RISK FACTORS FOR OVERWEIGHT IN EARLY AGES: LONGITUDINAL DESIGN WITH SPANISH PRESCHOOLERS

FACTORES DE RIESGO PARA EL SOBREPESO EN EDADES TEMPRANAS: DISEÑO LONGITUDINAL CON PREESCOLARES ESPAÑOLES

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Abstract

Previous studies have shown that there are several significant early-life risk factors associated with childhood overweight. However, research has mainly focused on school-aged children. The aim of this study is to identify risk factors in early life for overweight in a community sample of Spanish preschoolers. A sample of 622 three-year-olds was monitored until the age of 5, and their height and weight were registered annually. Overweight status was defined by World Health Organization standards. A large set of risk factors

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including sociodemographic variables, family structure, pregnancy, birth, postnatal period, school and neighborhood were measured through semi-structured interviews. Stepwise logistic regressions created predictive models with the best predictors of overweight for each age group. This is the first longitudinal study to examine a large set of risk factors among Spanish preschoolers. Several potential early risk factors in preschool children were associated with later overweight: high birth weight, ethnicity, excess screen time, low attention span, maternal smoking during pregnancy, inconsistent discipline, fewer rules, corporal punishment and parents psychopathology. Among them, the most powerful factor was high birth-weight (odds ratio = 1.89 at age 3, 1.87 at age 4, and 2.35 at age 5), underlining the importance of weight monitoring from postpartum and routine screening for overweight in children who have high birth weight. With the increasing prevalence of overweight in children at early ages, understanding the determinants for overweight risk becomes crucial for public health professionals and policy-makers in order to implement effective prevention and intervention programs.

Keywords: BMI; Overweight; Preschool children; Risk factor; Spain.

Resumen

Diferentes estudios han mostrado una asociación clara entre determinados factores de riesgo en edad temprana y sobrepeso en la infancia. Sin embargo, hasta ahora la investigación solo se ha centrado en niños en edad escolar. El objetivo de este estudio es el de examinar en niños preescolares los factores de riesgo para el sobrepeso en una muestra comunitaria de niños españoles. En el presente estudio se seleccionó una muestra de 622 niños de 3 años de edad a los que se siguió anualmente hasta los 5 años. El peso y la talla fueron registrados anualmente y el sobrepeso fue definido siguiendo los criterios definidos por la Organización Mundial de la Salud. A través de una entrevista semi-estructurada, se analizaron diversos factores de riesgo tales como estructura familiar, embarazo, parto, período post-natal, escuela y vecindario. Las regresiones logísticas múltiples permitieron crear modelos predictivos que seleccionaron los mejores predictores de sobrepeso para cada grupo de edad. El presente estudio es el primer estudio longitudinal en examinar diferentes factores de riesgo para el sobrepeso en niños españoles con edad preescolar. Diferentes factores de riesgo están asociados a un posterior sobrepeso: mayor peso al nacer, etnia, uso excesivo de pantallas, capacidad de atención baja, madre fumadora durante el embarazo, disciplina inconsistente, castigo físico y psicopatología parental. De entre ellos, el factor más importante fue: mayor peso al nacer (razón de probabilidades = 1.89 a los 3 años, 1.87 a los 4 años y 2.35 a los 5 años), subrayando la importancia de monitorizar el peso del niño desde el post-parto y realizar cribados rutinarios de sobrepeso en aquellos niños que nacieron con un peso elevado. La prevalencia cada vez mayor de sobrepeso en niños cada vez más pequeños hace que la comprensión e identificación de los factores de riesgo relacionados con el sobrepeso sea crucial para que los profesionales públicos de salud y los responsables políticos implementen programas de prevención e intervención efectivos.

Palabras clave: Factor de riesgo; IMC; Preescolares; Sobrepeso.

