

Association of overweight and obesity with psychological problems in school children

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Abstract: This study researched the relationship between overweight/obesity and psychological problems in children, emphasizing the interactive effects of gender, body dissatisfaction (BD) and socioeconomic status (SES). A total of 515 children with a mean age of 8.5 from Reus (Spain) were measured for weight and height and answered the Figure Rating Scale. Parents completed the Child Behavior Checklist. Children with obesity showed the greatest BD, were significantly more withdrawn/depressed (12.9% versus 3.2%) and had more aggressive behavior (9.7% versus 1.6%) than normal weight children ($p = .04$). The overweight and obese groups showed more somatic complaints than normal weight children (17.3% and 19.4% versus 9.4%; $p = .007$). The internalizing dimension, together with BD, was significantly related to the overweight/obese condition. Specifically, children with somatic complaints had a 2.64-fold increased probability of being overweight/obese. However, BD and SES did not mediate the relationship between internalizing problems and obesity. The study results support the relationship between obesity and internalizing problems in childhood.

Keywords: Psychopathology; obesity; emotional problems; children.

Asociación entre el sobrepeso y la obesidad con los problemas psicológicos en escolares

Resumen: El presente estudio investiga la relación entre sobrepeso/obesidad y problemas psicológicos en escolares, evaluando la interacción del género, insatisfacción corporal (IC) y nivel socioeconómico (NSE). Un total de 515 niños de 8.5 años (Reus, España) fueron pesados, medidos y respondieron la Figure Rating Scale. Los padres completaron el Child Behaviour Checklist. Los niños obesos presentaron más IC, mostraron significativamente más retraimiento/depresión (12.9% versus 3.2%) y conducta agresiva (9.7% versus 1.6%) que de los de peso normal ($p = .04$). Los niños con sobrepeso y sobrepeso/obesidad presentaron más quejas somáticas que los de peso normal (17.3% y 19.4% versus 9.4%; $p = .007$). La dimensión de problemas interiorizados, junto a la IC, estuvo significativamente relacionada con el sobrepeso/obesidad. Específicamente, los niños con quejas somáticas tuvieron 2.64 veces mayor probabilidad de ser obesos. No obstante, la IC y el NSE no mediaron la relación entre problemas interiorizados y obesidad. Los resultados apoyan la relación entre obesidad y los problemas interiorizados en edades tempranas.

Palabras clave: Psicopatología; obesidad; problemas emocionales; niños.

Introduction

Obesity is considered an eating behavior disorder within the broad range of weight-related and feeding

disorders. The etiology of obesity can be understood within a biopsychosocial model that involves multiple factors, such as early-life diet, socio-economic situation, dietary habits, sedentary lifestyle, genetic predisposition, physiological conditions and psychological state (Braet, 2005; Brands, Demmelair & Koletzko, 2014; Robinson et al., 2015; Spruijt-Metz, 2011; Vámosi, Heitmann, & Kyvik, 2010). The association between psychological problems and being overweight/obese appears to emerge early in life and both are significant public health problems.

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Between 10 and 20% of children suffer from psychological problems (Belfer, 2008; Kieling et al., 2011). Overweight and obesity in children range from approximately 10% in countries like Denmark to 30% in Mediterranean countries (Manios & Costarella, 2011). The relationship between a high BMI and psychological problems has been described for as early as 3 years of age (Griffiths, Dezateux, & Hill, 2011). Although the most related problems seem to be emotional, such as anxiety and depression disorders (Brumpton, Langhammer, Romundstad, Chen, & Mai, 2013; Chiang, Huang, Lo, Lee, & Wahlqvist, 2013; Esposito et al., 2014; Faith et al., 2011; Morrison, Shin, Tarnopolsky & Taylor, 2015; Mühlig, Antel, Föcker, & Hebebrand, 2016; Roberts & Duong, 2016), age, gender, the clinical or community sample, and cultural differences may explain the association with other psychological problems (Burke & Storch, 2015; Gibson et al., 2008; Griffiths et al., 2011; Sawyer et al. 2006; Seyedamini, Malek, Ebrahimi-Mameghani, & Tajik, 2012; Ter Bogt et al., 2006; Tso, Rowland, Toumbourou, & Guadagno, 2017). In contrast, other authors have not found a relationship between psychopathology and overweight/obesity (Freitas-Rosa, Goncalves, & Antunes, 2014), or the differences were so small that many associations became non-significant after adjusting for a range of sociodemographic covariates (Sawyer et al., 2006). It is currently unclear whether psychological problems are the cause or the consequence of childhood obesity or whether common factors promote both obesity and psychiatric disturbances in susceptible children and adolescents (Manna, Mamun, Doi, & Clavarino, 2016; Rankin et al., 2016). In any case, determining the mutual influence of these factors could be essential for designing effective intervention programs for obesity, since these programs often include training in central executive functions and emotional regulation (Segura et al., 2017).

