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Beyond the weight: the role of parenting outcomes on childhood obesity over time

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BEYOND THE WEIGHT: THE ROLE OF PARENTING OUTCOMES ON CHILDHOOD OBESITY OVER TIME

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A presente dissertação foi desenvolvida no âmbito do projeto de investigação "Intervenção no excesso de peso e na obesidade infantil: Eficácia de um programa para pais enquanto agentes de mudança (LifeStyle)" coordenado pela Professora Doutora Orlanda Maria da Silva Rodrigues da Cruz e pela Doutora Ana Catarina Miranda Canário. O projeto LifeStyle é promovido pela Faculdade de Psicologia e de Ciências da Educação da Universidade do Porto (FPCEUP), e financiado pela Fundação para a Ciência e Tecnologia (PTDC/SAUNUT/30715/2017).

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Resumo

Na última década, a prevalência de obesidade infantil (OI) aumentou substancialmente, estimando-se que 1/3 das crianças portuguesas tenham excesso de peso (EP) ou obesidade. Entre os diversos fatores que contribuem para a OI, os pais/cuidadores destacam-se enquanto agentes determinantes dos estilos de vida das crianças. O presente estudo teve como objetivos: caracterizar a prevalência de EP/OI em dois momentos de avaliação; explorar as associações entre as variáveis parentais e características sociodemográficas da família e o EP/a OI; testar os efeitos de moderação das variáveis parentais na evolução do índice de massa corporal padronizado (IMC z-score) das crianças entre dois momentos de avaliação. Participaram no estudo 128 pais de crianças dos 5 aos 12 anos, acompanhadas na consulta externa de pediatria de um hospital público português, onde recebem intervenção médica segundo as orientações da European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPHGAN). No primeiro momento, os pais completaram um questionário de autorrelato relativo aos seus comportamentos e práticas parentais, ajustamento psicológico e autorregulação para o tratamento, e de heterorrelato relativamente aos problemas de estilo de vida da criança. As medidas antropométricas das crianças foram recolhidas no início do estudo e 3 a 6 meses depois. Os resultados evidenciaram uma descida no IMC z-score médio entre avaliações. Todavia, no que respeita à prevalência de EP/OI, entre as duas avaliações, a maioria das crianças manteve-se na mesma categoria ou transitou para a categoria de IMC z-score inferior. Os resultados evidenciaram a associação entre o IMC z-score das crianças e variáveis parentais, nomeadamente, pobre monitorização, restrição, correlatos emocionais da obesidade, autoeficácia parental, stress e regulação externa, bem como características sociodemográficas dos participantes. Ademais, o stress, a autoeficácia parental e a regulação externa demonstraram moderar a evolução do IMC z-score ao longo do tempo.

Palavras-chave: Índice de Massa Corporal; Excesso de peso; Obesidade infantil; Práticas parentais; Pobre monitorização; Restrição; Correlatos emocionais; Autoeficácia parental; Stress; Regulação Externa.

Abstract

Over the last decade, the prevalence of childhood obesity (CO) has substantially increased, being estimated that 1/3 of Portuguese children are overweight (OW) or obese (O). From the several factors contributing to CO, parents/caregivers are highlighted as the main actors in shaping children's behaviors and lifestyles. The purposes of the current study were to: characterize the prevalence of childhood obesity in both assessment time points; explore the associations among parenting outcomes and family sociodemographic characteristics and obesity; test the moderation effect of the parenting variables on the relation between children's stantardized Body-Mass Index (BMI z-score) at both assessment time points. Participants were 128 parents of obese 5-to-12-years-old children, followed in an outpatient pediatric appointment in a Portuguese public hospital, where they receive intervention according to the European Society for Paediatric Gastroenteroloy Hepatoloy and Nutrition (ESPGHAN) guidelines. On the first assessment time point, parents completed self-reported measures on parenting behaviors and practices, psychological adjustment, and treatment self-regulation at baseline, and hetero-reported on the lifestyle-specific problems. Children's anthropometric measurements were evaluated at baseline and 3 to 6 months after. Results indicated na average decrease in the BMI z-score between evaluations. However, concerning the prevalence of OW/O, between both assessment time point, most of the children remained in the same category or changed to an inferior category. Results show an association between children's standardized Body Mass Index and parental outcomes, namely, poor monitoring, restriction, emotional correlates of being overweight, parental confidence, stress and external regulation, as well as some sociodemographic characteristics of the participants. Moreover, stress, parental confidence and external regulation were found to moderate the evolution of the BMI z-score over time.

Keywords: Body Mass Index; Overweight; Childhood obesity; Parenting practices; Poor monitoring; Restriction; Emotional correlates; Parental confidence; Stress; External regulation

Abbreviations' list

APQ – Alabama Parenting Questionnaire

BMI – Body Mass Index

CFQ – Child Feeding Questionnaire

CO – Childhood Obesity

DASS – Depression Anxiety Stress Scale

ESPGHAN – European Society for Paediatric Gastroenteroloy Hepatoloy and Nutrition

LBC – Lifestyle Behavior Checklist

M – Mean

PA – Physical Activity

TSRQ – Treatment Self-Regulation Questionnaire

SD – Standard Deviation

Introduction

In the last decades, the world has been noticing a substantial increase in childhood obesity (CO), which is defined as an abnormal fat accumulation that can impair physical and psychological health (Awasthi et al., 2020). In Portugal, it is estimated that one in every three children is overweight or obese (Rito et al., 2020). Considering the criteria defined by WHO, Portugal is one of the countries with a greater prevalence of CO; nevertheless, the rate has been decreasing in the last few years, showing a reverted tendency from 2008 to 2019 (Spinelli et al., 2019).

Childhood obesity has been linked to countless comorbidities, including Type 2 diabetes, cardiovascular disease, sleep apnea, asthma, hepatic disease, high cholesterol, insulin resistance, dermatological complications, menstrual abnormalities, and orthopedic problems (Phan et al., 2015; Sahoo et al., 2015). Although most of these problems may be prevented or reverted if the child reaches a healthy weight, its negative consequences extend until adulthood and throughout it (Sahoo et al., 2015) and, in the most severe cases, may cause premature mortality (Apperley et al., 2022). There are also many concerns on mental and psychological health, potentially affecting children's social and emotional wellbeing. Obese children tend to have lower self-esteem and self-confidence, a negative body-image, greater vulnerability to depression, lower academic performance, and reduced quality of life (Awasthi et al., 2020; Sahoo et al., 2015).

The literature highlights the multifactorial etiology of CO, resulting from the interaction between numerous elements and systems where the development of the child takes place (Bronfenbrenner, 1986; Sahoo et al., 2015). From a biological standpoint, the genetic susceptibility for the risk of CO has been identified (Harrison et al., 2011; Sahoo et al., 2015), being estimated that 35 to 40% of the predisposition to this condition comes from hereditary components, such as birth weight (Awasthi et al., 2020). Moreover, appetite regulation and consequent weight control suffer influence from hormonal and neural signs, particularly leptin and dopamine, both important agents in the regulation of food intake. The first one is involved in the control of fat and glucose metabolism (Coll et al., 2007) and, when ineffective, creates leptin resistance and promotes weight gain (Knight et al., 2010; Coll et al., 2007). The latter, related to motivated behavior, processes the rewarding aspects of food (Stice et al., 2013; Cameron et al., 2017).

