothers' BMI than the *Low Disordered Eating* cluster (mean difference = 4.17, $p=0.002$). Therefore, mothers' BMI was included as covariate in the following analysis.

MANCOVA showed a significant overall effect of cluster membership on mothers' psychological distress (depressive symptomatology and anxiety), while controlling for mothers' BMI [$F(2, 128)=4.38$, $p=0.014$; $\lambda_{\text{largest}}=0.068$; partial $\eta^2=0.064$]. Univariate analyses showed that depressive symptomatology (DASS-21) [$F(2, 128)=4.38$; $p=0.014$; partial $\eta^2=0.064$] was significantly different between clusters. No significant differences were found in univariate tests for anxiety levels (DASS-21) [$F(2, 128)=1.53$; $p=0.221$; partial $\eta^2=0.023$]. *Post hoc* Tukey's HSD tests revealed that mothers from the *Low Disordered Eating* cluster scored significantly lower on depressive symptomatology than mothers from the *Disordered Eating* (mean difference = -2.59 ;

Table 1. Mean Values of Three-Factor Eating Questionnaire-Revised 21 Dimensions in Each Cluster

TFEQ-R21 Dimensions	Cluster 1: "Disordered Eating" (n = 39)		Cluster 2: "Restrained Eating" (n = 48)		Cluster 3: "Low Disordered Eating" (n = 49)		F ^a	p	Post hoc tests		
	Mean (SD)	Percentile, mean (%)	Mean (SD)	Percentile, mean (%)	Mean (SD)	Percentile, mean (%)			LE vs. DE	LE vs. RE	DE vs. RE
Emotional Eating	58.86 (15.87)	86.97	15.16 (13.88)	47.87	8.28 (10.83)	39.14	172.91	0.001***	DE>LE***	RE>LE*	DE>RE***
Cognitive Restraint	57.55 (17.54)	59.31	71.76 (12.91)	77.91	33.56 (15.13)	26.07	78.68	0.001***	LE<DE***	RE>LE***	RE>DE***
Uncontrolled Eating	45.20 (14.10)	83.03	19.16 (16.56)	44.29	15.19 (13.23)	38.66	51.34	0.001***	DE>LE***	ns	DE>RE***

^aOne-way ANOVA; post hoc Tukey's HSD test; * $p < 0.05$; *** $p < 0.001$; DE; RE; LE; Emotional Eating, Cognitive Restraint and Uncontrolled Eating measured with the Three-Factor Eating Questionnaire-R21 ranging from 0 to 100; Three-Factor Eating Questionnaire-R21 mean and standard deviation values for the Portuguese population: Emotional Eating (M = 11.46, SD = 4.48); Cognitive Restraint (M = 13.26, SD = 3.95); Uncontrolled Eating (M = 18.45, SD = 4.96).³⁴
ANOVA, analysis of variance; DE, Disordered Eating Cluster; LE, Low Disordered Eating; RE, Restrained Eating Cluster; SD, standard deviation; TFEQ-R21, Three-Factor Eating Questionnaire-Revised 21.

$p = 0.003$) and *Restraint Eating* clusters (mean difference = -1.89 ; $p = 0.032$).

Differences between Clusters on Children's Problematic Eating Behaviors

Table 3 presents the differences between mothers' clusters on children's sociodemographic, anthropometric, and problematic eating behavior-related variables. There were no significant differences between clusters on children's gender $\chi^2(2) = 1.18$, $p = 0.554$, age $F(1, 129) = 0.942$; $p = 0.393$, BMI z score $F(1, 129) = 0.271$; $p = 0.763$, or waist circumference $F(1, 129) = 0.640$; $p = 0.529$.

MANCOVA results showed a significant overall effect of the clusters on children's problematic eating behaviors (problematic eating attitudes/behaviors and emotional overeating), while controlling for mothers' depressive symptomatology, which was found to vary between clusters in the previous analysis [$F(4, 252) = 4.547$, $p = 0.001$; Wilk's $\Lambda = 0.87$, partial $\eta^2 = 0.067$].

