# The Relationship between Weight Status and Emotional and Behavioral Problems in Spanish Preschool Children

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## Abstract

**Objective** To examine cross-sectional and longitudinal associations between behavioral problems and weight status, considering Body Mass Index (BMI) z-scores and overweight status, in a community sample of preschoolers. **Methods** The Strengths and Difficulties Questionnaire and the Diagnostic Interview for Children and Adolescents were administered to 611 parents. Adjusted general linear models and binary logistic regressions were used. **Results** Children who were overweight and had a higher BMI were at increased risk of peer problems and Attention Deficit/Hyperactivity Disorder (ADHD) symptoms. Prospective analyses showed that a higher BMI at age 3 was predictive of peer problems at ages 4 and 5, and hyperactivity and ADHD symptoms at age 4. **Conclusion** This is the first study using a diagnostic-based instrument that shows a relationship between weight status and ADHD symptoms in preschoolers. Overweight children might benefit from screening for behavioral disorders and peer relationship problems.


**Key words** behavioral problems; BMI; children; overweight; peer problems; preschool.

# The Relationship between Weight Status and Behavioral Problems in Spanish Preschool Children

Throughout the world, childhood obesity is a public health concern that poses serious threats to children's health and is being found at ever younger ages (Kim et al., 2006). At present, 43 million children aged 5 years and younger are overweight and obese, while 92 million more are at risk of becoming overweight (de Onis, Blössner, & Borghi, 2010).

Childhood obesity is associated with increased risk of numerous physical health conditions and a greater risk of obesity in adulthood (Singh, Mulder, Twisk, van Mechelen, & Chinapaw, 2008). There is growing interest, not only in the physical consequences of obesity, but also on understanding the relationship between obesity and mental health. Research has revealed several associations between overweight or obesity in children and health-related quality of life (Williams, Wake, Hesketh, Maher, & Waters, 2005), risk of bullying (Janssen, Craig, Boyce, & Pickett, 2004), social isolation (Strauss & Pollack, 2003) and behavioral problems (Mustillo et al., 2003). Nevertheless, most studies are cross-sectional and only focus on school-aged children. It is unclear how relevant these findings are for children under the age of 5.

The preschool years are a critical window for obesity prevention as rapid weight gain in early childhood is associated with later obesity (Baker, Olsen, & Sørensen, 2007) and lifestyle changes made during this period are more durable (Olstad & McCargar, 2009). As such, there is a need for studies that focus on the preschool years, and especially early adiposity rebound (Garthus-Niegel, Hagtvet, & Vollrath, 2010).

Few community studies have examined the cross-sectional association between overweight, Body Mass Index (BMI) and mental health in very young children. Five found positive associations, reporting that behavioral problems were positively related

to a higher BMI and overweight (Anderson, He, Schoppe-Sullivan, & Must, 2010; Datar & Sturm, 2004; Griffiths, Dezateux, & Hill, 2011; Olsen et al., 2013; Sawyer et al., 2006) although one found rather small effect sizes (Sawyer et al., 2006) and three others found none at all (Garthus-Niegel, Hagtvet, & Vollrath, 2010; Lawlor et al., 2005; Mackenbach et al., 2012). However, correlating these studies is difficult due to the age ranges of their subjects (2 to 5 years old) and the studies' differing behavioral constructs. Moreover, in existing studies, psychopathology is usually based only on dimensional measures; no study has used a diagnosis from the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000) as an outcome. Most of the limited research in this area has been carried out in the United States, Australia and northern European countries. Given the high prevalence of overweight and obesity across Southern Europe (van Stralen et al., 2012), further research is needed on preschoolers in these countries, including Spain. Finally, although often overlooked, increasing evidence points to a significant association between attention-deficit/hyperactivity disorder (ADHD) and both obesity and higher-than-average BMI standard deviation scores. This link has been established in adults, adolescents and children (Cortese & Vincenzi, 2012). However, most studies have examined this association in clinical samples while none has studied it in a community sample of preschoolers using a diagnostic interview to identify ADHD symptoms.

Accordingly, the aim of this study is to investigate cross-sectional and longitudinal associations between weight status (BMI z-scores and overweight status) and behavioral problems in a large community sample of Spanish preschool children aged 3 to 5. The study's longitudinal design allows us to examine whether early overweight signals the likelihood of psychological problems later in life. To ensure a comprehensive assessment, behavioral problems were assessed with standardized

questionnaires to capture dimensionally-scored symptoms and a diagnostic interview to identify psychological disorders according to DSM-IV-TR criteria.

It was hypothesized that children who had a higher BMI z-score (quantitative measure) and were overweight (qualitative measure based on the World Health Organization child growth standards for preschoolers) would be more likely to have more externalizing symptoms (Hypothesis 1). Specifically, given the body of literature (Cortese & Vincenzi, 2012), we hypothesized that children who had a higher BMI z-score and were overweight would be more likely to have ADHD symptoms (Hypothesis 2). Additionally, this study examined the relationship between peer problems and overweight. Based on theoretical and community studies (Griffiths, Dezateux & Hill, 2011), it was hypothesized that a higher BMI z-score and overweight would be associated with peer problems in the preschool years (Hypothesis 3). Finally, we hypothesized that BMI z-score and overweight at age 3 would predict behavioral problems and peer problems at ages 4 and 5 (Hypothesis 4).