Regardless of the relevance of biological factors in the predisposition to overweight, its long-term maintenance stems mainly from behavioral factors, emerging from the child's personal characteristics in association with significant elements from the contexts in which he/she is included (Dantas & Silva, 2019). One of the factors most significantly associated with obesity is sedentary lifestyle (Sahoo et al., 2015), defined as the lack of physical activity (PA) matched with a great exposure to screen devices (OECD, 2019). In Portugal, about 78% of the children aged 9-to-11-years-old accumulate at least three unhealthy lifestyle behaviors, such as sedentary habits, insufficient sleep, low consumption of fruits and vegetables, high consumption of sugary drinks and excessive screen time (Pereira et al., 2015). Additionally, it is estimated that 58% of Portuguese children do not comply with the WHO recommendations for daily PA (Lopes et al., 2017). These statistics are expected to have worsened in the last two years, due to the COVID-19 pandemic and consequent routine changes, along with increased stress and lack of structured activities (de Winter et al., 2020).

The maintenance of obesity and the lack of PA are strongly linked, since the first one leads to a weight increase which, in turn, triggers obstacles that make the child uncomfortable and unmotivated. Compared to eutrophic peers, obese children face difficulties in keeping up with peers' rhythm, have less physical resistance and poorer motor coordination (Sahoo et al., 2015), resulting in less motivation to stay active.

Dietary factors have been extensively studied, since obesity results from the imbalance between calorie intake and energy expenditure. Researchers have underlined the effect of excessive consumption of fast food and sugary drinks on the raising obesity rates. These products are less satiating than healthier options, leading to more frequent snacking and overall higher caloric intake (Sahoo et al., 2015).

It is important to consider that eating behavior emerges in the first years of children's lives and its establishment is influenced by factors such as breastfeeding (Jones et al., 2015), the introduction of complementary feeding after six months of age (Albuquerque et al., 2017; Costa et al., 2021), family feeding habits and socioeconomics characteristics of the family (Silva et al., 2016). Accordingly, some studies have shown that the quality of the first foods a child tastes predicts his/her eating behavior and future weight (Albuquerque et al., 2017; Costa et al., 2021). It seems clear that the child's lifestyle depends on the immediate proximal context (Harrison et al., 2011), and the family is assumed as the main environmental influence, potentialy able to mediate weight status and the risk of obesity (Anzman et al.,

2010). This influence occurs essentially through three pathways: parental perceptions and beliefs about CO; parental feeding practices and global family environment and characteristics.

What and how children eat is shaped by the food available at home and by the food habits of the family, transmitted through the daily observation and reproduction of the observed eating behaviors of the models (Awasthi et al., 2020; Morawska & Mitchell, 2018, p.295). These models are usually the parents, who are responsible for the diet structuration regarding quality and quantities and are also the main managers of emotions and socialization at mealtimes. Hence, parents control their children's eating behavior, and consequently parental attitudes towards it may compromise children's normal weight development (Anzman et al., 2010).

Parents' attitudes about eating behaviors and other healthy habits are probably connected with their perception of the child's nutritional status. An inappropriate perception may lead to incorrect practices and, consequently, to weight increase (Anzman et al., 2010). The literature has shown that as the prevalence of CO rises, so does the percentage of parents who underestimate their children's weight (Manios et al., 2015; Phan et al., 2015), which can probably be explained by the growing social acceptance of this condition and the parents' inability to recognize day-by-day changes in children's physical appearance (Awasthi et al., 2020). However, when parents show pronounced dissatisfaction with children's physical appearance and express their desirability for an ideal body through negative comments about their children's bodies, that may trigger body image dissatisfaction, eating disorders, restrictive eating behaviors (Chng & Fassnacht, 2016), depressive symptoms and long-term weight gain (de León-Vázquez et al., 2019). Research suggests that the main cognitive determinants of change regarding health-related behaviors seem to be parents' recognition of children's weight as a risk to their health, along with parents' self-efficacy to correctly manage CO (Rhee et al., 2005).

Still, even when parents have accurate perceptions of their child's overweight or obesity, they may experience difficulties in managing the problem, implementing strategies defined as parental practices of feeding control (Coelho et al., 2017). These are used to directly influence child's diet by increasing or decreasing the intake of certain foods. Three core practices – 1) restriction, 2) pressure to eat and 3) monitoring – along with behavioral modelling and food availability at home, seem to have an indirect impact on children's

weight (Larsen et al., 2015; Stang & Loth, 2011). Restriction is used to limit the access to some group of foods and control the type and size of ingested meals (Jansen et al., 2014; Stang & Loth, 2011). Pressure to eat aims at increasing the child's intake of preferable foods, by establishing rules regarding what is ingested (Coelho et al., 2017). Monitoring refers to the degree of supervision maintained over what the child eats (Jansen et al., 2014; Stang & Loth, 2011). Even though the presented parenting practices intend to regulate food consumption and improve weight status, the literature has emphasized that these practices may sometimes result in an opposite effect, affecting the child's preference, selectivity and self-regulation, by impairing his/her ability to perceive internal signals of hunger and satiety (Tschann et al., 2013) and leading to disordered eating behaviors that contribute to obesity (Coelho et al., 2017; Costa et al., 2021; Durão et al., 2015). Therefore, the link between parental child-feeding practices and the evolution of child's weight remains unclear.

Regarding family characteristics, researchers have highlighted its central role on the variety and adequacy of the diet during childhood, as well as in increased difficulties in managing weight-related problems (Barros et al., 2019; Law et al., 2020). Family structure and socioeconomic status, such as being an only child, living in a single-parent household and a low socioeconomic status seem to have a negative impact on the development of the child's eating behavior (Albuquerque et al., 2017; Barros et al., 2019; Gibson et al., 2016). Different educational levels may also influence parents' confidence in dealing with weight-related problems (Phan et al., 2015). Additionally, there is growing evidence on the interaction between psychological characteristics of parents and CO – obese children are more likely to come from families with poor family functioning (Halliday et al., 2014), higher maternal depression (Topham et al., 2009), frequent family conflict, and parental neglect (Tate et al., 2015).

Considering the alarming growth of CO rates and the complexity of this disease, both in terms of causes and consequences, it is urgent to act in its mitigation. Studies have shown that interventions similar to those usually developed with obese adults – such as very low-calorie diet or intensive exercising, are not appropriate for children. Also, treatment options based on pharmacotherapy or bariatric surgery, besides requiring further investigation on its effectiveness with young people, must be reserved for extremely severe cases (Apperley et al., 2022; Styne et al., 2017).

Although the research on the best treatment for CO is still ongoing, there is consensus on the importance of including parents in pediatric weight loss interventions (Barlow, 2007; Bean et al., 2020). In line with these assumptions, the medical appointments following the ESPHGAN guidelines are patient- and family-centered, targeting the improvement of long-term physical health through permanent healthy lifestyle habits. The clinicians encourage both patients and parents to adopt daily changes, such as adjusting quantities of fruits and vegetables, consuming five meals a day, eating a balanced breakfast, exercising at least 60 minutes per day, limiting screen time, and having family meals frequently (Barlow, 2007).

Despite other countries' growing evidence on the association between family characteristics and CO, recent studies on this matter in the Portuguese population are scarce. Hence, using a clinical sample of Portuguese overweight and obese children, the current study aims to: 1) characterize the prevalence of overweight and obesity in two assessment time points (ATP); 2) characterize the associations among parenting outcomes and family sociodemographic characteristics and CO (BMI z-score); 3) test the moderation effect of the parenting variables on the relation between children's BMI z-score at both assessment time points.

1. Method

1.1. Participants

The participants are part of a clinical sample, recruited from an outpatient pediatric appointment in a Portuguese public hospital, followed due to overweight or obesity. Exclusion criteria were applied when: parents were a) unable to commit to six months of regular contacts; b) not willing to make changes in their family's lifestyle; c) the family was already participating in another program targeting CO; d) the child had been diagnosed with endocrine disease causing overweight or obesity, or diagnosed with cognitive, motor or development delays, or had physical limitations, or was under medication known to cause overweight or obesity.

