



# Examining associations between obesity and mental health disorders from childhood to adolescence: A case-control prospective study

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## ABSTRACT

Childhood obesity and mental disorders often co-exist. To date, most of the studies are cross-sectional, involve the assessment of a specific disorder, and rely on self-report questionnaires. This study aimed to provide a comprehensive psychological assessment to examine the concurrent and prospective association between childhood obesity and mental health problems. We compared 34 children with obesity with 37 children with normal weight at baseline, and at a five-year follow-up, to examine the development of mental health disorders from childhood (8–12 years) to adolescence (13–18 years). Both assessments included a clinical interview and self-reported measures of psychosocial and family markers. Findings showed that the obesity group had a higher prevalence of mental disorders, and psychological comorbidity increased in five years. Prospectively, childhood obesity was associated with a psychological diagnosis in adolescence. Moreover, the obesity group displayed higher severity of symptoms at both times. Finally, body esteem contributed to predicting mental health disorders in adolescence regardless of weight status, while eating symptomatology was a specific marker for the obesity group. Therefore, in the management of childhood obesity is suggested to address also psychosocial variables such as weight-related teasing and body esteem, to prevent the onset or development of mental health problems.

## 1. Introduction

Childhood obesity has exponentially increased worldwide in the last decades (Lobstein et al., 2022). According to the Childhood Obesity Surveillance Initiative (COSI) conducted by the World Health Organization (WHO), Spain is among the five countries with the highest rates in the European region (COSI, 2022), with 39.6% of children between 6 and 9 years of age presenting excess weight for their sex and age (García-Solano et al., 2021). This is particularly worrying as childhood obesity tends to become chronic and interferes significantly with individuals' well-being (Ng et al., 2014).

Obesity often correlates with psychological complications (Erskine et al., 2015). Scientific evidence has repeatedly shown the high prevalence of psychological disorders among treatment-seeking samples; however, the generalization of these results may contain biases since the coexistence of obesity and psychopathology increases the probability of seeking clinical treatment (Malik et al., 2014). A few comprehensive

studies have been conducted among the adolescent population using non-clinical samples and a control group. For instance, Britz et al. (2000) evaluated, through structured clinical interviews, the rates of psychological disorders in a German sample, comparing a clinical group with extreme obesity undergoing weight loss treatment, a population-based group with obesity, and a control group. Higher rates of mental health disorders were observed in the clinical sample compared to the controls, but no significant differences were found between the population-based obesity group and the controls. However, Erermis et al. (2004) replicated the design of this study in a Turkish adolescent sample and did find a higher prevalence of mental health issues in the population-based sample compared to the control group. In addition, Sagar and Mehta (2021) evaluated 31 adolescents with obesity and 31 age- and sex-matched controls from educational settings in New Delhi. In this sample, significant differences were found as 7% of the control group participants and 68% of the participants with obesity were diagnosed with a DSM-IV disorder.

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In the pediatric population, studies assessing the prevalence of psychological diagnoses in children with obesity compared to a control group are lacking. Nevertheless, if the prevalence of mental health disorders among children and adolescents in the general population has been estimated between 12–13% (Polanczyk et al., 2015; Barican et al., 2022), these numbers seem to increase considerably in the population with obesity. In a pioneering study, Vila et al. (2004) assessed the prevalence of psychological disorders among 155 French children and adolescents with obesity under inpatient monitoring through clinical diagnostic interviews. 58% of the participants met a DSM-IV diagnosis (anxiety disorder: 32%, mood disorder: 12%, and attention deficit hyperactivity disorder [ADHD]: 16%). More recently, Sepúlveda et al. (2018) evaluated a sample of 170 Spanish children with overweight or obesity between 8 and 12 years of age who were not seeking treatment. Similarly, 57.06% of the sample met the criteria for a DSM-5 diagnosis (anxiety disorder: 30.8%, depression disorder: 10%, ADHD: 6.48%, eating disorder: 5.87%, and conduct disorder: 2.95%). Overall, cross-sectional studies support a greater susceptibility to psychological comorbidity among the population with childhood obesity, although new studies should further explore this issue using non-clinical populations and appropriate control groups.

Furthermore, toward the end of the twentieth century, Friedman and Brownell (1995) advocated for a generational shift from cross-sectional studies to follow-up research to assess the temporal sequence of associations. Increasing efforts in this direction have shown that obesity in childhood may be an incremental risk factor for mental health disorders in adolescence due to family distress, weight-related teasing (WRT), and negative body esteem (Pearl and Lessard, 2020; Weiss et al., 2020). However, as shown by prior systematic reviews, prospective evidence on the child population is limited and the results remain inconclusive (Burke and Storch, 2015; Mühlhig et al., 2016; Stabouli et al., 2021). Indeed, research to date has shown several methodological limitations. In addition to the frequent use of treatment-seeking samples, and the lack of a control group already mentioned, further limitations within follow-up research include the focus on a single diagnosis, the reliance on self-report psychological questionnaires and anthropometric data rather than a diagnostic clinical interview, the lack of control for relevant demographic characteristics, and the lack of consideration of additional variables such as parental psychopathology (Hebebrand and Herpertz-Dahlmann, 2009; Puder and Munsch, 2010; Rankin et al., 2016; Weiss et al., 2020).

The current study aims to overcome the above-mentioned shortcomings through a prospective design that compares a group of children with obesity (OG) with a similar-aged group with normal weight (NWG). The main aim was to investigate whether childhood obesity and psychological problems are related concurrently and prospectively from childhood ( $T_0$ ; baseline) to adolescence ( $T_1$ ; follow-up). Specifically, we aimed to assess the frequency and type of psychological disorders in both groups both at baseline, and at  $T_1$ , and examine whether presenting obesity in childhood influences the presence of psychological disorders in adolescence. The research also intends to compare psychosocial and family markers between the groups at both time points. Furthermore, it aims to examine in an exploratory manner the possibility of these markers at  $T_0$  to influence the development of mental disorders at  $T_1$  among both groups.