Univariate analyses showed that children's emotional overeating (CEBQ) [$F(2, 127) = 5.712$; $p = 0.004$; partial $\eta^2 = 0.083$] and problematic eating attitudes/behaviors (ChEAT total score) [$F(2, 127) = 3.523$; $p = 0.032$; partial $\eta^2 = 0.053$] were significantly different between clusters. Post hoc Tukey's HSD tests revealed that emotional overeating in children of mothers in the *Disordered Eating* cluster was significantly higher relative to children of mothers in the *Restraint Eating* (mean difference = 0.63 ; $p = 0.012$) and *Low Disordered Eating* clusters (mean difference = 0.90 ; $p < 0.001$). No difference was found between children of mothers in the *Restraint Eating* and the *Low Disordered Eating* clusters (mean difference = -0.27 ; $p = 0.388$). Additionally, problematic eating attitudes/behaviors were significantly higher in children of mothers in the *Restraint Eating* cluster relative to children of mothers in the *Low Disordered Eating* cluster (mean difference = 6.66 ; $p = 0.038$). No differences were found between children of mothers in the *Disordered Eating and Restraint Eating* clusters (mean difference = -6.15 ; $p = 0.083$) and of mothers in the *Disordered Eating and the Low Disordered Eating* clusters (mean difference = 0.51 ; $p = 0.982$). Figure 2 shows the mean z scores of children's emotional overeating and problematic eating attitudes/behaviors by mothers' cluster.

Discussion

Results from this study suggest three distinct eating behavior profiles of mothers based on eating dimensions assessed by the TFEQ-R21 (emotional eating, uncontrolled eating, and cognitive restraint): (1) the *Disordered Eating*, (2) the *Restraint Eating*, and (3) the *Low Disordered Eating* clusters. These three clusters were associated with differences in mother's BMI and depressive symptomatology, but also with problematic eating behaviors (emotional eating and problematic eating attitudes/behaviors) of children under weight loss

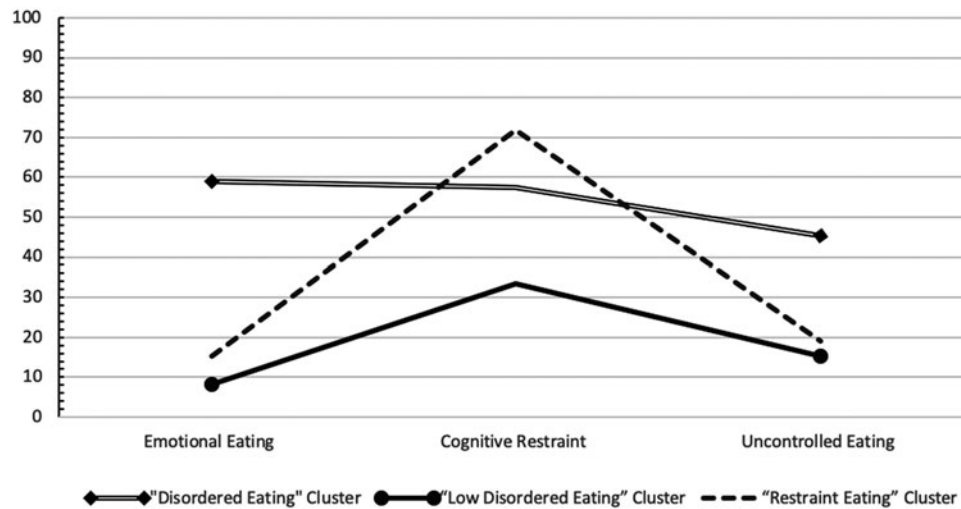


Figure 1. Mothers' eating behavior clusters: mean scores on TFEQ-R21 dimensions per cluster. TFEQ-R21, Three-Factor Eating Questionnaire-Revised 21.

treatment, even after controlling for mothers' depressive symptomatology.