The participants are 128 children and their parents. Children's ages range from 5 to 12 years (*M*=9.50; *SD*=1.89), 65 of them are girls (50.8%) and 63 are boys (49.2%). Most of the children have completed the first cycle of basic education, presenting on average 4.34 years of schooling (*SD*=1.76). Regarding the adults, 91 are female (72.2%) and 35 are male (27.8%); most of them are mothers (84.4%), employed (80.5%) and have completed, on average, 9 years of schooling (*M*=9.43; *SD*=3.38). Furthermore, 74.8% of the families in the study are original families and the majority has one or two children (82.9%). Descriptive statistics of sociodemographic characteristics are presented on tables 1 and 2.

Table 1.

Participants' sociodemographic characteristics (N=128*).*

Measure	*Min-Max*	*M (SD)*
Child's age (years)	5-12	9.50 (1.89)
Years of schooling	0-8	4.34 (1.76)
Adult's age (years)	25-69	39.86 (6.14)
Years of schooling	3-17	9.43 (3.38)

Note: Mean (*M*); Standard deviation (*SD).*

Table 2.

Participants' sociodemographic characteristics (N=128).

	n	*%*
Child's gender		
Male	63	49.2
Female	65	50.8
Adult's gender		
Male	35	27.8
Female	91	72.2
Adult's kinship		
Mother	108	84.4
Father	16	12.5
Other	4	3.1
Adult's paid work		
Yes	103	80.5
No	25	19.5

1.2. Procedure

The current study preceded a larger ongoing research project aimed at evaluating the effectiveness of Group Lifestyle Triple P (GLTP) in a Portuguese sample of parents of overweight and obese children. The project research plan was approved by the Board of the Department of Education, Training and Research of the hospital where data collection took place (2018-070, 062-DEFI/062).

Firstly, parents of overweight and obese children followed at the pediatric outpatient unit were told by the pediatrician about the project, and then contacted by the research team members who provided information on the purposes of the study. The study followed all the ethical procedures inherent to scientific research with humans. Parents were also informed that declining to take part in the study would not bring them negative consequences and that they would be able to follow through with their consultations with the pediatricians. Parents who agreed to take part in the research signed the informed consent and completed the evaluation protocol, at the hospital, in the presence of the researchers, who were available to answer any questions that parents might have. The evaluation protocol included items focusing the following measures: Positive parenting strategies; Poor monitoring; Ineffective parenting; Perceived parent weight; Perceived child weight; Parental concern about child weight; Parental responsibility; Restriction; Pressure to eat; Monitoring; Depression;

Anxiety; Stress; Misbehavior in relation to food; Overeating; Emotional correlates of being overweight; Physical activity; Parental confidence; and Parental self-regulation.

In order to ensure total confidentiality, a code was given to each participant, making it impossible to identify them otherwise. The second assessment time point included data on children's anthropometric measurements and occurred about six months after the first assessment (*M*=5.85; *SD*=5.69). Overall, data collection for this study was performed between March 2018 and May 2021. Due to the COVID-19 pandemic, the anthropometric data at the second ATP for six children was only collected from September 2020 to May 2021.

1.3. Measures

1.3.1. Anthropometric measures

Children's weight and height were measured using a SECA scale and a SECA stadiometer. These measurements were collected by the pediatricians involved in the project, during the appointments, where they follow the obese/overweight children according to ESPHGAN guidelines.

1.3.2. BMI z-score

Body Mass Index (BMI) is a measure of body weight adjusted for height, defined as weight in kilograms divided by the square of height in meters. BMI z-score is a measure of relative weight adjusted for child's height, using age and sex specific reference values (Flegal & Odgen, 2011).

1.3.3. Sociodemographic questionnaire

A sociodemographic questionnaire was applied to gather data on family and household's characteristics, such as family composition (e.g., number of children and marital status), residential area and whether the family received any social support, as well as the utilization of psychiatric or psychological services. Data about the parents was collected regarding sex, age, years of schooling, occupational status and self-reported height and weight.

1.3.4. Alabama Parenting Questionnaire

Parenting behaviors were assessed through APQ Portuguese Version for parents (Nogueira et al., 2020), a tool that evaluates caregivers' perceptions on their practices with children aged 6 to 13 years. The questionnaire consists of 42 items, rated on a 5-point Likert scale, in which the adult reports the typical frequency of a given behavior in the family, ranging from 1 ("Never") to 5 ("Always"). Higher scores suggest greater use of the assessed practices. The Portuguese version of the questionnaire showed good psychometric properties for a three-factor structure including positive parenting strategies, poor monitoring, and ineffective parenting. The reliability coefficients of the subscales were .82 (Positive Parenting) and .64 (Poor Monitoring). The Ineffective Parenting subscale was not included in the present study as the reliability coefficient was lower than .60.

1.3.5. Child Feeding Questionnaire

The Child Feeding Questionnaire assesses parents' perceptions and concerns regarding child's overweight and obesity, and their attitudes and practices concerning feeding control (Birch et al., 2001). The questionnaire contains 31 items focusing on seven dimensions. The four dimensions evaluate parents' concern about child weight that might trigger the use of controlling child-feeding practices, namely, perceived parent weight, perceived child weight, parental concern about child weight and parental responsibility. The last three dimensions assess parental control attitudes and practices in child-feeding, specifically the use of restriction, pressuring the child to eat and monitoring. Items are rated on a 5-point Likert scale (Birch et al., 2001). In the first four subscales, higher scores indicate greater awareness of the risk of obesity, while in the last three subscales higher scores denote higher use of control feeding-practices. The Cronbach's alpha values ranged from .68 (Restriction and Total scale) to .87 (Monitoring). Pressure to Eat subscale was not included as an outcome variable on the current study since its reliability coefficient was not deemed to be acceptable.

1.3.6. Depression Anxiety Stress Scales-21

The Portuguese version of the Depression Anxiety Stress Scales-21 (DASS-21; Pais-Ribeiro et al., 2004) was used to evaluate parent's symptoms of depression, anxiety and stress, considering parents' perceptions regarding the previous week. The questionnaire contains 21 items, and three scales, Depression, Anxiety and Stress. The score of each scale is given by seven items. Responses are given through a 4-point Likert scale considering the severity or frequency of the symptoms (0="Did not apply to me at all"; 3="Applied to me very much, or most of the time"). Higher scores in each scale suggest higher intensity of the

symptoms. In the current study, Cronbach's alpha values were .85, .82 and .90, for Depression, Anxiety and Stress scales, respectively.

1.3.7. Lifestyle Behavior Checklist

The Lifestyle Behavior Checklist was used to assess parent's perceptions on child's weight-related behaviors and their perceived self-efficacy for coping with those problems (West & Sanders, 2009). The checklist includes 26 items, repeated in two different subscales – Problem Scale and Confidence Scale – focusing four dimensions: Misbehavior in Relation to Food; Overeating; Emotional Correlates of Being Overweight; and Physical Activity. In the Problem Scale, parents indicate the extent to which they identify a given behavior as a problem on their child, rating it on a 7-point Likert scale (1="Not at all"; 7="Very much"). In the Confidence Scale, parents are asked how confident they feel in dealing with the referred behaviors, even if those don't occur daily, on a scale from 1 ("Certain I can do it") to 10 ("Certain I can't do it"). Higher scores reflect more lifestyle-specific behavioral problems and worst parental self-efficacy to address them. In the current study, the reliability coefficients were acceptable for Misbehavior in relation to food (α=.78), Overeating (α=.70) and Emotional correlates of being overweight (α=.75) subscales, and for Confidence Scale (α=.94).