The association between obesity and psychological problems may be mediated by several factors (Rankin et al., 2016). Specifically, the association between obesity and depression could differ in relation to gender and age (Anderson, Cohen, Naumova, & Must, 2006; Chiang et al., 2013; Pervanidou & Chrousos, 2011), as it is most problematical among adolescent females (Blaine, 2008; Mühlig et al., 2016; Rofey et al., 2009; Vámosi et al., 2010). Obesity may increase the risk of depression through stigmatization, body image dissatisfaction (BD), effects of dieting, and impairments in physical health and functioning. In a study conducted with children and adolescents from 9 to 16 years old, overweight/obese participants showed higher BD, lower

academic and corporal self-esteem, and higher levels of anxiety (Cebolla, Baños, Botella, Lurbe, & Torró, 2011). Among these factors, BD has been identified as the psychological correlate of obesity most related to depression, especially among women (Al Mamun et al. 2007; Ter Bogt et al. 2006; Weinberger, Kersting, Riedel-Hellerb, & Luck-Sikorskia, 2016). In addition, it can work in the opposite direction because depression can increase the risk of obesity through changes in lifestyle and direct biochemical effects on appetite regulation, so that the person eats to regulate their moods (Aparicio, Canals, Voltas, Hernández, & Arija, 2016; Vannucci et al., 2013). Byrne, O'Brien-Simpson, Mitchell, and Allen (2015) suggested a model whereby inflammation and obesity are outcomes of adolescent depression. Rises in sex hormones during puberty increase the risk of depression for females, which can lead to obesity, which in turn increases inflammation levels. However, some authors have found that there is no relationship between emotional disturbance and obesity in young children and adolescents (Drukker, Wojciechowski, Feron, Mengelers, & Van Os, 2009). In addition to emotional problems, behavioral and neurodevelopmental disorders have also been shown to have a relationship with obesity, or have been considered predictors of weight gain (Dahlgren & Björk 2014; Khalife et al. 2014; Korczak, Lipman, Morrison, Duku, & Szatmari, 2014; Mallan et al., 2017; Wentz, Björk, & Dahlgren et al., 2017). Among these disorders, meta-analytic evidence shows a significant association between ADHD and obesity, regardless of possible confounding factors such as other psychiatric comorbidities (Cortese & Tessari, 2017). This relationship has been found already in the preschool age by Perez-Bonaventura, Granero, & Ezpeleta (2015), who showed that a higher BMI at the age of 3 years was predictive of hyperactivity and ADHD symptoms at the age of 4 years. Several mechanisms may explain this association, highlighting the role, among others, of abnormal eating patterns secondary to food cue disorders and difficulties in inhibitory control over food, sedentary lifestyle and possible common genetic alterations (Van Den Akker, Stewart, Antoniou, Palmberg, & Jansen, 2014; Cortese & Tessari, 2017).

Another factor that is related to the increasing prevalence of obesity and psychological problems is a lower socioeconomic position. The systematic review carried out by Chung et al. (2016) showed that in economically advanced countries, socioeconomic inequalities are positively related to child and adolescent obesity prevalence. In Italian children aged 6 to 8 years old, Grassi et al. (2016) also found that being overweight

was associated with parents' lower level of education and employment. However, socioeconomic status (SES) is a significant risk factor for negative mental development due to economic stress, chaos in the home, parent depression, conflicts between parents, and parenting practices (Devenish, Hooley, & Mellor, 2017).

The aim of the present study was to investigate the association between overweight/obesity and psychological problems in Spanish schoolchildren in middle childhood. We report cross-sectional data on this relationship by focusing on the interactive effect of gender, BD and socioeconomic status (SES). Our hypothesis is that there is a relationship between a high BMI and psychological problems, and that internalizing problems are associated more with obesity than externalizing problems, as previously found in adolescents. This relationship could be mediated by BD and SES.