Mothers from the *Disordered Eating* cluster demonstrated the highest BMIs, falling within the obesity category, and present with additional depressive psychopathology. The psychopathological nature of maternal eating behaviors in this cluster could reflect a context of disorganized eating habits encouraging eating in response to emotions in their offspring. These results bring further evidence for the research suggesting that family attitudes and behaviors may impact children's eating style,^{17-19,49} highlighting the associations between maternal eating disorders and their children's eating behaviors that showed to be mediated by maternal anxiety and depression levels in previous studies.³² Research should investigate if these are the mothers of children who present poor weight loss outcomes during weight loss treatment. A personalized approach rather than a "one-size-fits-all" paradigm focused on identifying and treating mothers' disordered eating may be needed to impact children's problematic eating behaviors and optimize weight loss. Multifarious environmental factors related to childhood obesity, such as socioeconomic status and neighborhood-built environment features, should also be considered in the design of personalized interventions.

The *Restraint Eating* cluster is characterized by mothers scoring the highest solely on the cognitive restraint dimension, but showing relatively low levels of emotional and uncontrolled eating. It is possible that these mothers show high commitment and motivation to pursue a restrictive diet, perhaps due to unhealthy body ideals. By doing so, they may be modeling highly restrictive behaviors/attitudes and encouraging similar mindsets in their children. Indeed, children of mothers from this cluster scored significantly higher on overall eating disordered psychopathology attitudes and behaviors. Past research

showed that mothers who are concerned with their weight and present restrictive behaviors such as dieting may also restrict their children's food intake.^{30,50} Restrictive attitudes in mothers are probably linked to more severe children's weight control behaviors, which might be a trigger for the development of eating disorders, particularly in dieters,⁵¹ and should therefore be a focus of attention from clinicians in the field.

The *Low Disordered Eating* cluster includes mothers with the lowest levels across all eating behavior dimensions, as well as mothers with the lowest BMI and depressive symptomatology of the three groups. These mothers, with a more adaptive eating behavior style, also tended to have children scoring the lowest on emotional eating and eating psychopathology. Considering that the absence of disordered eating in individuals and children undergoing weight loss treatment is an indicator of good weight loss outcomes,^{52,53} future research should investigate if these are the mothers of children with the best treatment outcomes. This could also inform the design of interventions for preventing obesity in children, as literature has shown that early maternal guidance on positive/protective feeding practices is associated with healthier child eating behaviors in infancy, long-term maintenance of healthy eating habits, and reduction of the obesity risk.¹¹

Interestingly, our final three cluster solution seem to be in accordance with maternal eating behavior clusters founded in an earlier empirical research with a community sample.²⁷ In this study, the clusters did not differ on children's BMI z score. However, we should note that our sample was a clinical sample with overweight/obesity, which may have presented ceiling effects, since a Portuguese study with a community sample of children without obesity found that higher children BMI z scores are related to maternal restrictive and emotional/external

Table 2. Cluster Differences on Mothers' Sociodemographic, Anthropometric, and Psychological Distress Variables

	Disordered Eating; Cluster (n = 39)	Restraint Eating; Cluster (n = 48)	Low Disordered Eating Cluster (n = 49)	Test value	p	Post hoc tests		
						LE vs. DE	LE vs. RE	DE vs. RE
Educational level (n, %)				2.04 ^a	0.361	—	—	—
≤Middle school	19/48.7%	24/50.0%	32/65.3%					
≤High school	18/46.2%	20/41.7%	12/24.5%					
≤Bachelor degree	1/2.6%	3/6.3%	3/6.1%					
>Bachelor degree	1/2.6%	1/2.1%	2/4.1%					
Marital status (n, %)				0.79 ^b	0.992	—	—	—
Single	3/7.7%	4/8.3%	3/6.1%					
Married/living together with the child's parent	28/71.8%	35/72.9%	38/77.6%					
Married/living together with other than the child's parent	3/7.7%	3/6.3%	2/4.1%					
Divorced	5/12.8%	6/12.5%	6/12.2%					
Occupational status (n, %)				5.59 ^b	0.693	—	—	—
Student	3/7.7%	5/10.4%	5/10.2%					
Unemployed	13/33.3%	14/29.2%	12/24.5%					
Employed (part-time)	0/0%	2/4.2%	3/6.1%					
Employed	22/56.4%	27/56.3%	29/59.2%					
Retired	1/2.6%	0/0%	0/0%					
Age, years (M, SD)	38.95 (5.12)	39.87 (6.05)	39.80 (4.99)	0.38 ^c	0.688	—	—	—
BMI ^d , kg/m ² (M, SD)	31.74 (5.35)	30.05 (6.62)	27.57 (4.54)	6.15 ^c	0.003**	DE>LE**	ns	ns
Depression—DASS-21	4.41 (4.49)	3.70 (3.88)	1.81 (2.48)	4.38 ^e	0.014*	LE<DE**	LE<RE*	ns
Anxiety—DASS-21	4.05 (3.26)	3.92 (3.41)	2.76 (2.60)	1.53 ^e	0.221	ns	ns	ns

N = 136.