1.3.8. Treatment Self-Regulation Questionnaire

Treatment Self-Regulation Questionnaire is a tool based on self-determination theory that addresses self-efficacy, and the type and degree of motivation that each person has for adopting specific health-promoting behaviors (Levesque et al., 2007). It includes four questions on how confident parents feel on promoting and maintaining healthy habits along with their children, using a 7-point scale (Lemos, 2018). Parents are invited to indicate how much they agree with each reason to engage in healthy behaviors, regarding child's diet and PA (e.g.: "Because I believe that it is the best for my child's health"; "Because I feel pressure from others to do so"), from 1 ("Not true at all") to 7 ("Very true"). This questionnaire allows the identification of different types of motivation: 1) amotivation, i.e., the absence of motivation to treatment; 2) autonomous regulation, if the person's behavior is explained by the interest and pleasure derived from engaging in it; 3) introjected regulation, defining the tendency of the person to act to avoid feeling guilty and 4) external regulation, when the individual behaves to obtain a reward or approvement from others. Although the original scale contained 15 items, on the present study only 14 items were applied. Higher scores

indicate higher levels of self-efficacy and self-regulation. In the current study, we used the perceived parents' self-confidence subscale (α=.92), and two factors from the motivational subscale, the external regulation factor (α=.70), and one factor combining items from the autonomous motivation and introjected regulation subscales (α=.71).

1.4. Analytic plan

BMI z-score was calculated using a SPSS macro package (de Onis et al., 2007), designed to calculate anthropometric statistics for children aged between 5-19 years. Once the BMI z-scores were presented, different categories of overweight and obesity were defined, according to the cut-offs defined by WHO – overweight: >+1 z-score; obesity: >+2 z-scores; severe obesity: >+3 z-scores (de Onis et al., 2007).

The descriptive statistics for the variables under study were estimated. Table A.1. (see Appendix 1) presents the means, standard deviations, skewness and kurtosis for the parenting outcomes and children's BMI z-scores variables in study. As presented in the table, the data suggests that the variables present a normal distribution.

Different statistical analyses were performed to address the current study's objectives. To characterize the prevalence of CO in two ATP two analyses were performed. First, a paired sample *t* test was run to compare the mean scores of the BMI z-scores across the two ATP. Then, a *chi-square* association test was performed to evaluate the association of children's categories of BMI z-score between the two ATP.

To characterize the associations among parenting outcomes and family sociodemographic characteristics and children's BMI z-scores in both ATP, Pearson correlation analyses were performed. And finally, to test the moderation effect of the parenting variables on the relation between children's BMI z-scores in both ATP, moderation analyses were run, using the PROCESS macro, model 1 (Hayes, 2022), where BMI z-score at ATP1 was defined as the independent variable (*x*), at ATP 2 was defined as the dependent variable (*y*). Different models were tested to determine the role of parenting outcome variables as moderators (*w*).

A priori power analyses performed using the software G*Power 3.1 (Faul et al., 2007, 2009), determined that the sample size of 128 would be sufficient to obtain moderate effect size correlations with the parameters two tails, effect size $|p|>.30$, α prob error=.05, and Power (1- α prob error)=.95. In addition, the sample size of 78 would be enough to obtain moderate effect sizes in the paired sample t-test analysis, effect size $dz=0.50$, α prob

error=.05, and Power (1- α prob error)=.95, and on the linear multiple regression models, effect size f^2>.25, α prob error=.05, and Power (1- α prob error)=.95, for 3 predictors.

2. Results

2.1. Prevalence of childhood obesity in both assessment time points

The descriptive statistics (*M*, *SD* and frequencies) of children's BMI z-scores, and child obesity category according to the WHO reference, for both assessment time points (ATP) are presented in table 3.

Table 3.

Descriptive statistics of children's BMI z-score and child obesity categories.

	ATP 1	ATP2
	N=128	*N*=72
	M(SD)	
BMI z-score	2.81 (0.79)	2.69 (0.73)
Child obesity categories	*n* (%)	
Overweight	12 (9.4)	12 (16.7)
Obesity	77 (60.2)	43 (59.7)
Severe Obesity	39 (30.5)	17 (23.6)

At both assessment time points most of the participants (more than 59%) fell into the obesity category. As presented in table 4, in the second assessment time point, 72 participants attended the medical appointment and had their weight and height evaluated. From the first to the second ATP, the BMI z-score decreased for ten children, including them in inferior CO categories, four from obesity to overweight, and six from severe obesity to obesity. Two children, per opposite, showed increases in their BMI z-scores, going from obesity to severe obesity. The majority of the children (*n*=60) remained in the same category as in ATP1, 8 overweight, 37 obese, and 15 severely obese.

Table 4.

Children's evolution of BMI z-score category.

	ATP2		
	Overweight	Obesity	Severe Obesity
ATP1	*n*(%)	*n*(%)	*n*(%)
Overweight	8 (66.70)	0 (0.0)	0 (0.0)
Obesity	4 (33.3)	37 (86.0)	2 (11.8)
Severe Obesity	0 (0.0)	6 (14.0)	15 (88.2)

Note: $\chi^2(4)=80.18$, $p<.001$

A total of 72 participants attended both ATP. Those who did not attend ATP 2 (*M*= 2.82, *SD*=0.84) were not found to have a different BMI z-score at ATP1 than those who attended both ATP (*M*=2.80, *SD*=0.76), *t*(126)=0.15, *p*=.88. Mean differences were found for the 72 participants between ATP, *t*(71)=2.86, p=.006, with the mean BMI z-score decreasing from 2.81 (*SD*=0.79) to 2.69 (*SD*=0.73).

Overall, the results show a trend towards a decrease on children's BMI z-scores from ATP1 to ATP2, even though this change does not lead all children to fall within an inferior childhood obesity category at ATP2. Almost all children fell within the same category or an inferior category, whereas only 2 children fell into a superior category.

2.2. Associations among parenting outcomes, family sociodemographic characteristics and CO

The association between children's BMI z-scores at ATP1 and ATP2 with parental outcomes variables and family sociodemographic characteristics are presented in tables 5 and 6, respectively.

Table 5.

Pearson Correlations between child's BMI z-score and measures used.

	BMIz_M1	BMIz_M2	BMIz_M2-BMIz_M1
APQ – Poor Monitoring	-.164	-.124	.111
APQ – Positive Parenting	.114	.001	-.207
LBC – Misbehaviour in Relation to Food	.183*	.051	-.131
LBC – Overeating	.120	.056	.058
LBC – Emotional Correlates	.177*	.072	-.100
LBC – Physical Activity	.139	.217	.041
LBC – Confidence Scale	.206*	.085	.159
CFQ – Responsibility	.089	-.008	-.200
CFQ – Perceived Parent Weight	.110	.128	.077
CFQ – Perceived Child Weight	.145	.179	.122
CFQ – Concern about Child Weight	-.016	-.065	-.087
CFQ – Restriction	.234**	.161	.113
CFQ – Monitoring	.120	-.022	-.141
DASS – Depression	.083	.110	-.052
DASS – Anxiety	.160	.199	-.035
DASS – Stress	.187*	.246*	.122
TSRQ – Self-confidence	-.056	-.048	-.105
TSRQ – Autonomous Motivation	-.003	-.028	.086
TSRQ – External Regulation	.202*	.183	-.079

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

As depicted from table 5, children's BMI z-scores at ATP1 were negatively correlated with poor monitoring (APQ), and positively correlated with restriction (CFQ), misbehavior in relation to food (LBC), emotional correlates of being overweight (LBC), parental confidence to address children's lifestyle behavior problems (LBC), stress (DASS), and external regulation (TSRQ). Parents whose children had higher BMI z-scores at ATP1 also reported lower levels of poor monitoring, and higher levels of food restriction, of children's misbehavior in relation to food, of children's emotional correlates of being overweight, less parental confidence to address these lifestyle behavior problems, higher levels of stress, and mostly attributed their self-regulation towards their child's treatment to external causes.