## 2. Methods

### 2.1. Participants and procedure

The participants were part of the larger “ANOBAS” project, which aims to identify bio-psycho-family markers for childhood obesity (Ref. PSI2011-23127). Based on G-power analysis (Faul et al., 2007), a sample size of 40 or 50 is enough to reach good effect sizes with the aim of establishing differences between specific immunological correlates of an obesity group and the control group. The initial sample was made up

of 50 children in the OG (Body Mass Index [BMI] z-score  $> 2$ ) matched with 50 children in the NWG (BMI z-score from  $-1$  to  $1$ ) according to age, sex, and socioeconomic status (SES; Hollingshead, 1975). Matching by age minimizes age-related bias and matching by socioeconomic status reduces the impact of this important confounding variable. The OG was recruited from the “Daroca” Primary Health Center and none of these participants was seeking weight treatment at that time; the NWG was recruited from 13 primary schools in the area. For more detailed information on the recruitment process, procedures, and baseline results of the ANOBAS study, please refer to Sepúlveda et al. (2019). The current study presents a prospective two-wave design and compares the two cohorts—OG and NWG—with regard to the present and past five years of history of mental health disorders. Data at baseline ( $T_0$ ) were collected between 2013 and 2016 when the participants were 8 to 12 years old. Data at follow-up ( $T_1$ ) were collected five years later, between 2018 and 2021, when the participants were 13 to 18 years of age. Participation was voluntary and anonymous. A Research Ethics Committee approval was obtained from the following institutions: Children’s Hospital Niño Jesús ( $T_0$ : Ref. 0009/10;  $T_1$ : Ref.0076/18) and the Autonomous University of Madrid ( $T_0$ : CEI 27-673;  $T_1$ : CEI-98-103). The participation at each time point involved a semi-structured clinical interview with the child and the primary caregiver, a battery of self-report questionnaires, and a measurement of the child’s weight and height. The evaluations were carried out in person at a children’s hospital, and the questionnaires were completed on paper. Parents and adolescents provided written consent and assent, respectively; these were collected at both time points.

Out of 100 participants at  $T_0$ , 71 agreed to participate at  $T_1$  (OG:  $n = 34$ ; NWG:  $n = 37$ ). The main reasons for non-participation are specified in Fig. 1. Furthermore, 97.18% ( $n = 69$ ) of the primary caregivers who participated at  $T_1$  were mothers. Attrition analysis showed that the participants that completed the follow-up did not significantly differ from the ones that did not, except for gender; 37.70% of girls in contrast to 15.40% of boys did not complete the follow-up ( $\chi^2 = 5.76$ ;  $p = .016$ ). An omnibus test from a logistic regression analysis (with all the predictor variables entered in one step and attrition as the outcome) showed that sex, age and SES were not useful in predicting attrition ( $\chi^2 = 7.35$ ;  $p = .062$ ).

For this study, we used data only from those participants who participated at both time points, as we aimed to assess the evolution of psychopathology. When comparing the OG and NWG of children who completed the follow-up, no significant differences were found in terms of age, gender, and SES between  $T_0$  and  $T_1$  (see Table 1).

### 2.2. Measures

#### 2.2.1. Body mass index

Trained interviewers measured participants’ height and weight. Weight was measured using a Seca digital weighing scale (Type 799 and 769; kg). The participants wore indoor clothing and removed their shoes during the measurement. BMI ( $\text{kg}/\text{m}^2$ ) was calculated, and BMI standard deviation scores (BMI z-scores) were computed by comparing the child’s BMI with the BMI of the Spanish population of the same sex and age (Sobradillo et al., 2004). The BMI z-scores were categorized following World Health Organization’s recommendations (de Onis, 2007): underweight z-score  $< -1$ , normal weight z-score  $> -1$  to  $\leq 1$ , overweight z-score  $> 1$  to  $\leq 2$ , and obese z-score  $> 2$ . Weight status was measured following the same procedure at  $T_0$  and  $T_1$ .

#### 2.2.2. Basic data

Trained staff collected sociodemographic and clinical data of children/adolescents and their primary caregivers (information about age, marital status, level of education, occupation, and medical and psychological family history) at  $T_0$  and  $T_1$  by conducting structured clinical-psychosocial interviews. In each interview, the child/adolescent and the primary caregiver were interviewed together. Families’ SES was

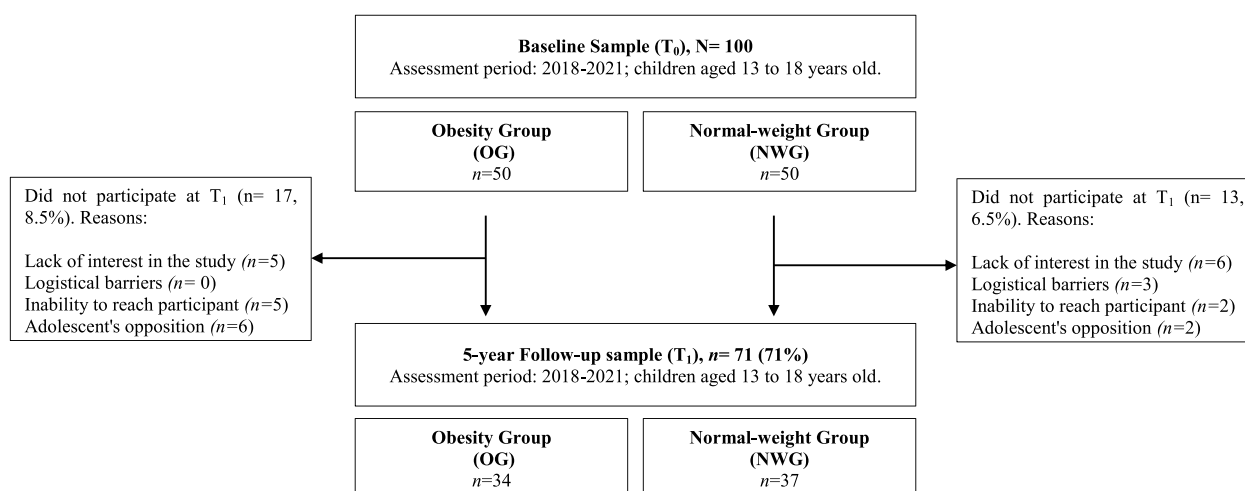


Fig. 1. Sample flow-chart for psychiatric diagnosis assessment.