## Methods

### Participants

The participants were 622 three-year-old children and their parents. The data were derived from the assessment of a large-scale longitudinal project on psychopathology and risk factors specifically focused on behavioral problems in preschool children (Ezpeleta, de la Osa, & Doménech, 2014). A community sample of 2,283 children in the first year of preschool education was randomly selected from the census of preschool facilities centers in Barcelona, Spain, in 2009. In the first phase, 1,341 families (58.7%) agreed to participate. There were no significant sex differences between the participants and those who declined to participate ($p$=.951). However, the

proportion of refusals was statistically higher for families in low socioeconomic status (SES; Hollingshead, 1975) groups ($p < .001$).

The screening procedure for the selection of children with possible behavioral problems was carried out by administering, to parents, four items from the Strengths and Difficulties Questionnaire (SDQ; Ezpeleta, Granero, de la Osa, Penelo, & Doménech, 2013) conduct problems scale plus four questions derived from the DSM-IV-TR diagnostic criteria for Oppositional Defiant Disorder (ODD). Based on the results of the screening process, two groups were formed. The positive screen group ($n$ = 205; 51.2% boys) included all the children who reached the threshold for behavioral problems as defined by SDQ$\geq$ 4 on the conduct problems scale, corresponding to Percentile 90 in community samples (Ezpeleta, de la Osa, & Doménech, 2014), or any "certainly true" responses to any of the eight parent's self-reported oppositional defiant symptoms. The negative screen group ($n$ = 417; 49.4% boys) included a random sample from the 30% of children who did not reach the threshold (the percentage of negative screen participants guaranteeing adequate statistical power for the analysis planned in the research). At this stage, in 135 cases (10.6%) the parents declined to continue with the study and follow-up; these cases did not differ in sex ($p$=.815) or type of school ($p$=.850) from those who agreed to continue, but the parents who agreed to participate were of a higher SES ($p$=.007). Exclusion criteria were: (a) child with intellectual disability or pervasive developmental disorder; (b) parental lack of fluency in Spanish or Catalan; (c) no parent to provide reports on the child; or (d) family relocating outside study area within 12 months. In all, 75 families were excluded.

Of the 622 families that agreed to take part in the follow-up (considered the second phase of the study), 11 children were excluded due to missing height or weight measurement data. Consequently, the sample for this study comprised $N$= 611 three-

year-old children and their parents. Children were followed-up yearly at age 4 ($N$ = 596) and 5 ($N$ = 564). Drop-outs were statistically equal by gender ($p$=.188) and SES ($p$=.062).

**Measures**

Psychopathology

The Strengths and Difficulties Questionnaire (Goodman, 1997) is a widely-used brief questionnaire for parents designed to assess children's behavioral and emotional difficulties. It contains 25 items, 5 in each of the five subscales: emotional symptoms, conduct problems, hyperactivity, peer problems and prosocial behavior. Response options are: "not true", "somewhat true" or "certainly true", scoring 0, 1, and 2 respectively. Higher scores indicate more problems on all five subscales. An overall emotional-behavioral difficulties score is generated by summing the subscale scores, with the exception of the prosocial behavior subscale. The total difficulties score ranges, for the remaining twenty questions, from 0 to 40, with higher scores indicating greater difficulties. The Spanish version of the SDQ has well-established psychometric properties (Ezpeleta, Granero, de la Osa, Penelo, & Doménech, 2013). The study sample alpha values for each subscale were as follows: .51 for the emotional subscale, .59 for conduct problems, .74 for hyperactivity, .53 for peer problems, .56 for prosocial behavior and .80 for the total difficulties scale (low consistency for first-order scales must be interpreted with caution as there were only 5 items).

The Diagnostic Interview for Children and Adolescents for Parents of Preschool and Young Children (DICA-PPY; Reich & Ezpeleta, 2009) is a computerized semi-structured diagnostic interview for parents of children between 3 and 7 years old. The instrument is administered by a clinician and used to assess the most common psychological disorders according to DSM-IV-TR criteria (American Psychiatric

Association, 2000). Diagnoses are generated through computerized algorithms, and disorders are assessed over the lifetime. The instrument has been translated into Spanish and validated. Validation has shown acceptable test-retest reliability and moderate convergence with other psychopathology measures, as well as the ability to differentiate preschoolers and young children who had used mental health services (Ezpeleta, de la Osa, Granero, Doménech, & Reich, 2011). This study only analyzed disruptive disorders including ADHD, ODD and conduct disorder.

Weight measures

Children were weighed and their height was measured while they were barefoot and wearing light clothes. Weight and height measurements were taken by nurses at outpatient pediatric primary care units during each child's annual visit to the pediatrician. These values were recorded in the child's medical records and were recovered annually during the course of this study. BMI was calculated as the ratio between weight (kg) and height ($m^2$). The BMI z-scores were calculated from WHO reference curves (World Health Organization, 2006). Children were classified in binary fashion as non-overweight or overweight according to the WHO international age- and sex-specific child growth standards (World Health Organization, 2006). Based on the WHO recommendations specifically for preschool-aged children, overweight was defined as having a BMI greater than two standard deviations from the mean weight in the WHO reference population (de Onis, Blössner, & Borghi, 2010). The WHO child growth standards are among the most internationally-accepted classifications and are extensively used in the Spanish setting. Classifying children based on BMI criteria has the potential to produce different results according to distinct clinical and public health contexts (Jansen, Mensah, Nicholson, & Wake, 2013). As such, two measures were

used through the study: (a) a qualitative, binary variable (overweight status); and (b) a quantitative variable (BMI z-score).

Family Demographic Characteristics

Parents' responses included information on social, demographic and health characteristics. Socioeconomic Status was coded according to the Hollingshead index (1975). With the combination of education and occupation five categories emerged: a) high; (b) mean-high; (c) mean; (d) mean-low; and (e) low.