Table 6.

Pearson Correlations between child's BMI z-score and sociodemographic characteristics.

	BMIz_M1	BMIz_M2	BMIz_M2-BMIz_M1
Child's Years of Schooling	-.432**	-.405**	.182
Child's Age	-.422**	-.422**	.178
Adult's BMI	-.051	-.083	.032
Adult's age	-.292**	-.293*	.299*
Adult's Years of Schooling	-.285**	-.246	.006

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

As depicted in table 6, children's BMI z-scores at ATP1 were negatively correlated with children and parents' age and years of schooling. Parents of children with higher BMI z-scores reported the children and themselves as being younger, and had lower education levels. Children's BMI z-score at ATP2 was positively correlated with parents' stress (DASS) evaluated at ATP1. Parents whose children had higher BMI z-scores at ATP2 had also higher stress levels at ATP1. Children's BMI z-scores at ATP2 were also negatively correlated with children's age and year of schooling and parents' age. Parents of children with higher BMI z-score reported the children and themselves as being younger.

Finally, no correlations were found between the children's BMI z-score differences from ATP1 to ATP2, but a positive correlation was found with parents' age, suggesting that the children of older parents present worse BMI z-score outcomes at ATP2.

2.3. Moderation effects of the parenting variables on the relation between children's BMI z-score at both assessment time points

Multiple moderation models were run to test the moderation effect of the parenting variables on the relation between children's BMI z-score at ATP1 and ATP2. As presented

in table A2.1 to table A2.16 (see Appendix 2), most of the interactions yielded non-significant results. Three parenting variables – stress, parental confidence, and external regulation – revealed a moderation effect of the association between children's BMI z-score at both assessment time points. The models' statistics are depicted in tables 7, 8 and 9, respectively.

Table 7.

Moderation effect of parents' Stress on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	0.48 (0.19)	2.48	.02	0.09, 0.87
BMI z-score ATP1	0.77 (0.07)	11.58	<.001	0.64, 0.90
Stress	-0.04 (0.03)	-1.45	.15	-0.09, 0.01
Interaction	0.02 (0.01)	1.93	.06	0.00, 0.03
Conditional effects of the focal predictor at values of the moderator				
Stress	*B (SE)*	*t*	*p*	*95%CI*
(M - 1 SD) 0.49	0.78 (0.06)	12.15	<.001	0.65, 0.91
(M) 6.24	0.87 (0.05)	17.23	<.001	0.77, 0.97
(M + 1 SD) 11.99	0.96 (0.07)	13.27	<.001	0.81, 1.10

Model Summary: R^2=0.83, F(3,67)=106.75, p<.001

Children who had higher BMI z-scores at ATP1 and whose parents reported lower levels of stress at ATP1 presented better BMI z-scores at ATP 2 than those whose parents reported higher levels of stress. Figure 1 presents the interaction effect between children's BMI z-score and parents' stress at ATP1 in the prediction of children's BMI z-score at ATP2.

Figure 1.

Graphic representation of the interaction effect between children's BMI z-score and parents' Stress at ATP1 in the prediction of children's BMI z-score at ATP2.

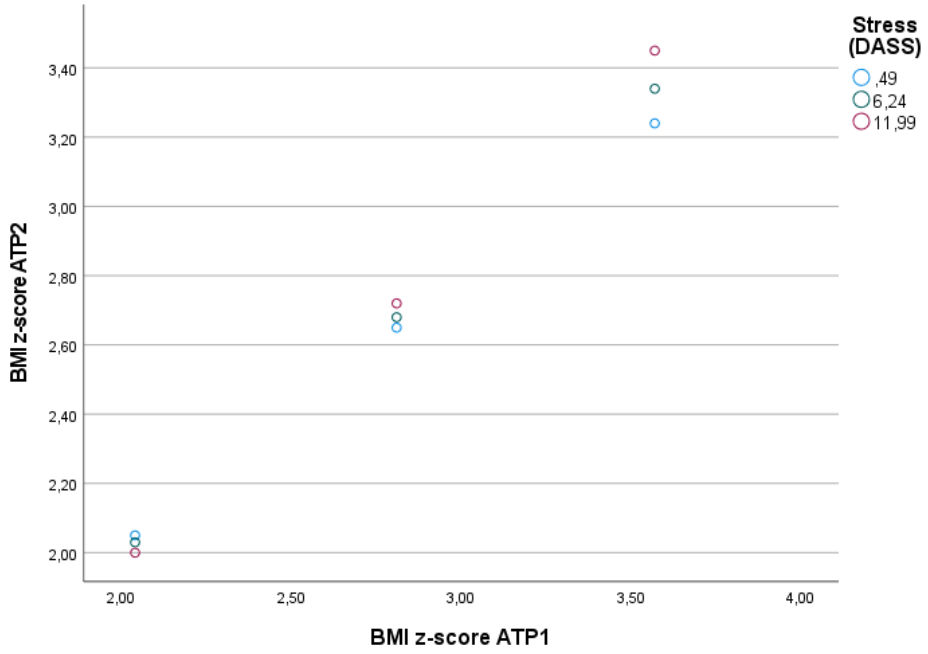


Table 8.

Moderation effect of Parental Confidence on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	-0.90 (0.72)	-1.25	.22	-2.33, 0.54
BMI z-score ATP1	1.34 (0.26)	5.23	<.001	0.83, 1.85
Parental confidence	0.20 (0.12)	1.62	.11	-0.05, 0.45
Interaction	-0.08 (0.04)	-1.86	.07	-0.17, 0.01
Conditional effects of the focal predictor at values of the moderator				
Parental confidence	*B (SE)*	*t*	*p*	*95%CI*
(M - 1 SD) 4.13	1.00 (0.08)	11.85	<.001	0.83, 1.17
(M) 5.52	0.88 (0.05)	17.56	<.001	0.78, 0.98
(M + 1 SD) 6.92	0.77 (0.07)	10.25	<.001	0.62, 0.92

Model Summary: R^2=0.82, F(3,68)=103.06, p<.001

Children with higher BMI z-score at ATP1 and whose parents reported greater confidence on promoting and maintaining healthy habits along with the children presented lower BMI z-score at ATP2. The interaction effect between children's BMI z-score and parental confidence at ATP1 in the prediction of children's BMI z-score at ATP2 is illustrated in figure 2.

Figure 2.

Graphic representation of the interaction effect between children's BMI z-score and Parental Confidence at ATP1 in the prediction of children's BMI z-score at ATP2.