Table 1

Descriptive statistics and weight status groups differences for the total follow-up sample (n = 71).

	Baseline (T <sub>0</sub> ), n = 71			Follow-up (T <sub>1</sub> ), n = 71		
	NWG (n = 37)	OG (n = 34)	Group Difference	NWG (n = 37)	OG (n = 34)	Group Difference
	M (SD) / N(%)	M (SD) / N(%)	t/χ <sup>2</sup>	M (SD) / N(%)	M (SD) / N(%)	t/χ <sup>2</sup>
BMI z-score	-0.43 (0.69)	2.61 (0.83)	-16.76***	-0.07 (0.99)	2.21 (1.39)	-7.81***
WC						
Age	10.72 (1.42)	10.58 (1.15)	0.44	15.84 (1.58)	16.52 (1.44)	-1.88
Gender			0.33			0.33
Males	16 (43.20)	17 (50.00)		16 (43.20)	17 (50.00)	
Females	21 (56.80)	17 (50.00)		21 (56.80)	17 (50.00)	
SES			5.48			7.45
I (lowest)	0 (0.00)	3 (8.80)		0 (0.00)	6 (17.60)	
II	4 (10.80)	5 (14.70)		7 (18.90)	6 (17.60)	
III	19 (51.40)	14 (41.20)		17 (45.90)	11 (32.40)	
IV	13 (35.10)	9 (26.50)		9 (24.30)	8 (23.50)	
V (higher)	1 (2.70)	3 (8.80)		4 (10.80)	3 (8.80)	

Note. Significant differences are in bold. Abbreviations. NWG: Normal-Weight group, OB: Obesity group; WC: Waist circumference; SES= Socioeconomic Status, BMI z-scores= Body Mass Index Z-scores; BES: Body Esteem Scale, BESAA: Body Esteem Scale for Adolescents and Adults, M= Mean, SD= Standard Deviation.

calculated using the Hollingshead Four-Factor Index of Socioeconomic Status (Hollingshead, 1975), which measures an individual's social status by categorizing them into one of the five levels.

### 2.2.3. Psychological diagnosis

Participants were interviewed through the Kiddie Schedule for Affective Disorders and Schizophrenia-Present and Lifetime version (K-SADS-PL; Arechavaleta et al., 2006; Kaufman et al., 1997) at T<sub>0</sub> and T<sub>1</sub>. It is a semi-structured diagnostic interview designed to assess psychopathology in children and adolescents. In addition, at T<sub>1</sub>, eating disorder diagnoses were verified by means of the Eating Disorders Examination (EDE, 17th edition; Fairburn et al., 2014). All the diagnoses were adapted to DSM-5 criteria (American Psychiatric Association [APA], 2013). Of note, primary diagnosis refers to at least one diagnosis; in the case of comorbidity, the one that generates the most interference in the participant's life). Secondary diagnosis refers to the coexisting diagnosis (i.e., comorbidity) distinct from the primary one.

### 2.2.4. Psychosocial markers

Age-appropriate assessment instruments were used for each psychological variable. When necessary due to the age range, different instruments were used in T<sub>0</sub> and T<sub>1</sub>.

**2.2.4.1. Depressive symptoms.** The Child Depression Inventory (CDI; Kovacs, 1992; Spanish validation by Del Barrio and Carrasco, 2004) was used at T<sub>0</sub> and T<sub>1</sub>. This self-report questionnaire consists of 27 items with

three response options (0–2) aimed to measure the cognitive, affective, and behavioral signs of depression. The total score ranges from 0 to 54. Higher scores show higher levels of depressive symptoms. In the current study, Cronbach's α for the CDI was 0.84 at T<sub>0</sub> and 0.90 at T<sub>1</sub>.

**2.2.4.2. Anxiety symptoms.** The State-Trait Anxiety Inventory for Children (STAIC; Spielberger et al., 1973; Spanish validation by Seisdedos, 1990) was used at T<sub>0</sub>, and the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1970; Spanish validation by Buela-Casal et al., 2011) was used at T<sub>1</sub>. Both comprise two scales of 20 items each. The State Anxiety (SA) scale measures transient levels of anxiety, while the Trait Anxiety (TA) scale measures more stable levels. Each STAIC item has three alternatives (1–3), and the score for each scale ranges from 20 to 60 points. The STAI has four response alternatives (1–4), and the score ranges from 20 to 80 points. Higher scores show higher levels of anxiety symptoms. In the current study, internal consistency for the STAIC (SA: α = 0.82; TA: α = 0.83) and the STAI (SA: α = 0.90; TA: α = 0.94) was adequate.

**2.2.4.3. Eating symptoms.** The Children's Eating Attitudes Test (ChEAT; Maloney et al., 1988; Spanish validation by De Gracia et al., 2007) was used at T<sub>0</sub>. It is a self-report questionnaire comprising 26 items with six alternatives that assess eating attitudes and behaviors, diet, and concern with food in children. The score ranges from 0 to 78 points, with higher scores indicating greater severity. In the current sample, Cronbach's α was 0.82. At T<sub>1</sub>, the EDE (17th edition; Fairburn et al., 2014) was

employed. It provides a global symptomatology score based on responses to 23 items rated by the interviewer on a seven-point scale ranging severity or frequency of restrained eating and weight and shape concern. Higher scores indicate greater levels of eating symptoms. In the current sample, Cronbach's  $\alpha$  for the EDE global score was 0.99.