Methods

Study population

Five hundred and fifteen children (250 boys and 265 girls) in the second to fourth grades from twenty randomly selected state (80%) and private (20%) primary schools in Reus (Spain) participated in the study after their parents signed the informed consent form. A potential population of 1623 students were invited to participate after permission was obtained from the Education Department to access schools. Of the 515 children, 20% were from families with low SES, 53% were from families with medium SES, and 23% were from families with high SES. The mean age of the participants was 8.54 ($\pm .64$) with a minimum age of 6.5 and a maximum of 10 years.

The sample was distributed into three groups: overweight ($n = 149$), obese ($n = 37$) and normal weight ($n = 316$). Underweight children were excluded from the analyses.

Measures

Child Behavior Checklist 6-18 (CBCL/6-18; Achenbach & Rescorla 2001). Parents completed the Spanish version of the CBCL, which has 113 items of behavioral problems with 3 possible answers on a Likert scale that provided scores for eight scales; anxious/depressed, withdrawn/depressed, somatic complaints, social problems, thought problems, attention problems, rule-breaking behavior and aggressive behavior. The first three scales build up the internalizing dimension,

the last two scales make up the externalizing dimension and the sum of scores for all the problem items make up the total psychological problems dimension. We used the CBCL scale scores for multicultural normative samples to classify the raw scores into normal, borderline and clinical categories. The internal consistency (Cronbach's alpha) for this sample was .94 for the full scale.

Anthropometric data. Weight and height were individually measured with a calibrated scale and a stadiometer (SECA 702 & SECA 2014, respectively), with the children standing in light clothing and barefoot in an individual room prepared at school for this purpose. Body Mass Index (BMI) was calculated as weight in kilograms divided by the square of height in meters. In order to be consistent with international research, as proposed by the International Obesity Task Force, age and sex specific cut-off points for BMI for overweight and obesity in children were estimated using dataset specific centiles linked to adult cut off points (25 kg/m² for overweight and 30 kg/m² for obesity; Cole, Bellizzi, Flegal, & Dietz, 2000).

Body Image perception. Children's own body image perception was assessed with the Figure Rating Scale (FRS; Eckstein et al., 2006). The FRS shows seven schematic sketches of children that can be used to examine the boys' and girls' ideas of their current and desired body size. The middle image in each series of sketches represents a child in the 50th BMI percentile; the other sketches are not tied to particular BMI percentile categories. These scales have been proven to be highly reliable (Eckstein et al., 2006). Therefore, body image dissatisfaction in children was measured by the discrepancy between the two figures chosen, and was dichotomized into being satisfied or being dissatisfied with their body image. Children with normal weight who were dissatisfied with their body image because they wanted to be fatter were excluded from the statistical analyses. The internal consistency for the items about current and desired body size in this sample was .33.

Socioeconomic status (SES). Parents were asked about their employment and the Classification of Occupations of the Statistical Institute of Catalonia (CCO-94/ca, Decree 98/1995) was used to code the information and define their socioeconomic status (SES). The SES was recoded into low, middle and high status.

Statistical Analyses

The statistical analyses were performed using IBM SPSS version 20.0 (Armonk, NY: IBM Corp.). EPIDAT 3.1 (Xunta de Galicia, Spain) was also used

to perform the two-proportion z-test and calculate the possible differences in psychological problems within each sociodemographic variable, BMI category (normal weight, overweight and obese) and body image. We performed a Chi-square test to compare groups according to anthropometric, psychopathological and sociodemographic variables. We used logistic regression models with the stepwise method to determine the associations between psychological problems as a predictor variable and BMI status as an outcome variable. For logistic regression, the BMI status was determined by two categories: normal weight or obesity (overweight, including obesity). All the CBCL scores were dichotomized into two categories: normal or disordered (borderline, including clinical). We entered the eight CBCL scales into a model (Pearson correlations between the CBCL scales showed there was no collinearity) and adjusted for age, gender, socio-economic status and body image dissatisfaction. Collinearity was found between the total problems dimension and both the internalizing ($r = .61$) and externalizing dimensions ($r = .65$). We performed logistic regression models for each single dimension as psychopathological predictors. A series of regression analyses called mediational models were applied to determine the possible mediator variables of the relationships found. Mediation analyses were carried out according to Baron and Kenny's criteria (Allen, Byrne, Blair & Davis, 2006; Preacher & Hayes, 2008). These criteria require that 1) the independent variable predicts the mediator, 2) the mediator predicts the dependent variable, and 3) a significant relationship between the independent and dependent variable becomes weaker when the effects of the mediator are considered.