## Procedure

This study was approved by the ethics review committee at the authors' institution. Families were recruited at the schools and, following a study description, parental consent was obtained. Parents of children in Grade P3 (three-year-olds) at the participating schools were invited to complete the SDQ at home and return it to the schools. Families who agreed and met the screening criteria were contacted by telephone and interviewed at the school. Interviewers were all experienced graduate students who received one week's intensive training from the third author on the developmental psychology and psychopathology of preschool children and the use of the DICA-PPYC interview and the SDQ assessment instrument. To ensure the reliability and validity of the tests, all the interviews were audio-recorded and supervised. Researchers conducted a face-to-face interview with the children's parents and gave the parents the SDQ to fill out. Participants and their families followed the same procedures at each annual assessment. Data were collected between November 2009 and July 2010; November 2010 and July 2011; and November 2011 and July 2012.

### *Statistical Analyses*

The statistical analysis was carried out with SPSS20 for Windows, specifying the List-wise procedure to manage the missing data. To handle the multistage design (the sample analyzed in this work was selected through a screening procedure), the Complex Samples module was used to draw up a planning file with weights inversely proportional to the probability of the participant's selection.

The comparison of the sample children's weight with a reference population (World Health Organization, 2006) is based on the creation of a binary variable (non-overweight *vs.* overweight). The BMI z-score as a dimensional score variable has also been analyzed since a dimensional measure allows more statistical power and accuracy.

Cross-sectional and longitudinal associations between weight status and behavioral problems were assessed. This was achieved by using general linear models (GLM) for quantitative outcomes (SDQ scores) and binary logistic regression for binary outcomes (presence *vs*. absence of DSM-IV disorders). Due to the strong association between children's weight status and SES (Stamatakis, Wardie, & Cole, 2010), as well as the relationship between SES and behavioral problems in preschoolers in developed countries (Sawyer, Harchak, Wake, & Lynch, 2011), all the analyses were controlled by including the SES covariate. For the analyses of longitudinal data, one additional variable was included as a covariate, SDQ scores at baseline (age 3), to obtain the specific risk of psychopathology attributable to the child's weight, independent of baseline. Children's sex was not included as a covariate due to the absence of a statistical association in the sample: a) $\chi^2$ comparing the prevalence of overweight by gender obtained $p$=.99, $p$=.81, $p$=.08, at ages 3, 4 and 5; b) t-test comparing the BMI means by gender obtained $p$=.75, $p$=.62, $p$=.14 at ages 3, 4 and 5.

All the effect sizes for the relationships analyzed in the work have been estimated. For comparisons of means and proportions, effect sizes were measured

through Cohen's *d* coefficient (small $|d|<0.5$, moderate $|d|>0.5$ and large $|d|>0.8$) and with the 95% confidence interval (95%CI) for mean differences (*MD*) and odds ratio (*OR*). The effect-size for linear and logistic regressions was measured through the 95%CI for the *B* (slope) and *OR*.

## Results

*Descriptives*

Demographic characteristics at baseline stratified by weight group are shown in Table I. Differences between weight groups were found for ethnicity and SES: the prevalence of overweight children was higher for Hispanics (from families of Latin American origin), other ethnic minority groups and families with lower SES.

Overall, 7.2% of children at age 3 were overweight (equal prevalence for boys and girls), 8.2% at age 4 (boys: 7.9%; girls: 8.5%) and 8.7% at age 5 (boys: 6.7%; girls: 10.8%). No statistical association emerged for gender and children's overweight status (age 3: $p$=1.00; age 4: $p$=.814; age 5: $p$=.083) or for gender and BMI (age 3: $p$=.754; age 4: $p$=.619; age 5: $p$=.143).

*Cross-sectional associations between weight status and behavioral problems*

Table II shows the descriptive statistics (means and percentages) for the behavioral problems stratified by age and weight status (BMI z-score and overweight) and the results of the GLM and binary logistics adjusted for the SES covariate. At age 3, children who were overweight had a higher prevalence of ODD than non-overweight children. At age 4, being overweight was associated with higher percentages of ADHD. At age 5, children who were overweight had significantly higher mean scores for peer relationship problems than non-overweight children. The effect sizes for the comparisons were low. At age 3, a higher BMI z-score was associated with more severe conduct problems and lower pro-social behavior scores. At age 4, a higher BMI z-score

was related to higher scores on the hyperactivity and total problems scale, and to higher percentages of ADHD and conduct disorder. At age 5, there was no association between BMI z-score and behavioral problems.

*Longitudinal associations between weight status and behavioral problems*

Table III presents the results of GLM models that evaluate the association between BMI z-score and overweight status at age 3 and subsequent behavioral problems at ages 4 and 5, after controlling for SES and SDQ scores at baseline. Overweight status at age 3 predicted higher scores in hyperactivity problems at age 4. There was no association between overweight at age 3 and behavioral problems at age 5. A higher BMI z-score at age 3 was related to higher mean scores in hyperactivity problems, peer relationship problems and total difficulties, and to higher percentages for ADHD at age 4. A higher BMI z-score at age 3 also predicted more peer relationship problems at age 5.

## Discussion

This study was designed to investigate the association between weight status and behavioral problems in preschool children selected from the general population. The results suggest, as hypothesized, that a higher BMI and overweight status are associated with specific behavioral problems at young ages.