Introduction

Childhood overweight continues to be a major challenge worldwide, associated with serious health consequences and psycho-social outcomes (Lakshman, Elks, & Ong, 2012; Reilly et al., 2003). Alarmingly, one out of four Spanish children is already overweight or obese by age five (Miqueleiz et al., 2014). This prevalence is of considerable concern owing to the adverse consequences of childhood overweight and the fact that weight status at 5 years of age is a good indicator of the future health of a child (Gardner et al., 2009). Furthermore, overweight during childhood tends to persist into adulthood (Freedman Mei, Srinivasan, Berenson, & Dietz, 2004) with resultant long-term consequences that are difficult to treat successfully in the long term. Therefore, prevention of the onset of overweight is a public health priority and should be a primary target (Cominato et al., 2018; Gordon-Larsen, Adair, Nelson, & Popkin, 2004). Indeed, the key to prevention is to examine and fully characterize the factors involved in the development of overweight.

Overweight is a multi-factorial condition influenced by diverse factors operating across the lifespan: genetic, neuroendocrine, metabolic, psychological, environmental and socio-cultural. To develop evidence-based policy and program decision-making, it is crucial to identify the risk factors associated with pediatric overweight. In a recent systematic review of thirty prospective studies from developed countries, several significant early-life risk factors were identified for childhood overweight: maternal pre-pregnancy overweight, high infant birth-weight, early infant rapid weight gain and maternal smoking during pregnancy (Weng, Redsell, Swift, Yang, & Glazebrook, 2012). However, research has mainly focused on school-aged children and adolescents, although the preschool years are a critical period for obesity prevention (Baker, Olsen, & Sørensen, 2007). Given the high prevalence of overweight across Southern Europe (van Stralen et al., 2012), research is particularly needed on preschoolers in these countries, including Spain.

This study explores the main risk factors for the development of childhood overweight in a large community sample of Spanish preschoolers longitudinally assessed from ages 3 to 5 years-old. The set of potential risk factors includes variables of the main areas associated with overweight during childhood and adolescence, including family structure, pregnancy, birth, postnatal period, medical history, school and neighborhood.

Method

Participants

The data were derived from a large-scale longitudinal project on psychopathology and risk factors specifically focused on behavioral problems in preschool children. A full description of the inclusion criteria, recruitment, and retention strategies is provided elsewhere (Ezpeleta, de la Osa, & Doménech, 2014). In the first phase of two-phase sampling, a community sample of 2,283 children in the first year of preschool education was randomly selected from the census of preschool center facilities in Barcelona, Spain, in 2009. The families were contacted and 1,341 (58.7 %) agreed to participate. There were no significant differences by gender among the participants and those who declined to take part (p = .951). However, the proportion of refusals was statistically higher in low socioeconomic status families (SES; Hollingshead index; Hollingshead, 1975) groups (p < .001). Screening of children with possible behavioral problems was carried out by administering, to parents, four items from the Strengths and Difficulties Questionnaire (SDQ; Ezpeleta et al., 2014) conduct problems scale plus four questions derived from the Diagnostic and Statistical Manual of Mental Disorders diagnostic criteria for Oppositional Defiant Disorder. Based on the results of the screening process, two groups were formed. The positive screen group (n = 205, 51.2 % boys) included all children who reached the threshold for behavioral problems while 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). In the second phase, n = 622 children and their parents agreed to take part although 11 children were excluded due to missing height or weight measurement data. Consequently, the sample for this study was n = 611 three-year-old children and their parents. Children were followed-up at age 4 (N = 596) and 5 (N = 564). Drop-outs were statistically equal by gender (p = .188) and SES (p = .062). Excluded were children with intellectual disability or pervasive developmental disorder, no parent to provide reports on the child, parental lack of fluency in Spanish or Catalan, or family relocating outside study area within 12 months.

Measures

Sociodemographic and health characteristics

The Schedule of Risk Factors (SRF; Unitat d'Epidemiologia i de Diagnòstic en Psicopatologia del Desenvolupament, 2009) is a semistructured interview answered by parents and conceived of as a compendium of the main areas of psychopathology risk in children. It provides information on the child (e.g., gender and ethnicity), the family (e.g., family structure and maternal smoking during pregnancy) and the community (e.g., distance to a traffic dense route and proximity to school) that could have an

impact on the children's psychological status. Inter-rater reliability and concurrent validity are acceptable in Spanish populations.