**2.2.4.4. General self-esteem.** Lawrence's Self-Esteem Questionnaire (LAWSEQ; Lawrence, 1981; Spanish validation by De Gracia et al., 2007) was used at T<sub>0</sub>. It comprises 16 items with a three-point response scale ("no," "yes," and "don't know"). The total score ranges from 0 to 24 points. The Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965; Spanish validation by Martín-Albo et al., 2007) was used at T<sub>1</sub>. It is made of 10 items scored on a four-point Likert scale (1–4). The total score ranges from 10 to 40 points. For both scales, higher scores indicate higher self-esteem. In the current study, the values of Cronbach's  $\alpha$  were 0.71 and 0.92 for LAWSEQ and RSES, respectively.

**2.2.4.5. Body esteem.** The Body Esteem Scale (BES; Mendelson and White, 1982; Spanish validation by De Gracia et al., 2007) at T<sub>0</sub> and the Spanish version of the Body Esteem Scale for Adolescents and Adults (BESAA-S; original scale by Mendelson et al., 2001; Spanish validation by Beltrán-Garrayo et al., 2022) at T<sub>1</sub> were used to collect information on feelings or perceptions about one's appearance and the way they believe they are valued by others. The BES is a 24-item self-reportscale that requires a yes/no response; its total score ranges from 0 to 24. The BESAA-S consists of 14 items on a five-point Likert scale ranging from 0 to 4. For both scales, higher scores imply greater body esteem. In the current study, Cronbach's  $\alpha$  for BES was 0.94, while it was 0.89 for BESAA-S.

**2.2.4.6. Perceived teasing.** The Spanish version of the Perception of Teasing Scale (POTS-S; original version by Thompson et al., 1995; Spanish validation by Lopez-Guimera et al., 2012) was used to assess the frequency of experiencing teasing at T<sub>0</sub> and T<sub>1</sub>. While the original scale consisted of 11 items, the Spanish version includes nine of these items and the same two subscales: WRT and competency teasing (CT). Participants respond to each item on a Likert scale ranging from 1 to 5. Higher scores indicate higher levels of perceived teasing. In the present study, adequate internal consistency was obtained at T<sub>0</sub> (WRT:  $\alpha$  = 0.90; CT:  $\alpha$  = 0.80) and T<sub>1</sub> (WRT:  $\alpha$  = 0.95; CT:  $\alpha$  = 0.88).

**2.2.5. Family markers.** The following measures were completed by family members at T<sub>0</sub> and T<sub>1</sub>.

**2.2.5.1. Depressive symptoms.** The Beck Depression Inventory-Second Edition (BDI-II; Beck et al., 1996; Spanish validation by Sanz et al., 2003) was completed by the primary caregivers to measure their somatic and cognitive-affective symptoms of depression. It is a self-report scale that contains 21 items. For each item, the respondent selects the response on a four-point Likert scale (0–3) that best describes how they felt during the past 14 days. Higher scores indicate higher levels of depression. The BDI-II demonstrated high internal consistency in the current sample (T<sub>0</sub>:  $\alpha$  = 0.90; T<sub>1</sub>:  $\alpha$  = 0.87).

**2.2.5.2. Anxiety symptoms.** The STAI (Spielberger et al., 1970; Spanish validation by Buela-Casal et al., 2011) was completed by the primary caregivers. The features of this questionnaire have been mentioned above. In the current study, at T<sub>0</sub>, Cronbach's  $\alpha$  for the SA scale was 0.95 and for the TA scale 0.91; at T<sub>1</sub>, it was 0.95 for SA and 0.93 for TA.

**2.2.5.3. Family functioning.** The family questionnaire (FQ; original version by Wiedemann et al., 2002; Spanish validation by Sepúlveda et al., 2014) is a 20-item self-report questionnaire examining a family's levels of expressed emotion (EE), defined by the levels of critical comments (CCs) and emotional overinvolvement (EOI) in the

communication between the parents and child. In the current study, adequate internal consistency was found (T<sub>0</sub>: EE  $\alpha$  = 0.88, EOI  $\alpha$  = 0.73; T<sub>1</sub>: EE  $\alpha$  = 0.87, EOI  $\alpha$  = 0.79).

### 2.3. Strategy of analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) 25.0 for Windows. Prevalence of mental disorders was analyzed using chi-squared tests. Risk estimations were computed using odds ratio (OR).

Descriptive statistics (mean  $\pm$  standard deviation) were calculated and reported for all psychological, social, and familial markers. The Shapiro–Wilk tests showed that all variables were not normally distributed. Therefore, longitudinal comparisons were carried out using Wilcoxon signed-rank tests. Since some psychological markers were assessed using different tests at T<sub>0</sub> and T<sub>1</sub> (i.e., SA and TA, eating symptoms, self-esteem, and body esteem), z-scores adjusted by age and sex were computed before the Wilcoxon tests considering the original standardization samples for those measures (see Measures) to make comparisons between both times appropriate. On the other hand, a series of one-way analyses of covariance (ANCOVA) was carried out to study cross-sectional comparisons among the two groups, using the logarithmic values on the psychosocial, social, and familial markers to normalize the distributions; sex, age, and SES at each time point were controlled for. For all significant differences, effect size statistics were calculated as the mean standardized differences. These values can be interpreted using Cohen's (1988) guidelines: 0.20 = small difference, 0.50 = medium difference, and 0.80 = large difference. Lastly, the capacity of these markers at T<sub>0</sub> (except for STAIC-SA) to predict the presence or absence of a mental disorder at T<sub>1</sub> was analyzed using a series of multiple hierarchical logistic regression. For the total sample, weight status at T<sub>0</sub> and the interaction between weight status and each marker were also included as predictors of the logistic regression.