In accordance with previous findings (Anderson, He, Schoppe-Sullivan, & Must, 2010), conduct problems and ODD were associated cross-sectionally with overweight and a higher BMI at age 3 and 4. Given the body of literature (Cortese & Vincenzi, 2012), a specific association, confirmed by this study, was expected between weight status and ADHD. This result is consistent with previous findings (Waring & Lapane, 2008) but, to the best of our knowledge, this is the first community-based study to

reveal this relationship in preschool children using a diagnostic interview. The literature has suggested three possible explanations for this correlation. First, ADHD symptoms, may lead to deficient inhibitory control and delay aversion, which may foster poor planning and difficulties in adherence to regular patterns, leading to abnormal eating behaviors and consequent weight gain (Cortese et al., 2008). However, in the preschool years, the timing, structure and content of the meals are largely determined by parents, although it is conceivable that young ADHD children are relatively inattentive to internal signs of hunger and satiety cues, as indicated by Davis, Levitan, Smith, Tweed and Curtis (2006). Second, being overweight may contribute to ADHD symptoms via neural or other mechanisms, possibly through sleep-disordered breathing (Bass et al., 2004). It may be that excessive daytime sleepiness, secondary to sleep-disordered breathing, leads to inattention via hypoxemia which, in turn, contributes to altered prefrontal functioning (Bass et al., 2004). Finally, ADHD and overweight status may be two manifestations of a common biological mechanism. Although the mechanism underlying the association is still unknown, preliminary evidence suggests the role of the dopaminergic reward system (Liu, Li, Yang, & Wang, 2008) or melanocortin system (Agranat-Meged et al., 2008).

As hypothesized, overweight status in young children was associated cross-sectionally with higher scores in peer relationship problems at ages 4 and 5. This result is consistent with previous research (Griffiths, Dezateux & Hill, 2011) and one study found this relationship to be even stronger by the time children were 8 to 9 years of age (Sawyer, Harchak, Wake, & Lynch, 2011). A number of related mechanisms might explain the link between overweight and peer relationship problems. Teasing and stigmatization of overweight children may play an important role since they can lead to social marginalization and low self-esteem (Storch et al., 2007). Several studies have

shown that this stigmatization begins early in life. Children as young as 3 years old attribute negative and positive adjectives to overweight and non-overweight individuals, respectively (Lowes & Tiggemann, 2003). Children who are 3 to 5-years-old even display a preference for the thin figure compared to one that is average (Harriger, Calogero, Smith, & Witherington, 2010*).*

In prospective analysis, we found that having a higher BMI z-score at age 3 was associated with peer relationship problems at ages 4 and 5. Together, these data suggest that relationships with peers may become a problem for young overweight children. Prospective analyses also revealed that the probability of having ADHD symptoms at age 4 was higher for children who had a higher BMI score at age 3. However, after controlling for potential confounding factors such as SES and behavioral problems at baseline, the magnitude of the differential odds was small and not clinically significant. Moreover, this association was not found in the overweight group analysis, and this relationship was not found at age 5. Our prospective results might point to specific temporal precedence of overweight status over ADHD, but cross-sectionally at age 3, children with higher weight had a tendency to score higher on hyperactivity scales and have a greater probability of suffering from ADHD. Indeed, ADHD is a neurodevelopmental disorder that starts early in life, and its detection is based on clinical features that may only become evident as the child grows. Further research is needed to provide more insight into the longitudinal pathways of this relationship. Early detection and treatment of children with both diagnoses (ADHD and overweight) is also important as it could lead to a reduction in the negative long-term consequences of overweight and ADHD in young people.

In our study, the overall proportion of overweight children was 9%, which is a figure that is consistent with European data for 2010 (11.7%, 95% CI 8.9-15.3; de Onis,

Blössner, & Borghi, 2010). Furthermore, in line with previous studies (Anderson, He, Schoppe-Sullivan, & Must, 2010; Stamatakis, Wardie, & Cole, 2010), we found higher rates of child overweight status among ethnic minorities and families in low socioeconomic status categories. This finding suggests that targeted intervention programs for children in low-income and minority-group families are needed as early as the preschool years.

This study has a number of strengths and makes some significant contributions to the field. A sample of Spanish preschoolers from the general population was followed prospectively. In contrast to similar studies, ADHD and other DSM-IV-TR disorders were assessed using a standardized, validated, strictly DSM-based instrument with good diagnostic properties designed specifically for use with preschoolers (Ezpeleta, de la Osa, Granero, Doménech, & Reich, 2011).

Some of the study's limitations should also be considered when interpreting the results. Firstly, we relied upon parents' reports of their child's behavior, which may introduce bias (Seifer, 2005). For example, it is possible that perceptions and judgments of the children's behavior are influenced by their weight status (Anderson, He, Schoppe-Sullivan, & Must, 2010). Nonetheless, parents' reports on child behavior have considerable value since they are based on their observations in a naturalistic setting over a long period. Another limitation concerns the measurement of the children's weight and height. Rather taking the anthropometrical measures in person for research purposes, we took the measures from the children's medical records. Nevertheless, the measures were taken using standardized protocols at all time periods and at all sites. In fact, routine weight measurements have been found to be highly accurate, which supports their usefulness for both clinical practice and research (Howe, Tilling, & Lawlor, 2009). Finally, two subscales of the Spanish version of the SDQ had

low alphas in the current sample, although this must be interpreted with caution due to the small number of items. Despite these limitations, this study fills an important gap in the literature of preschool psychopathology. Knowledge of the age at which the association between behavior and weight status becomes significant may be crucial for preventive interventions.