Results

Association between anthropometric status, sociodemographic variables and psychological problems

As can be seen in Table 1, there were no significant differences between gender, age, socioeconomic level or anthropometric status. Significant differences were found between anthropometric status and body image dissatisfaction. Overweight and obese children were more dissatisfied than normal-weight children ($\chi^2 = 18.79, p < .01$; $\chi^2 = 32.84, p < .01$, respectively), and obese children were more dissatisfied than overweight children ($\chi^2 = 11.32, p < .01$).

Table 2 shows the relationship between psychological problems and anthropometric status. Obese children showed both more withdrawn/depressed and aggressive behavior in the clinical range (12.9% and 9.7% respectively) than normal-weight children (3.2% and 1.6%, respectively) ($\chi^2 = 10.08, p = .04$ and $\chi^2 = 10.20, p = .04$). When obesity including overweight (overweight/obese) was considered, somatic complaints in the clinical range (9.1%) were also significantly higher ($\chi^2 = 7.82, p = .02$) in relation to normal weight children (3.9%).

When CBCL scores were dichotomized into normal or disordered (borderline, including clinical range), overweight and overweight/obese children had more somatic complaints (17.3% and 19.4%, respectively) than normal-weight children (9.4%) ($\chi^2 = 6.01, p = .01$ and $\chi^2 = 7.21, p = .007$). In addition, social problems were higher in overweight (9.0%) and overweight/obese (6.5%) children than normal-weight children (4.2%) ($\chi^2 = 4.26, p = .039$ and $\chi^2 = 3.94, p = .042$, respectively). Lastly, obese children also showed a significantly higher

Table 1. Sociodemographic characteristics by anthropometric status

		Normal Weight <i>n</i> (%)	Overweight <i>n</i> (%)	Obesity <i>n</i> (%)	χ^2 (<i>p</i>)
Gender	Male	157 (49.7)	70 (47.0)	18 (48.7)	.30
	Female	159 (50.3)	79 (53.0)	19 (51.4)	(.86)
School grade	2nd	97 (30.7)	38 (25.5)	10 (27.0)	3.76
	3rd	152 (48.1)	85 (57.1)	21 (56.8)	(.44)
	4th	67 (21.2)	26 (17.4)	6 (16.2)	
Socioeconomic status	Low	86 (28.6)	35 (26.3)	13 (41.9)	10.62
	Average	134 (44.5)	71 (53.4)	15 (48.4)	(.10)
	High	81 (26.9)	27 (20.3)	3 (9.7)	
Body image	Dissatisfaction	107 (44.0)	95 (66.9)	35 (94.6)	43.37
	Satisfaction	136 (56.0)	47 (33.1)	2 (5.4)	(< .01)