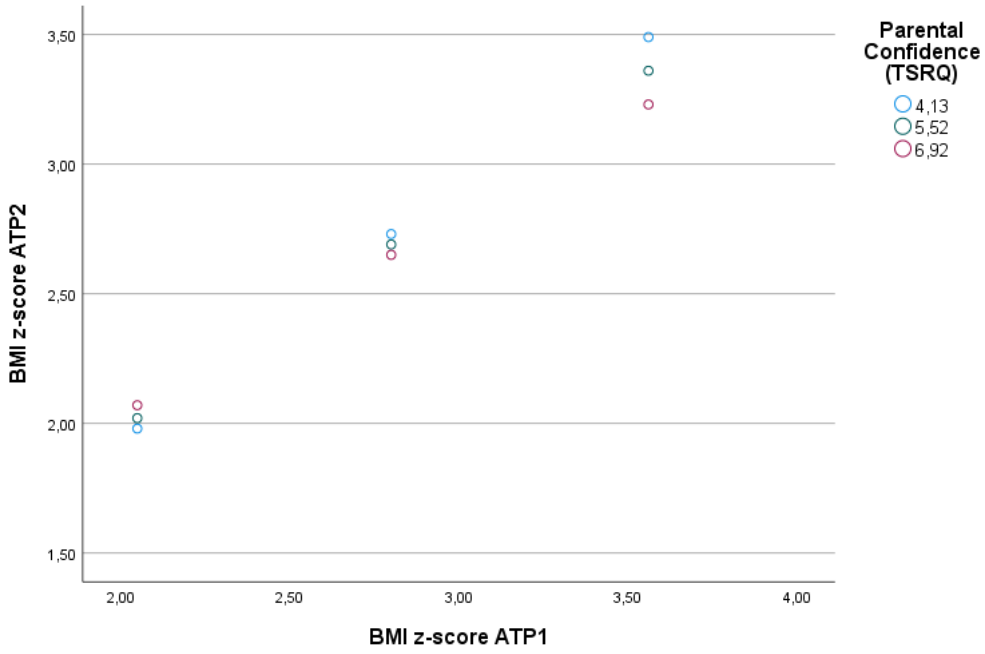


Table 9.

Moderation effect of parents' External Regulation on the association between children's BMI z-score at ATP1 and ATP2.

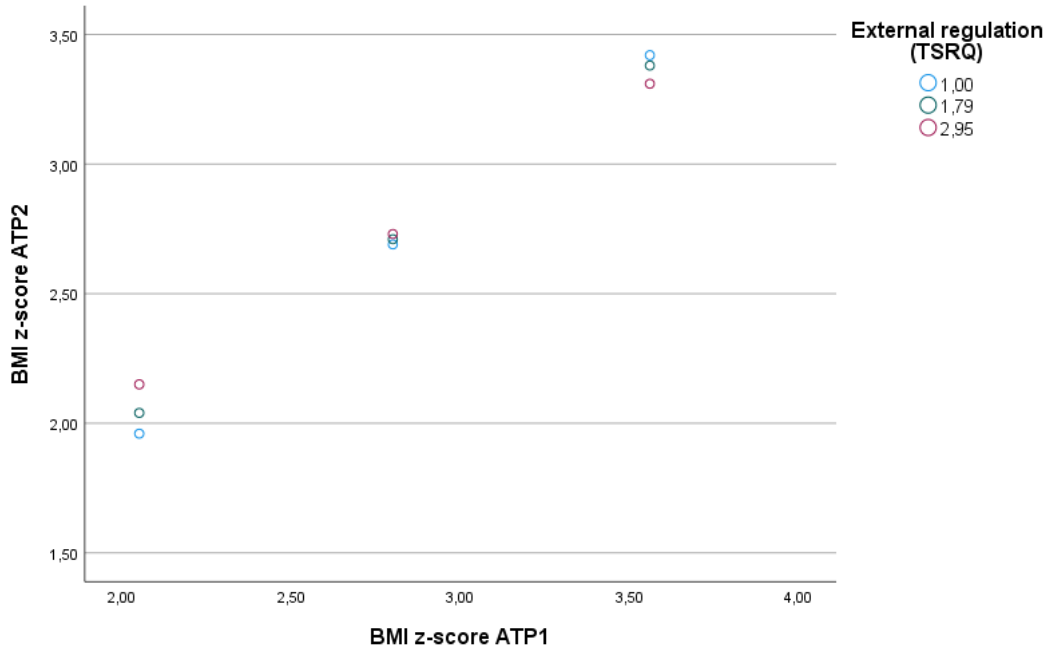
	B (SE)	*t*	*p*	*95%CI*
Constant	-0.33 (0.29)	-1.14	.26	-0.90, 0.25
BMI z-score ATP1	1.07 (0.10)	10.84	<.001	0.87, 1.27
External Regulation	0.31 (0.14)	2.22	.03	0.03, 0.59
Interaction	-0.10 (0.04)	-2.33	.02	-0.19, 0.01
Conditional effects of the focal predictor at values of the moderator				
External Regulation	*B (SE)*	*t*	*p*	*95%CI*
(M - 1 SD) 1.00	0.97 (0.06)	14.96	<.001	0.84, 1.10
(M) 1.79	0.89 (0.05)	17.36	<.001	0.78, 0.99
(M + 1 SD) 2.95	0.77 (0.07)	11.08	<.001	0.63, 0.90

Model Summary: R^2=0.82, F(3,68)=104.94, p<.001

Children who had higher BMI z-score at ATP1 and whose parents attributed their motivation to treatment mostly to external causes presented lower BMI z-score at ATP2, as depicted in figure 3.

Figure 3.

Graphic representation of the interaction effect between children's BMI z-score and External Regulation at ATP1 in the prediction of children's BMI z-score.



3. Discussion

The current study addressed the influence of parenting variables and family characteristics on the maintenance of CO. It aimed to characterize the prevalence of CO in a clinical sample of Portuguese children, followed on an outpatient paediatric unit, to explore the association between parenting outcomes and family sociodemographics characteristics and children's BMI z-score at both asssessment time points and also to test the moderation effect of the parenting variables on the progression of children's BMI z-scores at both assessment time points.

Results identified an average decrease of children's BMI z-score across ATP. Nevertheless, most of children in the current study fell into the category of obesity at both ATP. Regarding the evolution in terms of weight categories, the BMI z-score of 10 children decreased enough to include them in lower categories, whereas most children continued in the same category and only two cases switched to an upper category. These findings corroborate previous studies highlighting the alarming incidence of CO in Portuguese children (Instituto Ricardo Jorge, 2019; Rito et al., 2020). However, they contrast with other researches suggesting a tendency to a larger proportion of overweight, comparing to obesity or severe obesity (Spinelli et al., 2019). The small amount of children progressing to a lower category can be due to the fact that recruitment took place in a specific paediatric consultation focused on child nutrition, where more severe cases are more likely to be found. In addition, the longitudinal evaluations occurred within a short period of time, not allowing all of the children to experience a significant weight decrease. On a side note, it should be acknowledged that there were a few children (n=6) whose second assessments occurred after COVID-19 lockdown periods and yet they remained in the same category. This may be considered as a favourable outcome for children undergoing treatment, since it is opposite to previous studies indicating that lockdowns are a risk factor for major weight gain in result of a greater sedentarism (de Winter et al., 2020; Rito et al., 2020).

The analyses performed to address the second objective of the study revealed significant associations between children's BMI z-scores at ATP1 and ATP2 and some of the parenting measures. Parents whose children had higher BMI z-scores at ATP1 showed lower levels of poor monitoring (i.e. more consistent supervision over child feeding). This association between poor monitoring and BMI z-score needs to be explored in further

research, because monitoring seems to be a common practice of parents regardless of child's weight, and thus, not results in better weight outcomes (Coelho et al., 2017). Parents of children with higher BMI z-scores at ATP1 also reported higher levels of food restriction, confirming evidence highlighting the controverse effects of restrictive practices, which ultimately result in weight increase (Afonso et al., 2016; Durão et al., 2015; Coelho et al., 2017; Costa et al., 2021).

Higher BMI z-scores at ATP1 were also related to less parental confidence to address lifestyle behavior problems of the children, possibly because parents feel overwhelmed by their children obesity and perceive themselves as less capable to help the children improving their condition.

Higher BMI z-scores at ATP1 were also found to be linked with higher levels of stress reported by parents, following the trend of prior studies demonstrating that mothers of obese children report higher levels of stress, comparing to those whose children have an healthy weight (Ek et al., 2020). Increased stress can probably represent simultaneously a consequence of the challenges parents face regarding CO and a predictor of weight gain for children, since stressful environments can increase the predisposition to CO (Borges et al., 2017).