**Conclusion**

To the best of our knowledge, this is the first study to assess the relationship between weight status and behavioral problems in a large and representative sample of preschoolers, using a diagnostic interview based on DSM-IV-TR taxonomy. The results show that children who are overweight and have a higher BMI have increased odds of presenting attention deficit/hyperactivity symptoms, peer relationship problems and other behavioral issues. These findings suggest the need to screen for psychological problems and for difficulties with their peers in children who are overweight. Further studies are needed to examine the modifiers and mediating factors in the relationship between weight status and mental health with a view to improving healthy child development.

**References**

Agranat-Meged, A., Ghanadri, Y., Eisenberg, I., Ben Neriah, Z., Kieselstein-Gross, E., & Mitrani-Rosenbaum, S. (2008). Attention deficit hyperactivity disorder in obese melanocortin-4-receptor (MC4R) deficient subjects: a newly described expression of MC4R deficiency. *American Journal of Medical Genetics, 147,* 1547–1553. doi:10.1002/ajmg.b.30842.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders.* (4th ed., Text revised) Washington, DC: American Psychiatric Press.

Anderson, S. E., He, X., Schoppe-Sullivan, S., & Must, A. (2010). Externalizing behavior in early childhood and body mass index from age 2 to 12 years: longitudinal analyses of a prospective cohort study. *BMC Pediatrics, 14,* 10–49. doi:10.1186/1471-2431-10–49.

Baker, J. L., Olsen, L. W., & Sørensen, T. I. (2007). Childhood body-mass index and the risk of coronary heart disease in adulthood. *New England Journal of Medicine, 357,* 2329–2337.

Bass, J. L., Corwin, M., Gozal, D., Moore, C., Nishida, H., Parker, S., . . . Kinane, T. B. (2004). The effect of chronic or intermittent hypoxia on cognition in childhood: a review of the evidence. *Pediatrics, 114,* 805–816.

Cortese, S., Angriman, M., Maffeis, C., Isnard, P., Konofal, E., Lecendreux, . . . Mouren, M.C. (2008). Attention-deficit/ hyperactivity disorder (ADHD) and obesity: a systematic review of the literature. *Critical Reviews in Food Science and Nutrition, 48,* 524–537. doi:10.1080/10408390701540124.

Cortese, S., & Vincenzi, B. (2012). Obesity and ADHD: clinical and neurobiological implications. *Current Topics in Behavioral Neurosciences, 9,* 199–218.

Datar, A., & Sturm, R. (2004). Childhood overweight and parent- and teacher-reported behavior problems: evidence from a prospective study of kindergartners. *Archives of Pediatrics and Adolescent Medicine, 158,* 804–810.

Davis, C., Levitan, R. D., Smith, M., Tweed, S., & Curtis, C. (2006). Associations among overeating, overweight, and attention deficit/hyperactivity disorder: a structural equation modeling approach. *Eating Behaviors, 7,* 266–274.

de Onis, M., Blössner, M., & Borghi, E. (2010). Global prevalence and trends of overweight and obesity among preschool children. *American Journal of Clinical Nutrition, 92,* 1257–1264. doi:10.3945/ajcn.2010.29786.

Ezpeleta, L., de la Osa, N., & Doménech, J. M. (2014). Prevalence of DSM-IV disorders, comorbidity and impairment in 3-year-old Spanish preschoolers. *Social Psychiatry and Psychiatric Epidemiology, 49,* 145–155. doi:10.1007/s00127-013-0683-1.

Ezpeleta, L., de la Osa, N., Granero, R., Doménech, J. M., & Reich, W. (2011). The diagnostic interview for children and adolescents for parents of preschool children: psychometric properties in the general population. *Psychiatry Research, 190,* 137–144. doi:10.1016/j.psychres.2011.04.034.

Ezpeleta, L., Granero, R., de la Osa, N., Penelo, E., & Doménech, J. M. (2013). Psychometric properties of the Strengths and Difficulties Questionnaire 3-4 in 3 year-old preschoolers. *Comprehensive Psychiatry, 54,* 282–291. doi:10.1016/j.comppsych.2012.07.009.

Garthus-Niegel, S., Hagtvet, K. A., & Vollrath, M. E. (2010). A prospective study of weight development and behavior problems in toddlers: the Norwegian Mother and Child Cohort Study. *BMC Public Health, 626*. doi:10.1186/1471-2458-10-626.

Goodman, R. (1997). The Strengths and Difficulties Questionnaire: a research note. *Journal of Child Psychology and Psychiatry*, *38*, 581–586.

Griffiths, L. J., Dezateux, C., & Hill, A. (2011). Is obesity associated with emotional and behavioural problems in children? Findings from the Millennium Cohort Study. *International Journal of Pediatric Obesity*, *6*, 423–432. doi:10.3109/17477166.2010.526221.

Harriger, J. A., Calogero, R. M., Smith, J. E., & Witherington, D. C. (2010). Body size stereotyping and internalization of the thin ideal in preschool age girls. *Sex Roles*, *63*, 609–620.

Hollingshead, A. A. *Four-factor index of social status*. New Haven, CT: Yale University; 1975. Unpublished manuscript.

Howe, L. D., Tilling, K., & Lawlor, D. A. (2009). Accuracy of height and weight data from child health records. *Archives of Disease in Childhood*, *94*, 950–954. doi:10.1136/adc.2009.162552.

Jansen, P. W., Mensah, F. K., Nicholson, J. M., & Wake, M. (2013). Family and neighbourhood socioeconomic inequalities in childhood trajectories of BMI and overweight: longitudinal study of Australian children. *PLoS One*, *8*, e69676. doi:10.1371/journal.pone.0069676.