Note. $p \leq .05$

Table 2. Psychological characteristics by anthropometric status

		Normal Weight^a n (%)	Overweight n (%)	Obesity n (%)	χ^2 (p)	Overweight + Obesity^b n (%)	χ^2 (p) ^{ab}
Anxiety/Depressed	Normal	272 (87.7)	127 (88.2)	28 (90.3)	4.73	155 (88.5)	2.20
	Borderline	21 (6.8)	14 (9.7)	1 (3.2)	(.32)	15 (8.6)	(.33)
	Clinical	17 (5.5)	3 (2.1)	2 (6.5)		5 (2.9)	
Withdrawn /Depressed	Normal	273 (88.1)	124 (86.1)	27 (87.1)	10.08	151 (86.3)	1.09
	Borderline	27 (8.7)	15 (10.4)	0 (0.0)	(.04)	15 (8.6)	(.58)
	Clinical	10 (3.2)	5 (3.5)	4 (12.9)		9 (5.1)	
Somatic complaints	Normal	281 (90.6)	119 (82.7)	25 (80.6)	7.99	144 (82.3)	7.89
	Borderline	17 (5.5)	12 (8.3)	3 (9.7)	(.09)	15 (8.6)	(.02)
	Clinical	12 (3.9)	13 (9.0)	3 (9.7)		16 (9.1)	
Social problems	Normal	297 (95.8)	131 (91.0)	29 (93.5)	5.50	160 (91.4)	4.42
	Borderline	8 (2.6)	9 (6.2)	2 (6.5)	(.24)	11 (6.3)	(.11)
	Clinical	5 (1.6)	4 (2.8)	0 (0.0)		4 (2.3)	
Thought problems	Normal	295 (95.1)	138 (95.8)	28 (90.3)	5.75	166 (94.9)	1.48
	Borderline	7 (2.3)	2 (1.4)	0 (0.0)	(.22)	2 (1.1)	(.48)
	Clinical	8 (2.6)	4 (2.8)	3 (9.7)		7 (4.0)	
Attention problems	Normal	267 (86.1)	122 (84.7)	26 (83.9)	1.55	148 (84.6)	.31
	Borderline	27 (8.7)	12 (8.3)	4 (12.9)	(.82)	16 (9.1)	(.86)
	Clinical	16 (5.2)	10 (7.0)	1 (3.2)		11 (6.3)	
Rule breaking behavior	Normal	290 (93.5)	135 (93.7)	30 (96.8)	3.15	165 (94.3)	1.74
	Borderline	13 (4.2)	3 (2.1)	1 (3.2)	(.48)	4 (2.3)	(.42)
	Clinical	7 (2.3)	6 (4.2)	0 (0.0)		6 (3.4)	
Aggressive behavior	Normal	277 (89.4)	122 (84.7)	27 (87.1)	10.20	149 (85.1)	7.66
	Borderline	28 (9.0)	14 (9.7)	1 (3.2)	(.04)	15 (8.6)	(.02)
	Clinical	5 (1.6)	8 (5.6)	3 (9.7)		11 (6.3)	
Internalizing	Normal	219 (70.6)	92 (63.9)	19 (61.3)	4.01	111 (63.4)	2.75
	Borderline	36 (11.6)	21 (14.6)	3 (9.7)	(.41)	24 (13.7)	(.25)
	Clinical	55 (17.8)	31 (21.5)	9 (29.0)		40 (22.9)	
Externalizing	Normal	250 (80.6)	111 (77.1)	24 (77.4)	1.78	135 (77.2)	1.29
	Borderline	28 (9.0)	14 (9.7)	2 (6.5)	(.78)	16 (9.1)	(.53)
	Clinical	32 (10.4)	19 (13.2)	5 (16.1)		24 (13.7)	
Total Problems	Normal	257 (82.9)	114 (79.2)	21 (67.8)	5.85	135 (77.2)	3.43
	Borderline	28 (9.0)	12 (8.3)	5 (16.1)	(.21)	17 (9.7)	(.18)
	Clinical	25 (8.1)	18 (12.5)	5 (16.1)		23 (13.1)	

Note. $p \leq .05$

prevalence of total psychological problems (32.2%) than normal-weight children (17.1%; $\chi^2 = 4.30$, $p < .05$).

Association between psychological problems and overweight/obesity: multivariate models

The logistic regression model analyzed the relationships of the eight CBCL scales (borderline including clinical) with anthropometric status (overweight/obesity) after adjustment had been made for BD and sociodemographic variables (see table 3).

Those children with somatic complaints showed a 2.64-fold increased probability of being overweight/obese. Body image dissatisfaction was also related to being overweight/obese (OR 3.02). These two factors explained 12.6% of the variance of being overweight/obese.

Three logistic regression models were performed to analyze the separate association of each CBCL dimension (borderline including clinical) with anthropometric status. Only the internalizing dimension was significantly related to the condition overweight/obese. Having internalizing problems and body dissatisfaction

Table 3. Significant logistic regression models: the effect of psychological problems on being overweight/obese.