Parents of children with higher BMI z-score at ATP1 also reported higher levels of children's misbehavior in relation to food and more emotional correlates of being overweight in their children. These findings illustrate the complexity of aspects related to mental and psychological well-being of the child, possible to be perceived as consequences of CO but also as contributors to the maintenance of the condition. In addition, parents of children with higher BMI z-score at ATP1 indicated they mostly attributed their self-regulation towards their child's treatment to external causes. This external regulation could possibly result from increasing social stigma and pression to fit in preferable weight patterns (Sahoo et al., 2015), along with raising awareness of the seriousness of this condition transmitted by significant references, such as family members or medical professionals.

Concerning sociodemographic characteristics, BMI z-scores seem to be related by children's age and parents' age and education level, both in ATP1 and ATP2, indicating that children with higher BMI z-score and their parents are usually younger and have completed less years of schooling. Regarding children's age, our data is contrary to the 2019 COSI annual report (Instituto Ricardo Jorge, 2019), revealing that obesity was most prevalent in

older children. However, in the current study we present data from a convenience sample, which most likely is not representative of the Portuguese reality regarding CO. Findings concerning education level are in agreement with literature suggesting that parents with lower educational levels are probably less aware of the importance of taking part of behavioral change and being models for their children, and face more difficulties on acknowledging the most appropriate strategies for addressing weight problems (Gibson et al., 2016; Keech et al., 2018; Phan et al., 2015).

Recognising the strong association between children's BMI z-score at ATP1 and ATP2, it was appropriate to explore whether any parental outcomes were predicting these trajectories. Moderation analyses showed that treatment outcomes are influenced by three parenting variables – stress, parental confidence and external regulation. Better BMI z-score outcomes, that is, lower BMI z-scores at ATP2, were verified when BMI z-scores were higher and participants reported lower levels of stress at ATP1. In line with the assumptions described above, on the association among higher BMI z-score at ATP1 and higher stress at ATP1, there could be several explanations for this effect of stress. Parents of obese children usually report lack of significant others' (including husbands/wives or medical teams) simpathy, lack of support to manage CO and experience more burden related to their children's condition (Ek et al., 2020; Sahoo et al., 2015; Borges et al., 2017), which can lead to less capacity to invest in children's weight improvement. In contrast, when parents experience lower levels of stress, they probably feel less overwhelmed and it is not surprising that a better outcome appears.

A combination of higher BMI z-score at ATP1 and higher parental confidence on promoting and maintaing also predicted better outcomes at ATP2, probably because when parents have accurate perceptions of weight status and its challenges, and perceive themselves as more capable to cope with the problem, they are more willing to engage in treatment and in improving behaviours, as demonstrated in previous studies (Gomes et al., 2020; Phan et al., 2015). Finally, when parents of children with higher BMI z-score at ATP1 reported mostly external regulation, better outcomes at ATP2 were found. As mentioned before, parents' external regulation potentially emerges as an impact of social desirability (Sahoo et al., 2015) and as protector mechanism from the difficulties their children could face. This finding can be interpreted as a result of parental permeability to social desirability, leading to admit the protective function of external regulation in the case of child overweight and obesity.

4. Conclusion

Our research provides relevant insights that add to the literature on CO and to clinical intervention in the condition. First, it demonstrated that although CO primarily affects the children, its maintenance also depends on characteristics of significant caregivers. Second, highlighted that parents of children with obesity and severe obesity experience particular struggles. Moreover, besides confirming previous literature on the importance of involving both children and their families in CO treatment, by recruiting the entire family system to engage in behavioral change, our study emphasized the importance of addressing psychological variables that may compromise or enhance treatment outcomes. In sum, it reinforces the need to develop CO interventions as a multidisciplinary and collaborative work including both medical professionals and psychologists, to address all the variables relevant to the treatment.

This study had a number of strengths, namely, the use of de Onis (2007) macro for calculating BMI z-scores, providing a more rigorous process of data; the definition of three BMI z-score categories according to updated parameters, which allowed us to perform exact comparisons within participants; and the use of an extensive set of parenting dimensions assessed on the evaluation protocol. Some limitations also demand to be noted. The first limitation is the participants' dropout from ATP1 to ATP2. Second, parental outcomes were self-reported and assessed exclusively on the baseline. Finally, our sample was recruited from an outpatient pediatric appointment in the north of Portugal, which impedes the generatization of the results for all Portuguese obese children.

In order to extend knowledge on the contribution of parent characteristics as mediators and moderators of CO treatment, further studies should benefit from using a larger sample and repeated measures to explore parental variables other than those addressed in the current study. Additionally, adopting a longitudinal design, with multiple assessment time points and larger time intervals could offer pertinent evidence on the association between CO and family characteristics and practices.

Overall, data from our research draw attention to the reality of overweight and obesity in Portuguese children. The associations established among variables in study indicate that several parental characteristics do influence children's trajectories on an

intervention focusing weight loss. In particular, parental stress, parental confidence, and external regulation were found to play a major role in predicting changes in children's weight status over time. Hopefully, other studies can address our findings and use them as a stepping stone to improve our understanding on how to promote the health and wellbeing of Portuguese children and their families.

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Appendix 1.

Table A1.

Descriptive statistics of the outcome variables in study (mean, standard deviation, minimum-maximum, skewness and kurtosis).

	M (SD)	*Min-Max*	*Skewness*	*Kurtosis*
1. APQ – Poor Monitoring	1.40 (0.66)	1.00-4.20	2.13	4.38
2. APQ – Positive Parenting	4.38 (0.46)	2.73-5.00	-0.99	0.98
3. LBC – Misbehavior in Relation to Food	17.22 (8.74)	7.00-46.00	1.12	0.96
4. LBC – Overeating	20.07 (6.84)	7.00-48.00	1.13	2.24
5. LBC – Emotional Correlates	10.03 (5.97)	5.00-33.00	1.76	3.35
6. LBC – Physical Activity	14.67 (5.46)	5.00-31.00	0.67	0.45
7. LBC – Confidence Scale	67.26 (41.65)	24.00-195.00	1.25	0.75
8. CFQ – Responsibility	4.30 (0.83)	1.67-5.00	-1.18	0.69
9. CFQ – Perceived Parent Weight	3.22 (0.59)	1.25-4.50	-0.31	0.60
10. CFQ – Perceived Child Weight	3.34 (0.43)	2.25-5.00	0.45	1.25
11. CFQ – Concern about Child Weight	4.57 (0.64)	1.33-5.00	-2.30	6.96
12. CFQ – Restriction	3.43 (0.68)	1.00-5.00	-0.24	0.62
13. CFQ – Monitoring	4.47 (0.68)	2.00-5.00	-1.26	1.20
14. DASS – Depression	3.19 (4.45)	0.00-18.00	1.81	2.71
15. DASS – Anxiety	2.96 (4.17)	0.00-20.00	1.89	3.72
16. DASS – Stress	6.58 (5.82)	0.00-21.00	0.68	-0.49
17. TSRQ – Self-confidence	5.44 (1.37)	1.75-7.00	-0.65	-0.42
18. TSRQ – Autonomous Motivation	6.35 (0.76)	3.57-7.00	-1.60	2.72
19. TSRQ – External Regulation	1.79 (1.15)	1.00-6.25	1.57	2.10
20. BMI z-score at Assessment Time Point 1	2.81 (0.79)	1.08-6.48	1.25	3.60
21. BMI z-score at Assessment Time Point 2	2.69 (0.73)	1.31-5.15	1.17	2.76

Note: Mean (*M*); Standard deviation (*SD*), Range, Skewness and Kurtosis.

Appendix 2.