Janssen, I., Craig, W. M., Boyce, W. F., & Pickett, W. (2004). Associations between overweight and obesity with bullying behaviors in school-aged children. *Pediatrics*, *113*, 1187-1194.

Kim, J., Peterson, K. E., Scanlon, K. S., Fitzmaurice, G. M., Must, A., Oken, E., . . . Gillman, M. W. (2006). Trends in overweight from 1980 through 2001 among preschool-aged children enrolled in a health maintenance organization. *Obesity*, *14*, 1107–1112.

Lawlor, D. A., Mamun, A. A., O'Callaghan, M. J., Bor, W., Williams, G. M., & Najman, J. M. (2005). Is being overweight associated with behavioural problems in childhood and adolescence? Findings from the Mater-University study of pregnancy and its outcomes. *Archives in Disease in Childhood*, *90*, 692–697.

Liu, L. L., Li, B. M., Yang, J., & Wang, Y. W. (2008). Does dopaminergic reward system contribute to explaining comorbidity obesity and ADHD? *Medical Hypotheses*, *70*, 1118–1120.

Lowes, J., & Tiggemann, M. (2003). Body dissatisfaction, dieting awareness and the impact of parental influence in young children. *British Journal of Health Psychology*, *8*, 135–147.

Mackenbach, J. D., Tiemeier, H., Ende, Jv., Nijs, I. M., Jaddoe, V. W., Hofman, A., . . . Jansen, P. W. (2012). Relation of emotional and behavioral problems with body mass index in preschool children: the Generation R study. *Journal of Developmental & Behavioral Pediatrics*, *33*, 641–648. doi: 10.1097/DBP.0b013e31826419b8.

Mustillo, S., Worthman, C., Erkanli, A., Keeler, G., Angold, A., & Costello, E. J. (2003). Obesity and psychiatric disorder: developmental trajectories. *Pediatrics*, *111*, 851–859.

Olsen, N. J., Pedersen, J., Händel, M. N., Stougaard, M., Mortensen, E. L., & Heitmann, B. L. (2013). Child behavioural problems and body size among 2-6 year old children predisposed to overweight. Results from the "healthy start" study. *PLoS One*, *8*, e78974. doi: 10.1371/journal.pone.0078974.

Olstad, D. L., & McCargar, L. (2009). Prevention of overweight and obesity in children under the age of 6 years. *Applied Physiology, Nutrition, and Metabolism*, *34*, 551–570. doi:10.1139/H09-016.

Reich, W., & Ezpeleta, L. (2009). Diagnostic Interview for Children and Adolescents - Version for Parents of Preschoolers. Barcelona: Unitat d'Epidemiologia i de Diagnòstic en Psicopatologia del Desenvolupament, Departament de Psicologia Clínica i de la Salut, Universitat Autònoma de Barcelona.

Sawyer, M. G., Harchak, T., Wake, M., & Lynch, J. (2011). Four-year prospective study of BMI and mental health problems in young children. *Pediatrics, 128,* 677–684. doi:10.1542/peds.2010-3132.

Sawyer, M. G., Miller-Lewis, L., Guy, S., Wake, M., Canterford, L., & Carlin, J. B. (2006). Is there a relationship between overweight and obesity and mental health problems in 4- to 5-year-old Australian children? *Ambulatory Pediatrics, 6,* 306–311.

Seifer, R. (2005). Twin studies, biases of parents, and biases of researchers. *Infant Behavior & Development, 26,* 115–117.

Singh, A. S., Mulder, C., Twisk, J. W., van Mechelen, W., & Chinapaw, M. J. (2008). Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obesity Review, 9,* 474–488. doi:10.1111/j.1467-789X.2008.00475.x.

Stamatakis, E., Wardie, J., & Cole, T. J. (2010). Childhood obesity and overweight prevalence trends in England: evidence for growing socioeconomic disparities. *International Journal of Pediatric Obesity, 34,* 41–47. doi:10.1038/ijo.2009.217.

Storch, E. A., Milsom, V. A., Debraganza, N., Lewin, A. B., Geffken, G. R., & Silverstein, J. H. (2007). Peer victimization, psychosocial adjustment, and physical activity in overweight and at-risk-for-overweight youth. *Journal of Pediatric Psychology, 32,* 80–89.

Strauss, R. S., & Pollack, H. A. (2003). Social marginalization of overweight children. *Archives of Pediatrics and Adolescent Medicine, 157,* 746-752.

van Stralen, M. M., te Velde, S. J., van Nassau, F., Brug, J., Grammatikaki, E., Maes, L., . . . Chinapaw, M. J. (2012). Weight status of European preschool children and associations with family demographics and energy balance-related behaviours: a pooled analysis of six European studies. *Obesity Reviews*, 13, 29–41. doi:10.1111/j.1467-789X.2011.00959.x.

Waring, M. E., & Lapane, K. L. (2008). Overweight in children and adolescents in relation to attention-deficit/hyperactivity disorder: results from a national sample. *Pediatrics, 122*, e1–6. doi:10.1542/peds.2007–1955.

Williams, J., Wake, M., Hesketh, K., Maher, E., & Waters, E. (2005). Health-related quality of life of overweight and obese children. *Journal of the American Medical Association, 293*, 70–76.

World Health Organization Multicentre Growth Reference Study Group. (2006). WHO child growth standards based on length/height, weight and age. *Acta Paediatrica, 450*, 76–85.