## 3. Results

### 3.1. Prevalence of mental disorders

Table 2 shows the prevalence of psychological diagnoses according to the K-SADS-PL interview.

Regarding the NWG, 8.1% of the participants at T<sub>0</sub> (2.7% present, 5.4% subthreshold) and 16.2% of the participants at T<sub>1</sub> (10.8% present, 5.4% subthreshold) met a clinical or subclinical diagnosis according to DSM-5 criteria. Our results did not indicate a significant difference in the proportions of primary diagnoses (present, subthreshold, absent) or in the type of diagnostic category ( $\chi^2$  = 0.63;  $p$  = .996) between T<sub>0</sub> and T<sub>1</sub>. Concerning secondary diagnoses, no participant showed comorbidity at T<sub>0</sub>, whereas one participant exhibited comorbidity at T<sub>1</sub>.

In the OG, 61.8% of the participants (35.3% present, 26.5% subthreshold) met a primary diagnosis both at T<sub>0</sub> and T<sub>1</sub>. Accordingly, no significant changes were found in the proportion of primary diagnoses between the time points, although we did find significant changes in the type of diagnosis ( $\chi^2$  = 82.03;  $p$  < .001; Cramer's  $V$  = 0.70). Specifically, the most frequent primary diagnoses at T<sub>0</sub> were anxiety disorders ( $n$  = 7; obsessive-compulsive disorder = 1, separation anxiety disorder = 3, and generalized anxiety disorder = 3), while at T<sub>1</sub> the most frequent diagnoses were eating disorders ( $n$  = 5; bulimia nervosa = 2 and binge eating disorder = 3). In addition, the results indicated a significant increase in the proportion of secondary diagnoses (i.e., present or subthreshold comorbidity) between T<sub>0</sub> (26.50%) and T<sub>1</sub> (29.40%) in the OG (Cramer's  $V$  = 0.40).

### 3.2. Association between childhood obesity and psychological disorders

Considering Table 2 (see differences between weight groups), at the cross-sectional level, our results show a significant association between



**Table 2**

Differences between prevalence of psychological disorders according to the K-SADS-PL by weight status group and timepoints.

	NWG (n = 34)		Difference: T <sub>0</sub> vs T <sub>1</sub> $\chi^2$ -test, p-value	OG (n = 37)		Difference: T <sub>0</sub> vs T <sub>1</sub> $\chi^2$ -test, p-value	Weight group differences	
	T <sub>0</sub>	T <sub>1</sub>		T <sub>0</sub>	T <sub>1</sub>		T <sub>0</sub> : NWG vs OG	T <sub>1</sub> : NWG vs OG
	n (%)	n (%)		n (%)	n (%)		$\chi^2$ -test (OR)	$\chi^2$ -test (OR)
Absent psychological disorder	34 (91.90)	31 (83.80)	0.63, p = .959	13 (38.20)	13 (38.20)	2.64, p = .621	22.80*** (18.31)	15.60*** (8.35)
At least one psychological disorder	1 (2.70)	4 (10.80)	0.14, p = .706 <sup>a</sup>	12 (35.30)	12 (35.30)	1.27, p = .260 <sup>a</sup>	17.51*** (16.80) <sup>a</sup>	9.97** (7.15) <sup>a</sup>
Depressive disorder	–	2 (5.40)		1 (2.90)	3 (8.80)			
Anxiety disorder	–	1 (2.70)		7 (20.40)	1 (2.90)			
Conduct disorder	–	–		2 (5.90)	3 (8.80)			
Elimination disorder	1 (2.70)	–		1 (2.90)	–			
Eating disorder	–	1 (2.70)		1 (2.90)	5 (14.70)			
At least two psychological disorders (comorbidity)	0 (0.00)	1 (2.70)	–	9 (26.50)	10 (29.40)	10.86, p = .028	11.22** (–) <sup>c</sup>	9.65** (15.00)
Depressive disorder	–	–		2 (5.90)	6 (17.60)			
Anxiety disorder	–	1 (2.70)		2 (5.90)	1 (2.90)			
Elimination disorder	–	–		1 (2.90)	–			
Eating disorder	–	–		4 (11.80)	3 (8.80)			
At least one subthreshold diagnosis	2 (5.40)	2 (5.40)	0.14, p = .706 <sup>b</sup>	9 (26.50)	9 (26.50)	1.25, p = .264 <sup>b</sup>	11.11** (7.36) <sup>b</sup>	10.02** (10.73) <sup>b</sup>
Subthreshold Depressive disorder	–	–		–	2 (5.90)			
Subthreshold Anxiety disorder	2 (5.40)	2 (5.40)		6 (17.70)	4 (11.80)			
Subthreshold Eating disorder	–	–		3 (8.80)	1 (2.90)			
Subthreshold Personality disorder	–	–		–	1 (2.90)			
Subthreshold Substance use disorder	–	–		–	1 (2.90)			

Note. NWG: Normal-Weight group, OB: Obesity group, OR: Odds Ratio.

<sup>a</sup> Comparisons were made considering absence and presence of a psychological disorder (not subthreshold).<sup>b</sup> Comparisons were made considering absent and subthreshold psychological disorder (not present).<sup>c</sup> Odds ratio could not be estimated due to the inexistence of secondary psychological diagnosis in NWG at T<sub>0</sub>. \* p < .05; \*\* p < .01; \*\*\* p < .001.

the OG and primary psychological diagnosis (present or subthreshold) at T<sub>0</sub>, with the group having a higher risk of psychological diagnosis than the NWG, as shown by OR in all analyses. Furthermore, at the longitudinal level, a significant association can be seen between the OG and the

presence of any primary diagnosis at T<sub>1</sub>. Again, OR statistics show that the OG had a higher risk of psychological diagnosis than the NWG. After controlling for the effect of primary diagnosis at T<sub>0</sub>, this association remained significant (Mantel–Haenszel = 6.66; p = .01). This was also

**Table 3**

Differences the psychological, social, and family markers between NWG and OG and timepoints.