Model 1	Odds ratio (95% CI)	<i>p</i>
Body image dissatisfaction (Yes)	3.02 (1.94 to 4.70)	< .01
Somatic complaints (borderline plus clinical)	2.64 (1.39 to 5.02)	< .01
<i>Model parameters: p = .002; $\chi^2_{2.383} = 37.53$; $r^2_{Nagelkerke100} = 12.6\%$.</i>		
Variables entered in the model: age, gender, socio-economic status, body image dissatisfaction and eight CBCL scales.		
Model 2	Odds ratio (95% CI)	<i>p</i>
Body image dissatisfaction (Yes)	3.02 (1.94 to 4.70)	< .01
Internalizing problems (borderline plus clinical)	1.60 (1.02 to 2.52)	< .05
<i>Model parameters: p = .04; $\chi^2_{2.383} = 32.60$; $r^2_{Nagelkerke100} = 11\%$.</i>		
Variables entered in the model: age, gender, socio-economic status, body image dissatisfaction and total problems dimension.		

Table 4. Results (β) of regression analyses of mediation.

Mediational chains (IV → MV → DV)		IV → MV	MV → DV	IV → DV	IV + MV → DV
Model A	Internalizing problems → body image dissatisfaction → obesity	1.69*	3.37***	ns	MV = 3.29*** IV = ns
Model B	Internalizing problems → socio-economic status → obesity	.48**	.61*	ns	MV = ns IV = 1.57*
Model C	Body image dissatisfaction → internalizing problems → obesity	1.69*	ns	3.37***	MV = ns IV = 3.29***
Model D	Obesity → body image dissatisfaction → internalizing problems	3.37***	1.69*	ns	MV = 1.75* IV = ns

Note. IV = independent variable; MV = mediator variable; DV = dependent variable. * $p < 0,05$ ** $p < 0.01$, *** $p < 0.001$.

increased the probability of overweight/obesity 1.6-fold and 3.0-fold, respectively.

Considering the associations found and the previous literature, we used mediational models to test the relationship of the directionality between obesity (including overweight), internalizing problems (borderline including clinical), BD and SES (Table 4). Obesity was bidirectionally related to BD but BD was not related to internalizing problems. Although some significant relationships were found, the analyses did not meet sufficient statistical criteria to support any mediational model. Thus, model A found a significant relationship between internalizing problems (independent variable; IV) and BD (mediational variable; MV) but no relationship was found between IV and obesity (dependent variable; DV). The same situation was found in model D, when the BD was considered a mediator between obesity (IV) and internalizing problems (DV). However, when the SES was explored as mediator between internalizing problems (IV) and obesity (DV), the model (B) was not significant, although SES was related to internalizing problems and obesity. Model C showed that internalizing problems did not mediate the relationship between BD and obesity.

Discussion

This study supports a relationship between psychopathology and obesity in school-aged children. Obese children showed a higher prevalence of total psychological problems (borderline including clinical) than normal-weight children, in agreement with other studies with clinical and non-clinical samples (Esposito et al., 2014; Griffiths et al., 2011; Gibson et al., 2008; Rankin et al., 2016; Sawyer et al., 2006; Seyedamini et al., 2012; Vila et al., 2004). Specifically, among the different scales of CBCL/6-18, somatic complaints, withdrawn/depressed, aggressive behavior and social problems were significantly associated with the overweight and/or obesity status. When we adjusted these relationships for sociodemographic variables, being overweight/obese was associated with somatic complaints and also with the internalizing problems dimension. In this regard, it should be noted that somatizations are part of internalizing problems and are also associated with other internalizing problems, such as depression and anxiety (Ask, Waaktaar, Seglem, & Torgersen, 2016; Campo, 2012; Shanahan et al., 2015). While our study found a higher prevalence of withdrawn/depressed in