Table A2.1.

Moderation effect of Poor Monitoring on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	-0.30 (0.50)	-0.59	.56	-1.31, 0.71
BMI z-score ATP1	1.05 (0.18)	5.83	<.001	0.69, 1.42
Poor monitoring	0.40 (0.37)	1.10	.27	-0.33, 1.13
Interaction	-0.14 (0.14)	-1.02	.31	-0.41, 0.13

Model Summary: R^2=0.81, *F*(3,68)=97.83, p<.001

Table A2.2.

Moderation effect of Positive Parenting on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	-0.35 (1.54)	-0.23	.82	-3.43, 2.72
BMI z-score ATP1	1.33 (0.59)	2.26	.03	0.16, 2.50
Positive Parenting	0.14 (0.36)	0.38	.70	-0.58, 0.85
Interaction	-0.10(0.14)	-0.77	.45	-0.37, 0.17

Model Summary: R^2=0.82, *F*(3,68)=100.93, p<.001

Table A2.3.

Moderation effect of Misbehaviour in Relation to Food on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	0.56 (0.37)	1.53	.13	-0.17, 1.29
BMI z-score ATP1	0.78 (0.13)	5.87	<.001	0.51, 1.04
Misbehaviour in Relation to Food	-0.02 (0.02)	-1.00	.32	-0.05, 0.02
Interaction	0.01 (0.01)	0.82	.42	-0.01, 0.02

Model Summary: R^2=0.81, *F*(3,67)=96.18, p<.001

Table A2.4.

Moderation effect of Overeating on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	0.63 (0.59)	1.06	.29	-0.55, 1.82
BMI z-score ATP1	0.72 (0.19)	3.73	<.001	0.34, 1.11
Overeating	-0.02 (0.03)	-0.67	.51	-0.08, 0.04
Interaction	0.01 (0.01)	0.80	.43	-0.01, 0.03

Model Summary: R^2=0.81, *F*(3,68)=97.17, p<.001

Table A2.5.

Moderation effect of Emotional Correlates on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	0.14 (0.28)	0.52	.60	-0.41, 0.69
BMI z-score ATP1	0.92 (0.09)	10.25	<.001	0.74, 1.10
Emotional Correlates	0.01 (0.03)	0.42	.68	-0.04, 0.07
Interaction	0.00 (0.01)	-0.56	.58	-0.02, 0.01

Model Summary: R^2=0.81, F(3,68)=96.64, p<.001

Table A2.6.

Moderation effect of Physical Activity on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	-0.28 (0.53)	-0.53	.60	-1.35, 0.78
BMI z-score ATP1	1.04 (0.19)	5.33	<.001	0.65, 1.42
Physical Activity	0.03 (0.03)	1.05	.30	-0.03, 0.10
Interaction	-0.01 (0.01)	-0.89	.37	-0.03,0.01

Model Summary: R^2=0.81, F(3,67)=95.05, p<.001

Table A2.7.

Moderation effect of Confidence Scale (LBC) on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	0.05 (0.30)	0.18	.86	-0.54, 0.65
BMI z-score ATP1	0.91 (0.10)	8.67	<.001	0.70, 1.12
Confidence Scale (LBC)	0.00 (0.00)	1.23	.22	0.00, 0.01
Interaction	0.00 (0.00)	-0.90	.37	0.00,0.00

Model Summary: R^2=0.81, F(3,63)=88.83, p<.001

Table A2.8.

Moderation effect of Responsibility on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	1.52 (0.90)	1.70	.09	-0.27, 3.31
BMI z-score ATP1	0.52 (0.32)	1.64	.11	-0.11, 1.15
Responsibility	-0.30 (0.21)	-1.46	.15	-0.71, 0.11
Interaction	0.08 (0.07)	1.15	.25	-0.06,0.23

Model Summary: R^2=0.82, F(3,68)=102.07, p<.001

Table A2.9.

Moderation effect of Perceived Parent Weight on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	0.74 (0.82)	0.91	.37	-0.89, 2.37
BMI z-score ATP1	0.64 (0.27)	2.37	.02	0.10, 1.18
Perceived Parent Weight	-0.15 (0.25)	-0.60	.55	-0.66, 0.35
Interaction	0.07 (0.08)	0.86	.39	-0.09,0.24

Model Summary: R^2=0.81, F(3,68)=98.19, p<.001

Table A2.10.

Moderation effect of Perceived Child Weight on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	-0.23 (1.21)	-0.19	.85	-2.64, 2.18
BMI z-score ATP1	0.88 (0.43)	2.06	.04	0.03, 1.73
Perceived Child Weight	0.15 (0.34)	0.43	.67	-0.53, 0.83
Interaction	0.00 (0.12)	-0.04	.97	-0.24,0.23

Model Summary: R^2=0.81, F(3,68)=98.77, p<.001

Table A2.11.

Moderation effect of Concern about Child Weight on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	-1.73 (1.51)	-1.15	.26	-4.75, 1.28
BMI z-score ATP1	1.65 (0.51)	3.20	<.001	0.62, 2.67
Concern about Child Weight	0.44 (0.33)	1.32	.19	-0.22, 1.10
Interaction	-0.17 (0.11)	-1.51	.13	-0.40,0.05

Model Summary: R^2=0.82, F(3,68)=100.67, p<.001

Table A2.12.

Moderation effect of Restriction on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	-0.12 (0.79)	-0.15	.88	-1.69, 1.45
BMI z-score ATP1	0.91 (0.26)	3.56	<.001	0.40, 1.42
Restriction	0.11 (0.23)	0.48	.63	-0.35, 0.57
Interaction	-0.01(0.07)	-0.17	.87	-0.16,0.13

Model Summary: R^2=0.81, F(3,68)=98.30, p<.001

Table A2.13.

Moderation effect of Monitoring on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	-0.71 (1.27)	-0.56	.58	-3.24, 1.81
BMI z-score ATP1	1.31 (0.44)	2.96	<.001	0.43, 2.20
Monitoring	0.20 (0.27)	0.75	.46	-0.34, 0.75
Interaction	-0.09 (0.10)	-0.99	.33	-0.28,0.10

Model Summary: R^2=0.81, *F*(3,68)=99.44, p<.001

Table A2.14.

Moderation effect of Depression on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	0.35 (0.19)	1.82	.07	-0.03, 0.74
BMI z-score ATP1	0.84 (0.07)	12.08	<.001	0.70, 0.97
Depression	-0.05 (0.06)	-0.80	.43	-0.16, 0.07
Interaction	0.02 (0.02)	0.79	.43	-0.02,0.06

Model Summary: R^2=0.81, *F*(3,67)=96.78, p<.001

Table A2.15.

Moderation effect of Anxiety on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	0.44 (0.19)	2.29	.03	0.06, 0.82
BMI z-score ATP1	0.80 (0.07)	11.62	<.001	0.66, 0.94
Anxiety	-0.08 (0.05)	-1.55	.13	-0.19, 0.02
Interaction	0.03 (0.02)	1.64	.11	-0.01,0.06

Model Summary: R^2=0.82, *F*(3,67)=98.43, p<.001

Table A2.16.

Moderation effect of Autonomous Motivation on the association between children's BMI z-score at ATP1 and ATP2.

	B (SE)	*t*	*p*	*95%CI*
Constant	-1.11 (1.45)	-0.76	.45	-4.02, 1.79
BMI z-score ATP1	1.27 (0.49)	2.61	.01	0.30, 2.25
Autonomous Motivation	0.21 (0.22)	0.94	.35	-0.24, 0.66
Interaction	-0.06 (0.08)	-0.82	.41	-0.21, 0.09

Model Summary: R^2=0.81, *F*(3,68)=97.27, p<.001