	NWG (n = 37)			OG (n = 34)			Weight group differences	
	T <sub>0</sub>	T <sub>1</sub>	Difference: T <sub>0</sub> vs T <sub>1</sub>	T <sub>0</sub>	T <sub>1</sub>	Difference: T <sub>0</sub> vs T <sub>1</sub>	T0: NWG vs OG	T1: NWG vs OG
	<i>M (SD)</i>	<i>M (SD)</i>	<i>Wilcoxon (size effect)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>Wilcoxon (size effect)</i>	<i>One-way ANCOVA (size effect)</i>	
<b>Psychological markers</b>								
State-anxiety (STAIC/STAI- S)	24.14 (3.03)	13.00 (8.07)	−1.12	26.26 (5.78)	18.47 (13.41)	−1.19	3.81	0.11
Trait-anxiety (STAIC/STAI-T)	29.27 (5.92)	14.11 (8.57)	−0.14	32.65 (6.30)	23.41 (13.57)	−1.26	6.19* (−0.55)	4.02* (−0.82)
Depressive symptoms (CDI)	5.84 (3.46)	8.28 (4.54)	−2.79** (−0.52)	9.65 (6.05)	12.94 (8.66)	−2.36* (−0.44)	7.14* (−0.78)	2.11
Eating symptoms (ChEAT/EDE)	4.65 (4.78)	0.80 (0.64)	−4.81*** (−0.92)	10.47 (8.04)	2.29 (1.19)	−4.18*** (−1.13)	5.53* (−0.89)	31.09*** (−1.62)
Self-esteem (LAWSEQ/RSE)	21.51 (2.51)	34.00 (5.37)	−3.19** (0.62)	18.65 (5.84)	31.24 (7.79)	−2.20* (0.41)	6.09* (0.65)	2.39
Body esteem (BES/BESAA)	20.59 (2.42)	2.62 (0.65)	−2.09* (0.35)	10.53 (6.50)	1.83 (0.75)	−3.99*** (−1.03)	50.19*** (2.09)	18.08*** (1.12)
<b>Socio-family markers</b>								
Weight-Teasing (POTS-WRT)	4.00 (0.00)	4.00 (0.00)	0.00	7.88 (4.53)	9.97 (5.56)	−1.77	48.75*** (−1.24)	47.59*** (−1.52)
Competency-Teasing (POTS-CT)	5.73 (1.43)	8.18 (3.28)	−3.56*** (−0.74)	8.65 (3.48)	10.06 (5.73)	−0.83	28.53*** (−1.11)	0.23
Trait-anxiety symptoms (STAIC-R)	35.54 (6.23)	35.51 (9.15)	−0.01	40.91 (10.24)	38.48 (13.25)	−1.49	6.46* (−0.64)	0.51
Family- Criticism (FQ-CC)	17.70 (4.61)	17.69 (4.07)	−0.11	20.50 (5.81)	18.86 (5.79)	−1.12	4.44* (−0.54)	0.20
Family- Overinvolvement (FQ-EOI)	19.05 (3.64)	20.40 (4.31)	−2.27	23.50 (4.53)	22.90 (5.63)	−0.07	18.69*** (−1.09)	2.04

Note. NWG: Normal-Weight group, OB: Obesity group; Mean and standard deviation are presented in raw scores. Size effects are reported only for significant differences between groups/times (in longitudinal comparisons, T<sub>0</sub> was used as reference; in cross-sectional comparisons, NWG was used as reference).

\* p &lt; .05.

\*\* p &lt; .01.

\*\*\* p &lt; .001.

true after controlling for the effect of a past (Mantel–Haenszel = 9.15;  $p = .002$ ) and current treatment (Mantel–Haenszel = 7.58;  $p = .006$ ) and the effect of age at  $T_1$  ( $p > .05$ ).

Regarding secondary diagnosis, a significant association was found with the OG, both at  $T_0$  and  $T_1$ . As seen in Table 2, OR statistics showed that the OG had a higher risk of secondary psychological diagnosis than the NWG.

### 3.3. Psychological, social, and family markers

Differences in all psychological, social, and family markers between the two groups and time points are reported in Table 3.

The NWG participants showed fewer depressive symptoms and eating symptoms, fewer frequency of perceived competency teasing, and higher levels of self- and body esteem at  $T_0$  than at  $T_1$ . Moreover, eating symptoms showed a high difference between  $T_0$  and  $T_1$ , and body esteem showed a low difference, whereas the other four markers showed medium or medium-to-high differences across time points.

Regarding the OG, significant differences between  $T_0$  and  $T_1$  were found, with fewer depressive symptoms, eating symptoms, and body esteem issues and higher self-esteem at  $T_0$  than at  $T_1$ . Moreover, eating symptoms and body esteem showed high differences between  $T_0$  and  $T_1$ , while depressive symptoms and self-esteem showed medium differences between the time points.

As for the differences between the NWG and the OG, after controlling for age, gender, and SES, the OG participants reported higher levels of anxiety and eating symptoms and lower body esteem than the NWG at both time points ( $p < .05$ ). Higher levels of depressive symptoms and lower self-esteem were found for the OG at  $T_0$ . Effect sizes showed that all significant differences between the groups ranged from medium to high. The OG participants also reported higher weight-related teasing at both  $T_0$  and  $T_1$ , resulting in a significant difference from the NWG. For the remaining markers, significant differences were observed only at  $T_0$ , with the OG reporting higher frequency of competency teasing, and higher levels of family anxiety, criticism, and overinvolvement.