The Children's Behaviour Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001) is designed to assess temperament in 3 to 7-year-old children. Completed by parents, it contains 94 items over 15 scales clustered in 3 broad dimensions of temperament: negative affectivity (anger-frustration, discomfort, fear, sadness, falling reactivity-soothability), effortful control (attention focusing, inhibitory control, low-intensity pleasure, perceptual sensitivity), and surgency-extraversion (activity level, high-intensity pleasure, impulsivity, shyness). The study sample alpha values ranged between α = .50 for sadness and α = .79 for shyness.

The Adult Self Report (ASR; Achenbach & Rescorla, 2003) is a self-report questionnaire that assesses behavioral problems in adults aged 18 to 59. The emotional and behavioral problems section includes 8 empirical syndromes that can be classified as internalizing problems, externalizing problems and total problems. Internal consistency for mothers' reports in this sample ranged between .83 for externalizing problems and .92 for the total score while, for fathers, it ranged between .86 for externalizing problems and .93 for the total score.

The Alabama Parenting Questionnaire-Pr (APQ-Pr; Osa, Granero, Penelo, Domènech, & Ezpeleta, 2014) assesses the behavior of parents of children with externalizing disorders. It contains 42 items, clustered in 5 subscales: parental involvement (α = .56), positive parenting (α = .66), poor monitoring/supervision (α = .20), inconsistent discipline (α = .43) and corporal punishment (α = .42). In the Spanish version of the APQ-Pr, two subscales were added: norms (α = .88) and autonomy (α = .81), this version shows moderate to very good internal consistency in our study sample.

The Four-Factor Hollingshead Index of Social Status (Hollingshead, 1975) based on parents' educational level and occupation was used to code the SES into five levels.

Finally, the *Diagnostic Interview of Children and Adolescents for Parents of Preschool and Young Children* (DICA-PPYC; Ezpeleta, de la Osa, Granero, Doménech, & Reich, 2011) is a semi-structured interview designed to assess the most common psychological disorders at ages 3–7 years according to DSM-IV-TR criteria. Parents were interviewed about the presence of feeding problem symptoms.

Anthropometric variables

Children were weighed and their height was measured while barefoot and wearing light clothes. Measurements were taken and noted in the child's medical record by nurses at outpatient pediatric primary care units during each child's annual visit. These values were recorded in the child's medical records and were recovered annually during the course of this study. BMI (Body Mass Index) was calculated as the ratio between weight (kg) and height (m2). Children were classified as non-overweight or overweight (obesity included) according to the World Health Organization (WHO) international age- and sex-specific child growth standards specifically for preschool-aged children (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). However, categorizing children based on BMI criteria can produce different classifications with varying clinical and public health implications (Jansen, Mensah, Nicholson, & Wake, 2013). Therefore, the BMI z-scores were also calculated from WHO reference curves (World Health Organization, 2006). As such, throughout the study, two measures were analyzed: (a) a binary variable (non-overweight status vs overweight) extensively used in clinical settings; and (b) a quantitative variable (BMI z-scores) mainly used for research purposes.

Procedure

This longitudinal project was approved by the ethics review committee at the authors' institution. Heads of the participating schools and parents were provided with a full description of the study. Families were recruited at the schools, and parental consent was obtained. Parents of children in Grade P3 (three-year-olds) at the participating schools were invited to answer the SDQ at home and re-

turn 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 training on the developmental psychology and psychopathology of preschool children and on the use of the DICA-PPYC and the Schedule of Risk Factors. 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 before the parents answered the questionnaires. Participants and their families followed the same procedures at each annual assessment. Data were collected annually between November, 2009 and July, 2012.

Statistical analysis

The statistical analysis was carried out with SPSS20 for Windows. Due to the multi-sampling design (the data analyzed in this work were selected through a sampling procedure including a screening tool), the Complex Samples module (CS) was used, assigning to each child a weight inversely proportional to the probability of the participant's selection in the second phase of the design (after the screening).

The association of overweight with demographic variables was analyzed using Chi square tests for categorical measures and t-test for quantitative measures.