^aKruskal–Wallis test.

^bChi-square test.

^cOne-way analysis of variance (*post hoc* Tukey's HSD).

^dThere are some missing values.

^eMANCOVA for mothers' Depressive Symptomatology and Anxiety, controlling for mothers BMI with pairwise univariate contrasts (*post hoc* Tukey's HSD)— $F(2, 128) = 4.38, p = 0.014; \lambda_{\text{largest}} = 0.068; \text{partial } \eta^2 = 0.064$.

DASS-21, Depression Anxiety Stress Scales; DE, Disordered Eating Cluster; LE, Low Disordered Eating Cluster; MANCOVA, multivariate analysis of covariance; RE, Restraint Eating Cluster; *post hoc* Tukey's HSD test.

* $p < 0.05$; ** $p < 0.01$.

eating styles.²⁷ Furthermore, it seems worthwhile to consider that dissemination of effective interventions for pediatric obesity is still limited in public health care settings and that less is known about the extent to which family feeding dynamics, comprising not only maternal but also paternal psychological and behavioral characteristics, can impact outcomes of ambulatory pediatric obesity interventions. In fact, promoting consonant

healthy feeding practices and behaviors among mothers and fathers may be related to a healthier child dietary quality.⁵⁴ This is particularly relevant since pediatric obesity prevalence rates continue to be high in developed countries and are still rising for youth from low socioeconomic backgrounds⁵⁵ for whom ambulatory obesity treatment on public health care settings are frequently the only affordable option.

Table 3. Cluster Differences on Children’s Sociodemographic, Anthropometric, and Problematic Eating Behavior Variables

	Disordered Eating; Cluster (n = 39)	Restraint Eating; Cluster (n = 48)	Low Disordered Eating Cluster (n = 49)	Test value	p	Post hoc tests		
						LEvs.DE	REvs.LE	DEvs.RE
Gender (n, %)				1.18 ^a	0.554	—	—	—
Male	16/41.0%	20/41.7%	25/51.0%					
Female	23/59.0%	28/58.3%	24/49.0%					
Age, years (M, SD)	10.03 (1.39)	10.00 (1.31)	10.35 (1.42)	0.75 ^b	0.474	—	—	—
BMI z score ^c (M, SD)	2.75 (0.62)	2.83 (.75)	2.72 (0.73)	0.03 ^b	0.967	—	—	—
Waist circumference ^c , cm (M, SD)	87.59 (8.29)	89.73 (10.57)	90.38 (11.33)	0.74 ^b	0.482	—	—	—
Disordered Eating Attitudes/Behaviors (ChEAT-Total score)	48.51 (9.37)	53.12 (11.54)	48.13 (8.13)	3.52 ^d	0.032*	ns	RE>LE*	ns
Emotional Overeating (CEBQ)	55.15 (9.78)	49.20 (9.86)	46.65 (8.75)	5.71 ^d	0.004**	DE>LE***	ns	DE>RE*

N = 136.

^aChi-square test.

^bOne-way analysis of variance.

^cThere are some missing values.

^dMANCOVA for Problematic Eating Attitudes/Behaviors (ChEAT total score) and Emotional Overeating (CEBQ) controlling for mothers depressive symptomatology with *post hoc* Tukey’s— $F(4, 252) = 4.547, p = 0.001$; Wilk’s $\Lambda = 0.87$, partial $\eta^2 = 0.067$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

post hoc Tukey’s HSD test.

CEBQ, Children’s Eating Behavior Questionnaire (T-Scores); ChEAT, Children’s Eating Attitudes Test (T-Scores); DE, Disordered Eating Cluster; LE, Low Disordered Eating Cluster; RE, Restraint Eating Cluster; ns, nonsignificant.