### 3.4. Influence of psychological, social, and family markers at $T_0$ on mental disorders at $T_1$

Table 4 shows the results of multiple hierarchical logistic regression analyses. The final regression models made a significant contribution to the prediction of the primary psychiatric diagnosis at  $T_1$ , and they accounted for 17% to 31% of the variance. Regarding the total sample, only the body esteem at  $T_0$  made a significant contribution to the prediction of the primary diagnosis at  $T_1$ . However, when analyzing each group separately, only the anxiety trait at  $T_0$  was a significant predictor in the NWG, whereas eating symptoms at  $T_0$  were the only significant predictor of the primary diagnosis at  $T_1$  in the OG.

## 4. Discussion

Enhancing our understanding of the risk factors associated with psychological disorders is necessary to improve their prevention. The present study contributes to the growing body of research on psychopathology and psychosocial and family markers among children with obesity. Specifically, it is based on a case-control design that assesses, through clinical diagnostic interviews, the development of mental disorders in children with obesity compared to those with normal weight at childhood ( $T_0$ ) and adolescence ( $T_1$ ).

Regarding the prevalence of mental disorders, 61.8% of the OG participants met a full or subthreshold diagnosis at both time points, supporting the high prevalence of psychological disorders among children with obesity reported in previous studies (Sepúlveda et al., 2018; Vila et al., 2004). Moreover, a significant increase was found in secondary diagnosis between  $T_0$  (26.50%) and  $T_1$  (29.40%). Hence, our results suggest that the transition from childhood to adolescence is a critical period for the development of this comorbid symptomatology, which is highly prevalent in adults with obesity (Duarte-Guerra et al., 2022) and is associated with increased disorder severity, chronicity, and deterioration in the quality of life (Jacobson and Newman, 2017). Moreover, the type of diagnosis varied within the OG, shifting from a higher prevalence of conduct and anxiety disorders in childhood to eating and depressive disorders in adolescence. These changes are congruent with the literature, as anxiety disorders are found to be the most frequent conditions in children, followed by behavior disorders (Kessler et al., 2007), while eating and depressive disorders are found to be serious mental problems that rise sharply during puberty (Polanczyk et al., 2015). In the case of the NWG, only 8.1% of the participants met a complete or subthreshold DSM-5 primary diagnosis at  $T_0$ , which increased non-significantly to 16.2% at  $T_1$ ; while comorbidity was minimal.

As for the comparison between OG and NWG, at the cross-sectional level, our results support prior evidence of a higher rate of mental health disorders in the OG than in the NWG at  $T_0$  (Britz et al., 2000; Erermis et al., 2004; Sagar and Mehta, 2021). At the longitudinal level, as hypothesized, we found that childhood obesity was associated with mental disorders in adolescence, even after controlling for the effect of primary diagnosis at  $T_0$ , past or current treatment, and age at  $T_1$ . This is a preliminary and pioneering finding that reflects that childhood obesity may imply a risk of general mental diagnosis even in the medium to long term. Next, we delve into psychosocial and family markers that might contribute to the understanding of this association.

Psychological markers revealed that both groups showed statistically higher severity of depressive and eating symptoms, and lower self-esteem and body esteem at  $T_1$  than at  $T_0$ , reflecting the multiple changes that take place during adolescence that may pose a risk of mental health problems (Rapee et al., 2019). Moreover, the OG reported higher levels of TA and depressive and eating symptoms and lower self-esteem and body esteem at  $T_0$ , which is consistent to prior literature (Burke and Storch, 2015; Mühlig et al., 2016; Puder and Munsch, 2010;

**Table 4**  
Multiple hierarchical logistic regression: final regression coefficients for each group.

Sample	Dependent variable	Independent variable	Overall model effect $\chi^2$ ( $R^2$ )	Unstandardized coefficients (B)	Exponential B	Wald test
Total sample ( $n = 71$ )	Primary clinical diagnosis ( $T_1$ )	Intercept	18.60**** (0.31)	−0.566	0.046	3.98**
		BES ( $T_0$ )		−0.166	0.847	14.74****
NWG ( $n = 37$ )	Primary clinical diagnosis ( $T_1$ )	Intercept	5.24** (0.23)	−1.678	0.187	10.95***
		STAIC-T ( $T_0$ )		0.169	1.184	4.57**
OG ( $n = 34$ )	Primary clinical diagnosis ( $T_1$ )	Intercept	4.67** (0.17)	0.250	1.283	3.73*
		ChEAT ( $T_0$ )		0.110	1.117	0.42

Note: NWG: Normal-Weight group, OB: Obesity group,  $R^2$ : R-Squared, indicates the percentage of explained variance;.

\*  $p < .10$ .

\*\*  $p < .05$ .

\*\*\*  $p < .01$ .

\*\*\*\*  $p < .001$ .

Rankin et al., 2016). Longitudinally, group differences remained significant for TA, eating symptomatology, and body esteem at T<sub>1</sub> but not for depressive symptoms and self-esteem. These results add to the previous literature, as the limited number of longitudinal studies precluded the possibility of drawing any conclusions regarding associations between childhood obesity and prospective anxiety (Burke and Storch, 2015) and eating disorders (Stabouli et al., 2021). Moreover, inconsistent findings have been reported regarding depressive symptoms. For instance, in a systematic review by Mühlig et al. (2016), only three out of eight studies found an influence of childhood obesity on later depressive symptoms. Subsequent studies should further investigate the mechanisms (e.g., peer teasing, low body esteem) which promote the longitudinal association between obesity and depression. Our results support that body esteem is the aspect of self-esteem which is most consistently associated with BMI (Mendelson et al., 2000). Given that self-esteem is determined by feelings of adequacy in different domains (e.g., academic, athletic, social, familial; Harter, 1993), it is possible that throughout development, differences in self-worth between children with and without obesity become less evident, precisely because for other domains than body image, experiences are similar for both groups. For instance, our findings showed that the OG exhibited greater perceptions of WRT and CT at T<sub>0</sub>, but these differences remained significant at T<sub>1</sub> only for WRT. In fact, WRT shows stronger correlations with lower body esteem, while CT is associated with general self-worth (Rojo-Moreno et al., 2013). Finally, regarding family markers, we found significant differences at T<sub>0</sub> (i.e., higher severity of family TA, family criticism, and overinvolvement), but these did not remain significant at T<sub>1</sub>. This could support previous findings on the role of family markers in the etiology of childhood obesity (Smith et al., 2018), which may become less pronounced in adolescence (i.e., unlikely to be a consequence of obesity).