We longitudinally assessed associations between early risk factors (independent variables) before age 3 and weight status (presence of overweight and z-BMI scores; dependent variables) at 3, 4, and 5 years-old. This was achieved by using binary logistic regressions through stepwise procedures to select the best discriminative models of the children's weight group (non-overweight vs. overweight) and stepwise multiple linear regressions to select the best predictors of the child's z-BMI score. Due the large set of risk factors considered, seven independent models were built for groups of variables: child's characteristics, temperament CBQ-scales, family characteristics, mother psychopathology (ASR), father psychopathology (ASR), parenting style (APQ-Pr) and community. Additionally, due to the strong association between children's weight status and SES (Stamatakis, Wardle, & Cole, 2010), all the analyses were controlled by family SES. The analyses were also controlled for child's gender. This was carried out entering in a first block of the multiple and logistic regressions the covariates family SES and child's gender. The predictive capacity of the risk factors selected in the final models was measured through the change in the R2 coefficient (linear regressions) and the change in Nagelkerke's-R2 (logistic regressions) (ΔR2), comparing the first block with the covariates and the second block with the selected risk factors.

Table 1.

Descriptives for the sample at baseline (age 3 years-old).

		Non-overweight (N= 558)		Overweight (N= 53)		*p*
Gender (male); *n (%)*		278	(49.8%)	27	(50.9%)	.876
Ethnicity; *n (%)*	Caucasian	505	(90.5%)	40	(75.5%)	.006
	American-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%)	
BMI; *mean (standard deviation)*		15.5	(1.59)	20.7	(2.79)	< .001

Note. p-value obtained through χ^2 for categorical measures and T-TEST for quantitative measures. BMI = body mass index (kg/m^2), SES = Socioeconomic status.

Results

Sample characteristics

Table 1 includes the characteristics of the sample at baseline (age 3 years-old) stratified by children's weight group. Overall, 7.2 % of children at age 3 were overweight (7.2 % boys and 7.2 % girls, $p = 1.00$), 8.2 % at age 4 (7.9 % boys and 8.5 % girls, $p = .814$) and 8.7 % at age 5 (6.7 % boys and 10.8 % girls, $p = .083$). No statistical association emerged for gender and z-BMI ($p = .754$, $p = .619$ and $p = .143$ at ages 3-4-5). Statistical differences related to overweight emerged for ethnicity and SES; prevalence of overweight was higher for Hispanics (Latin American origin), other ethnic minority groups and families with lower SES.

Risk Factors for child's overweight

Table 2 presents the results for the second block/step of the final stepwise logistic regressions selecting the main risk factors for child's overweight at ages 3, 4, and 5.

Table 2.

Final predictive models for children's group of weight (0=non-overweight vs. 1=overweight).

	Significant predictors	B	SE(B)	Sig	OR	95%CI for OR		ΔR^2
Overweight at age 3								
Child characteristics	Birth-weight (kg)	0.639*	0.324	.049	1.895	1.004	3.576	0.04
	Number delays in development	0.464**	0.165	.005	1.591	1.150	2.201	
CBQ-Temperament	Attention focusing	-0.347*	0.141	.014	0.707	0.536	0.932	0.02
	Smoking during pregnancy	0.770*	0.367	.036	2.161	1.051	4.440	
ASR-Mother	*None*							
ASR-Father	*None*							
APQ Parenting style	Inconsistence	0.135*	0.062	.029	1.144	1.014	1.291	0.02
Community	None							
Overweight at age 4								
Child characteristics	Ethnic (non- Caucasian)	0.856**	0.430	0.046	2.354	1.014	5.464	0.10
	Television viewing (minutes)	0.009**	0.003	0.004	1.009	1.003	1.016	
	Presence of feeding symptoms	-1.129**	0.518	0.029	0.323	0.117	0.893	
	Birth-weight (kg)	0.624*	0.319	0.050	1.866	1.000	3.487	
	Number delays in development	0.361*	0.170	0.034	1.435	1.027	2.004	
CBQ	*None*							
ASR-Mother	*None*							
ASR-Father	Total score	0.023**	0.008	0.003	1.023	1.008	1.038	0.04
APQ Parenting style	Norms	-0.149**	0.047	0.002	0.862	0.786	0.945	0.04
Community	*None*							
Overweight at age 5								
Child characteristics	Ethnic (non-Caucasian)	0.933*	0.453	.040	2.543	1.046	6.186	0.09
	Birth-weight (kg)	0.853**	0.327	.009	2.347	1.237	4.454	
	Frequent doctor appointments	0.859*	0.424	.043	2.360	1.027	5.421	
	Daily medication	0.730*	0.376	.050	2.076	1.000	4.338	
CBQ	*None*							
ASR-Mother	*None*							
ASR-Father	Total score	0.020**	0.007	.007	1.020	1.005	1.035	0.03
APQ Parenting style	*None*							
Community	*None*							