Table I. *Descriptives for the sample (age 3)*

| | | Non-overweight (N= 558) | | Overweight[a] (N= 53) | | $p^b$ |
|---|---|---|---|---|---|---|
| Gender (male); *n (%)* | | 278 | (49.8%) | 27 | (50.9%) | .876 |
| Ethnicity; *n (%)* | White | 505 | (90.5%) | 40 | (75.5%) | .006 |
| | Hispanic | 37 | (6.6%) | 10 | (18.9%) | |
| | Other | 16 | (2.9%) | 3 | (5.7%) | |
| SES; *n (%)* | High | 194 | (34.8%) | 9 | (17.0%) | .005 |
| | Mean-High | 178 | (31.9%) | 14 | (26.4%) | |
| | Mean | 77 | (13.8%) | 9 | (17.0%) | |
| | Mean-Low | 81 | (14.5%) | 15 | (28.3%) | |
| | Low | 28 | (5.0%) | 6 | (11.3%) | |
| One single parent; *n (%)* | | 27 | (4.8%) | 2 | (3.8%) | .769 |
| Number of family members; *mean (SD)* | | 4.00 | (0.86) | 4.19 | (0.94) | .139 |
| Body mass index; *mean (SD)* | | 15.5 | (1.59) | 20.7 | (2.79) | <.001 |

*Note.* [a] Children were classified as non-overweight or overweight according to the World Health Organization international age- and sex- specific criteria. [b] *p*-value obtained through $\chi^2$ for categorical measures and T-TEST for quantitative measures. SES = Socioeconomic status based on education and occupation (Hollingshead, 1975); SD = standard deviation.

Table II. *Cross-sectional associations between group of weight and psychological measures*

| | Age 3 | | | | | | | Age 4 | | | | | | | Age 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Independent variable | | | | | Independent variable | | Independent variable | | | | | Independent variable | | Independent variable | | | | | Independent variable | |
| | Overweight | | | | | BMI | | Overweight | | | | | BMI | | Overweight | | | | | BMI | |
| | NO | YES | | | | n=611 | | NO | YES | | | | n=596 | | NO | YES | | | | n=564 | |
| SDQ; *mean* | n=558 | n=53 | MD | \| *d* \| | 95%CI MD | B | 95%CI B | n=541 | n=55 | MD | \| *d* \| | 95%CI MD | B | 95%CI B | n=508 | n=56 | MD | \| *d* \| | 95%CI MD | B | 95% CI B |
| Emotion | 1.44 | 2.06 | -0.46 | 0.40 | -0.95, 0.03 | 0.011 | -0.060, 0.081 | 0.93 | 1.44 | -0.54 | 0.30 | -1.27, 0.19 | 0.067 | -0.002, 0.136 | 1.01 | 1.07 | -0.02 | 0.04 | -0.44, 0.40 | 0.026 | -0.064, 0.115 |
| Conduct | 2.57 | 3.44 | -0.64 | 0.47 | -1.28, 0.00 | **0.092*** | 0.006, 0.179 | 1.84 | 1.87 | -0.04 | 0.02 | -0.52, 0.43 | 0.036 | -0.052, 0.124 | 1.42 | 1.53 | -0.05 | 0.07 | -0.57, 0.47 | -0.012 | -0.113, 0.088 |
| Hyperactivity | 3.87 | 4.62 | -0.35 | 0.31 | -1.06, 0.37 | 0.049 | -0.057, 0.154 | 2.98 | 3.72 | -0.57 | 0.27 | -1.52, 0.37 | **0.151*** | 0.026, 0.275 | 3.10 | 3.21 | 0.07 | 0.05 | -0.64, 0.79 | 0.088 | -0.064, 0.241 |
| Peer | 1.30 | 1.69 | -0.18 | 0.22 | -0.76, 0.40 | -0.037 | -0.136, 0.062 | 0.85 | 1.38 | -0.51 | 0.30 | -1.22, 0.21 | 0.068 | -0.004, 0.139 | 0.79 | 1.38 | **-0.50*** | 0.42 | -1.00, 0.00 | 0.067 | -0.013, 0.147 |
| Pro-social | 2.12 | 2.02 | 0.01 | 0.06 | -0.52, 0.54 | **-0.113*** | -0.218, -0.009 | 1.67 | 2.03 | -0.44 | 0.19 | -1.18, 0.30 | 0.023 | -0.089, 0.136 | 1.60 | 1.62 | -0.05 | 0.01 | -0.54, 0.43 | 0.007 | -0.088, 0.101 |
| Total | 9.18 | 11.74 | -1.54 | 0.49 | -3.37, 0.28 | 0.109 | -0.117, 0.335 | 6.59 | 8.40 | -1.67 | 0.31 | -3.90, 0.57 | **0.322*** | 0.083, 0.561 | 6.32 | 7.20 | -0.50 | 0.18 | -1.96, 0.97 | 0.169 | -0.127, 0.464 |
| DICA-PPY*; %* | | | OR | \| *d* \| | 95%CI OR | OR | 95%CI OR | | | OR | \| *d* \| | 95%CI OR | OR | 95%CI OR | | | OR | \| *d* \| | 95%CI OR | OR | 95%CI OR |
| Any disruptive | 9.4 | 20.6 | 1.92 | 0.32 | 0.87, 4.21 | 1.06 | 0.90, 1.25 | 8.3 | 17.3 | 1.79 | 0.27 | 0.80, 4.03 | 1.04 | 0.92, 1.18 | 9.6 | 7.4 | 0.66 | 0.08 | 0.27, 1.65 | 1.00 | 0.79, 1.27 |
| ADHD | 3.3 | 8.3 | 1.67 | 0.22 | 0.60, 4.68 | 0.95 | 0.70, 1.29 | 4.4 | 13.6 | **2.68*** | 0.33 | 1.02, 7.02 | **1.17*** | 1.03, 1.34 | 4.3 | 3.7 | 0.58 | 0.03 | 0.16, 2.07 | 0.95 | 0.66, 1.37 |
| ODD | 6.3 | 16.5 | **2.40*** | 0.33 | 1.02, 5.67 | 1.12 | 0.96, 1.31 | 5.1 | 6.2 | 0.89 | 0.05 | 0.33, 2.37 | 1.01 | 0.87, 1.18 | 6.5 | 4.9 | 0.73 | 0.07 | 0.24, 2.19 | 1.01 | 0.71, 1.43 |
| Conduct | 1.3 | 2.8 | 1.58 | 0.11 | 0.32, 7.90 | 1.11 | 0.93, 1.32 | 0.1 | 1.2 | 7.16 | 0.14 | 0.67, 76.81 | **1.23*** | 1.01, 1.50 | 0.6 | 0.0 | --- | --- | --- --- | 1.13 | 0.92, 1.39 |