Since peers and family are relevant social agents that influence children's well-being (Lee and Yoo, 2015), and psychological symptoms during childhood may precede full-blown syndromes during adolescence (Balázs et al., 2013), we were interested in further exploring the influence of these markers at T<sub>0</sub> on mental disorders at T<sub>1</sub>. Results showed body esteem at T<sub>0</sub> as a significant predictor of primary diagnosis at T<sub>1</sub> in the entire sample, while TA and eating symptoms at T<sub>0</sub> were significant predictors for the NWG and the OG, respectively. Therefore, low body esteem is likely to be a general risk factor for mental health disorders regardless of weight status (Cho et al., 2012), while eating symptomatology at T<sub>0</sub> (e.g., restrained eating, binge episodes, guilt after eating, and food concerns) might be a specific risk factor for the OG. Notably, body esteem has been consistently linked to depressive and eating disorders prospectively (Paxton and McLean, 2019), which were the most prevalent problems in our sample at T<sub>1</sub> (particularly in the OG). Undoubtedly, most of these psychological outcomes seem to be related, and might be the onset of several dysfunctional consequences, particularly for the OG. For instance, WRT might worsen body image concerns, which in turn might increase avoidance of physical activity, social isolation, and psychological distress (Abdollahi et al., 2016; Blanco et al., 2019; Spettigue et al., 2020). Similarly, social withdrawal can intensify stress responses and lead to disordered eating behaviors, including cravings for sweets or high-carbohydrate and high-sugar junk foods and increased snacking as a way to alleviate anxiety symptoms, which could potentially contribute to obesity (Hemmingsson, 2018; Sepúlveda et al., 2022).

Overall, our results reinforce the relevance of addressing body dissatisfaction from an early age, regardless of body weight (Grogan, 2021). Indeed, it may have beneficial effects on the population with obesity, as previous research shows. Since promoting positive body image can reduce eating symptomatology and obesity simultaneously (Jones et al., 2019), a possible approach is to address WRT in obesity preventive interventions which is linked to low body esteem and poorer mental health prognosis (Pearl and Lessard, 2020).

Our findings should be interpreted considering study limitations. First, our sample size was relatively small as it was limited to case-

control study participants (Sepúlveda et al., 2019) and the 5 years follow-up entailed sample loss, albeit within the expected range for this follow-up time (Wells et al., 2009). Therefore, we could not evaluate differences between weight groups regarding specific psychological diagnoses, and subgroup analyses for gender differences and age could not be performed. Additionally, for design reasons, the OG was recruited through a primary care center during generic follow-up appointments, and the NWG from educational centers in the area. It is recommended future studies to be conducted with larger and more representative samples comprising cohorts from exactly the same population. Another limitation might be that different raters administered the diagnostic interviews; however, each rater was a well-trained research assistant supervised by a doctoral-level clinician. Ultimately, our study presents some worth mentioning strengths, such as its prospective design, the comparison with a control group, and the recruitment of an OG from a population that did not seek weight loss treatment. In addition, we performed a rigorous and comprehensive assessment through different methods (i.e., clinical/developmental history interviews, DSM-5 diagnostic clinical interviews, self-report questionnaires), and contrast information from various sources (i.e., participants and caregivers). To the best of our knowledge, no previous studies fulfill these major considerations by prospectively following up participants from infancy to adolescence.

## 5. Conclusions

The present study provides new insights into the development of psychological problems among children with obesity (compared to the NWG) and their development through adolescence. Overall, the OG had higher rates of psychological distress at baseline and follow-up, and childhood obesity was prospectively associated with mental health disorders during adolescence, even after controlling for relevant confounders. Moreover, at both time points, the OG had experienced higher frequency of weight-related teasing, which is considered an important marker of body esteem and is associated with a poorer mental health prognosis. Recognition of the psychological vulnerability of children with obesity could improve early diagnosis. Therefore, we recommend a multidisciplinary approach to the management and treatment of childhood obesity that includes mental health and psychosocial variables too.

## Compliance with ethical standards

The study received ethical approval from the Ethics Committee of the Niño Jesus Children Hospital (T<sub>0</sub>: Ref. 0009/10, T<sub>1</sub>: Ref.0076/18) and the Research Ethics Committee of University Autonomous of Madrid (T<sub>0</sub>: CEI 27-673, T<sub>1</sub>: CEI-98-103). All procedures performed in this study involving human participants were under the ethical standards and with de Helsinki Declaration and its later amendments or comparable ethical standards.

## Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Funding information

The authors did not receive financial support from any organization for the submitted work.

## Informed consent

Informed consent was obtained from all the surveyed participants and their parents.

## CRedit authorship contribution statement

**Lucía Beltrán-Garrayo:** Conceptualization, Investigation, Data curation, Writing – original draft, Writing – review & editing. **María Solar:** Data curation, Formal analysis, Methodology. **Miriam Blanco:** Investigation, Resources. **Montserrat Graell:** Resources, Visualization. **Ana Rosa Sepúlveda:** Conceptualization, Funding acquisition, Project administration, Supervision.

## Declaration of Competing Interest

The authors declare that they have no conflict of interest. All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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