Note. Models obtained through binary logistic regressions (stepwise procedure) adjusted for socioeconomic status and child's sex. APQ = Alabama Parenting Questionnaire, ASR = Adult Self Report, B = Regression coefficient, CBQ = Children's Behaviour Questionnaire, SE = standard error, SES = Socioeconomic status, Sig = Statistical significance, OR = Odds Ratio, ΔR2 = Change in R2. *$p < .05$, ** $p < .01$, ** $p < .001$.

These results are adjusted for family's SES and child's sex covariates. The presence of overweight at age 3 was related to lower CBQ-attention focusing score, higher birth weight, more developmental delays, smoking during pregnancy and higher scores in the APQ-inconsistent discipline scale.

Being over-weight at age 4 was predicted by non-Caucasian ethnicity, higher birth weight, more hours watching TV, the absence of feeding symptoms, more developmental delays and lower scores in the parenting style norms scale before age 3.

Overweight at age 5 was predicted by non-Caucasian ethnicity, higher birth weight, more visits to the doctor, daily medication and higher ASR-father-total score before age 3.

The predictive capacity of the final logistic regressions selecting the best overweight risk factors was low to moderate. The lowest ΔR2 corresponded to the models; parenting style at age 3 (1.9%), CBQ at age 3 (2.4%) and ASR-father at age 5 (2.9%). The highest ΔR2 was for the child characteristics models at age 4 (10.1%) and 5 (8.5%).

Risk Factors for child's z-BMI

Table 3 shows the results for the second block/step of the final stepwise multiple regressions selecting the main variables related to the z-BMI score, adjusted for the family's SES and child's sex covariates. The set of predictors selected was similar to that obtained with the logistic regressions for the dependent variable child's overweight. However, for the dependent variable z-BMI score, at age 3 the variable "living near to a dense street" was selected, at age 4 the variable "teasing for appearance" was a sig-

Table 3.

Final predictive models for children's z-BMI.

Z-BMI at age 3	Significant predictors	B	SE (B)	Beta	Sig	95%CI for B		ΔR^2
Child characteristics	Ethnic (non-Caucasian)	0.763	0.248	0.128	.002	0.275	1.250	.04
	Presence of feeding symptoms	-0.334	0.161	-0.083	.038	-0.650	-0.019	
	Birth-weight (kg)	0.395	0.115	0.140	.001	0.170	0.621	
CBQ	Attention focusing	-0.139	0.061	-0.092	.024	-0.260	-0.019	.01
Family characteristics	SES (1=high to 5=low)	0.175	0.056	0.127	.002	0.066	0.285	.02
ASR-mother	*None*							
ASR-father	Externalizing	0.024	0.012	0.086	.048	0.000	0.048	.01
APQ-Parenting style	Corporal punishment	0.144	0.063	0.093	.023	0.020	0.269	.01
Community	Distance dense route (< 300 m)	0.289	0.141	0.086	.041	0.012	0.566	.01
Z-BMI at age 4								
Child characteristics	Ethnic (non-Spanish)	0.767	0.230	0.139	.001	0.315	1.220	.08
	Birth-weight (kg)	0.415	0.124	0.163	.001	0.172	0.658	
	Prematurity	0.651	0.260	0.120	.012	0.141	1.161	
	Breastfeeding	0.316	0.147	0.087	.032	0.027	0.606	
	Television viewing (minutes)	0.003	0.001	0.108	.013	0.001	0.006	
	Teased for appearance	1.527	0.637	0.096	.017	0.276	2.777	
	Presence of feeding symptoms	-0.289	0.146	-0.080	.048	-0.576	-0.002	
CBQ	*None*							
Family characteristics	SES (1=high to 5=low)	0.209	0.051	0.166	<.001	0.109	0.310	.03
ASR-Mother	*None*							
ASR-Father	Total score	0.008	0.003	0.104	.018	0.001	0.014	.01
Parenting style	Norms	-0.047	0.023	-0.082	.044	-0.093	-0.001	.01
Community	*None*							