obese children, like other authors (Erickson, Robinson, Haydel, & Killen, 2000; Esposito et al., 2014; Morrison et al., 2015; Rankin et al., 2016), our findings did not support a higher prevalence of anxiety problems as shown in other studies (Chiang et al., 2013; Goldfield et al., 2010; Esposito et al., 2014). This association might be observed later in life, as some research has found that symptoms of anxiety or depression during childhood and adolescence predict later obesity (Aparicio et al., 2013; Blaine, 2008; Mannan et al., 2016; Robert & Duong, 2016; Rofey et al., 2009; Vámosi et al., 2010). It is also possible that at early ages, the manifestations of internalizing problems are based more on somatic complaints. One possible explanation of the relationship between internalizing problems, somatic complaints and high BMI is that these children do not have adequate strategies to regulate emotional distress, which they express through somatizations or they may eat to stay calm. Furthermore, somatization in children may limit their activities, such as leading to a reduction in physical activity, which is a contributory factor to high BMI. The relationship found between social problems and obesity/overweight could be interpreted as a consequence of the limitations of the BMI; obese children may be less accepted by their peers, they play less group sport, which is a normal activity for children of these ages, and they also have lower body satisfaction that interferes with self-esteem and social relationships. In this sense, Al-Agha, Al-Ghamdi, and Halabi (2016) studied children with a mean age of 10 years in Western Saudi Arabia and found that a higher BMI was associated with social problems related to the difficulty of doing things that other children could do. In early stages of development (children of 3.5 to 5 years old), other authors also found more peer relationship problems in cases of higher BMI (Griffits et al., 2011; Mallan et al., 2017; Perez-Bonaventura et al., 2015).

The mediational models did not show that the relationship between internalizing problems and obesity was mediated by BD or SES, although both variables were associated with obesity. It is probable that the relationship between internalizing problems and obesity is influenced by the interaction of multiple variables. The most significant relationship was found between BD and obesity, as other authors have reported for both adolescents (Doyle, Le Grange, Goldschmidt, & Wilfley, 2007; Babió, Arija, Sancho, & Canals, 2008) and children. This indicates that overweight and obese children were significantly more dissatisfied with their body image than normal-weight children (Allen et al., 2006; Goldfield et al., 2010). In agreement with Mond van den Berg, Boutelle, Hannan, and Neumark-

Sztainer (2011), we found a significant relationship between internalizing problems and BD. However, the relationship between low SES and obesity was consistent with other authors (Chung et al., 2016; Grassi et al., 2016) and, as reported in Tandon et al. (2012), could be indirectly due to parenting practices and family eating habits, which may be important influences on children's sedentary, eating and emotional coping behaviors. In this sense, our results showed a relationship between low SES and internalizing problems that supports the effect of a family's low social and economic level on emotional status (Devenish, Hooley & Mellor, 2017).

Looking at gender differences in our study, the female sex did not explain the relationship between emotional problems and obesity as has been shown by other studies with children (Erickson et al., 2000; Gibson et al., 2008) and adolescents (Mühlig et al., 2016).

According to the relationship between externalizing problems and obesity, we found that aggressive behavior was more frequent in obese children. These results are similar to those obtained by Griffits et al. (2011), who showed more conduct and peer relationship problems in obese 5-year-old boys.

However, Anderson, He, Schoppe-Sullivan, and Must, (2010) suggested that externalizing behaviors in early childhood were associated with higher BMI throughout the elementary school years, but they found that the magnitude of the effect was modest. Recently, Mallan et al. (2017) showed that among maternal-reported child eating behaviors, food responsiveness mediated the association between conduct problems and BMI z score. Therefore, we hypothesize that children with behavioral problems may be more likely to have a higher weight because they have less behavioral adjustment strategies and consequently, like other subjects with emotional distress, they eat impulsively.

We did not find a significant relationship between ADHD problems and obesity as has been found in recent years by other authors (Cortese & Tessari, 2017; Khalife et al., 2014; Dahlgren and Björk, 2014; Griffits et al., 2011; Perez-Bonaventura et al., 2015). Several aspects could explain this lack of association; for instance, our study did not use specific tests for ADHD while other studies used ADHD patients or had a longitudinal design to explore the risk of one disorder on the other.

In conclusion, the results of this study support that in middle childhood there is a relationship between being overweight/obese and psychological problems, mainly internalizing problems, as well as a relationship between high BMI and BD. Since the simple mediational models were not significant, future studies should carry out mediational analyses with

multiple mediators to assess this problem. However, the cross-sectional design of our study did not allow us to draw conclusions on the directionality between psychopathology and obesity. Another limitation of the study was the sample size because a high number of parents did not participate.

In Spain, there are few studies on obesity and psychological problems in children. The results of this study indicate that there is a relationship between obesity and psychopathology in school-aged children, which could affect the persistence and negative consequences of these two disorders. A multidisciplinary approach to obesity management that considers emotional troubles as well as other psychological and socio-family factors could be used to improve obesity prevention and treatment strategies.

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