*Note.* Results for GLM (SDQ scores) and binary logistic regressions (DICA diagnoses) adjusted for socioeconomic status. *Bold, significant result (.05 level). MD = mean difference (no vs yes); OR = odds ratio; |*d*| = Cohen's-d coefficient; --- = Not estimated due to small sample size. SDQ = Strengths and Difficulties Questionnaire; DICA-PPY = Diagnostic Interview for Children and Adolescents for Parents of Preschool and Young Children.

Table III. *Longitudinal associations between group of weight at age 3 and psychological measures at ages 4 and 5*

| | Psychological measures at age 4 | | | | | | | Psychological measures at age 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Independent variable: Overweight | | | | | Independent variable: BMI | | Independent variable: Overweight | | | | | Independent variable: BMI | |
| | NO | YES | | | | n=593 | | NO | YES | | | | n=526 | |
| SDQ; *mean* | n=540 | n=53 | MD | \| *d* \| | 95%CI MD | B | 95% CI B | n=478 | n=48 | MD | \| *d* \| | 95%CI MD | B | 95% CI B |
| Emotion | 0.91 | 1.62 | -0.54 | 0.42 | -1.17, 0.08 | 0.057 | -0.009, 0.123 | 0.99 | 1.32 | -0.14 | 0.24 | -0.55, 0.26 | .021 | -.055, .097 |
| Conduct | 1.81 | 2.26 | -0.20 | 0.26 | -0.69, 0.29 | -0.010 | -0.088, 0.069 | 1.42 | 1.53 | 0.11 | 0.07 | -0.44, 0.66 | -.039 | -.131, .053 |
| Hyperactivity | 2.95 | 4.15 | **-0.77*** | 0.50 | -1.47, -0.06 | **0.114*** | 0.021, 0.207 | 3.04 | 3.91 | -0.54 | 0.37 | -1.16, 0.08 | .075 | -.042, .193 |
| Peer | 0.87 | 1.25 | -0.30 | 0.24 | -0.93, 0.33 | **0.078*** | 0.015, 0.142 | 0.81 | 1.12 | -0.13 | 0.24 | -0.49, 0.23 | **.071*** | .005, .137 |
| Pro-social | 1.66 | 2.14 | -0.59 | 0.25 | -1.25, 0.08 | 0.075 | -0.012, 0.162 | 1.59 | 1.78 | -0.27 | 0.12 | -0.71, 0.17 | .056 | -.013, .125 |
| Total | 6.54 | 9.28 | -1.56 | 0.51 | -3.40, 0.28 | **0.229*** | 0.022, 0.436 | 6.27 | 7.89 | -0.46 | 0.35 | -1.87, 0.95 | .116 | -.120, .351 |
| DICA-PPY; % | | | OR | \| *d* \| | 95%CI OR | OR | 95%CI OR | | | OR | \| *d* \| | 95%CI OR | OR | 95%CI OR |
| Any disruptive | 8.7 | 13.7 | 0.89 | 0.16 | 0.28, 2.80 | 1.02 | 0.88, 1.18 | 9.0 | 14.1 | 1.05 | 0.16 | 0.32, 3.39 | 0.95 | 0.79, 1.16 |
| ADHD | 4.5 | 13.7 | 2.35 | 0.32 | 0.80, 6.90 | **1.20*** | 1.06, 1.36 | 4.1 | 7.1 | 0.94 | 0.13 | 0.29, 3.04 | 0.98 | 0.76, 1.28 |
| ODD | 5.1 | 6.9 | 0.63 | 0.08 | 0.22, 1.80 | 0.96 | 0.82, 1.13 | 6.0 | 9.9 | 1.16 | 0.14 | 0.27, 5.00 | 0.95 | 0.67, 1.33 |
| Conduct | 0.1 | 1.4 | --- | --- | --- --- | 2.20 | 0.65, 7.38 | 0.5 | 1.4 | 1.12 | 0.09 | 0.09, 14.05 | 1.16 | 0.81, 1.64 |

*Note.* Results for GLM (SDQ scores) and binary logistic regressions (DICA diagnoses) adjusted for socioeconomic status and SDQ scores at baseline. *Bold, significant result (.05 level). MD = mean difference (no vs yes); OR = odds ratio; |*d*| = Cohen's-d coefficient ; --- = Not estimated due to small sample size. SDQ = Strengths and Difficulties Questionnaire; DICA-PPY = Diagnostic Interview for Children and Adolescents for Parents of Preschool and Young Children.