Strengths and Limitations

This study has some limitations. The clusters that emerged in our study are of mothers with high BMIs, most of them falling within the overweight/obesity range, with children who have overweight/obesity. Therefore, these

clusters may not replicate in a normal-weight population. This was a clinical sample and consequently mother–children dyads may experience more distress and psychopathology than community dyads. Moreover, mothers reported on children’s emotional overeating in CEBQ,

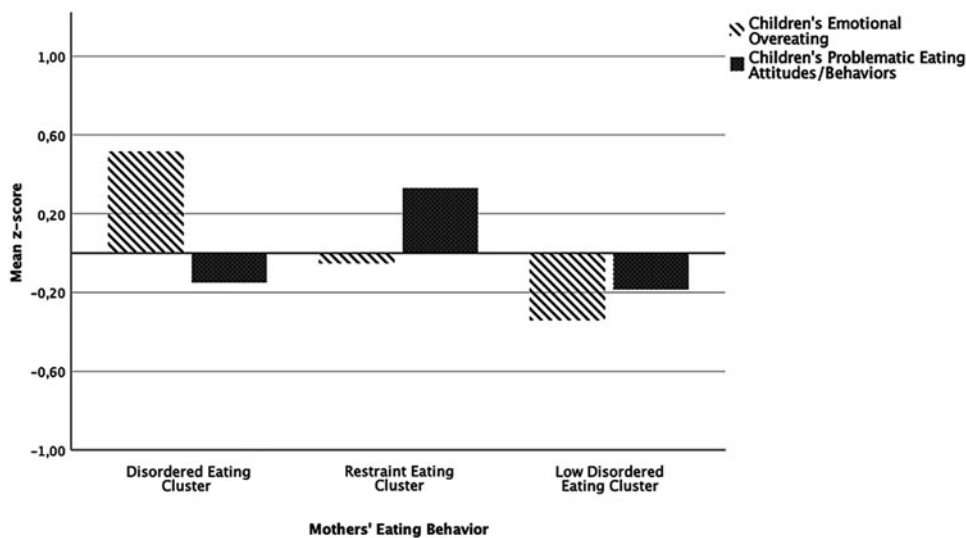


Figure 2. Mean z scores of children’s emotional overeating and problematic eating attitudes/behaviors by mothers’ eating behavior clusters.

which may result in some social desirability bias, considering that children were approached while in treatment, and some of the responses might reflect the treatment orientations that they were receiving. Additionally, considering the cross-sectional nature of this study we cannot conclude about the impact of these profiles on their children's weight, eating behaviors, or treatment outcomes, rendering the discussion to the concurrent association between these variables.

Despite the limitations, maternal eating attitudes and behaviors may be a changeable factor within the “obesogenic environment” interrelated to children's success in obesity treatment. Additionally, the use of an understudied sample of children with overweight and obesity pursuing weight loss in hospital-based treatment, together with the objective measurement of children's and mothers' anthropometric variables and use of validated questionnaires, strengthens the integrity of the study results. Finally, data were collected in two public central hospitals for pediatric obesity treatment in the north of the country indicating representativeness of the sample of children undergoing outpatient hospital treatment in the north of Portugal.

The study findings provide the groundwork for future research exploring the continuity and stability of mothers' eating behavior profiles during developmental trajectories, in order to test if these profiles can predict or mediate the children's anthropometric and psychosocial treatment outcomes. Comparative studies of mothers' eating behaviors in children with and without overweight/obesity will be important to increase the current understanding of the influence of mothers' disordered eating on parental feeding practices and ultimately on the onset of children's problematic eating behaviors.

Conclusions

Our study identified three phenotypes (clusters) based on eating behaviors of mothers of children with overweight/obesity undergoing outpatient weight control treatment. Children's emotional overeating was higher in the *Disordered Eating* cluster relative to the *Restraint Eating* cluster. Children problematic eating attitudes/behaviors were significantly higher in the *Restraint Eating* cluster when compared with the *Low Disordered Eating* cluster. Furthermore, our results suggest the need for more studies about the role of maternal eating behaviors in the long-term effectiveness of pediatric weight management interventions.^{56,57}

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