Note. Models obtained through binary logistic regressions (stepwise procedure) adjusted for socioeconomic status and child's sex. APQ = Alabama Parenting Questionnaire, ASR = Adult Self Report, B = Regression coefficient , BMI = body mass index, CBQ = Children's Behaviour Questionnaire, SE = standard error, SES = Socioeconomic status, Sig = Statistical significance, OR = Odds Ratio, ΔR2 = Change in R2. *p < .05, ** p < .01, ** p < .001.

Table 3 (continued).

Final predictive models for children's z-BMI.

Z-BMI at age 5	Significant predictors	B	SE (B)	Beta	Sig	95%CI for B		ΔR^2
Child characteristics	Ethnic (non-Spanish)	0.666**	0.234	0.120	.005	0.206	1.126	.06
	Birth-weight (kg)	0.366***	0.104	0.147	<.001	0.162	0.570	
	Clumsy	0.545**	0.183	0.123	.003	0.186	0.904	
	Frequent doctor appointments	0.397*	0.202	0.082	.049	0.001	0.794	
CBQ	None							
ASR-Mother	None							
ASR-Father	Total	0.010**	0.004	0.131	.003	0.004	0.017	.02
Parenting style	*None*							
Community	*None*							

Note. Models obtained through binary logistic regressions (stepwise procedure) adjusted for socioeconomic status and child's sex. APQ = Alabama Parenting Questionnaire, ASR = Adult Self Report, B = Regression coefficient , BMI = body mass index, CBQ = Children's Behaviour Questionnaire, SE = standard error, SES = Socioeconomic status, Sig = Statistical significance, OR = Odds Ratio, ΔR2 = Change in R2. *p < .05, ** p < .01, ** p < .001.

nificant predictor, and at ages 4 and 5 "being clumsy" was an additional predictor.

Discussion

To the best of our knowledge, this is the first community-based study to examine a variety of risk factors for overweight in a sample of Spanish preschoolers.

Socioeconomic status was independently associated with overweight, and this pattern remained for both genders over the 3-year assessment. As in other studies (Stamatakis et al., 2010), we observed a gradient whereby children of socioeconomically disadvantaged families were more likely to be overweight. That this is seen in preschool years suggests that differences in adiposity by socioeconomic status may emerge early in life.

The stepwise regression analysis carried out revealed several risk factors for overweight. Among them, infant birth weight was the most relevant predictor for overweight. Therefore, the risk of overweight escalates with increasing birth weight in both genders. Several studies have demonstrated an association between high birth weight and overweight in children (Mitchell et al., 2016; Weng et al., 2012;), underlining the importance of weight monitoring from postpartum and routine screening for overweight in children who had high birth weight as a means of preventing adverse health outcomes.

In this study, American-Hispanic children had tripled the prevalence of overweight found in Caucasian children and being an ethnic minority was associated with overweight at age 4 and 5. Ethnic minorities have been shown to be more prone to overweight in many European countries (Veldhuis et al., 2013). Members of minority ethnic groups often have lower socioeconomic status, which is in turn associated with a greater risk of obesity in children. Inequities in a range of factors (such us income, stable and affordable housing and access to quality education), disparate access to affordable, healthy food or safe places to be physically active and the fact that less nutritious, calorie-dense foods are often less expensive than healthier foods contribute to higher rates of obesity in ethnic minorities. Addressing these disparities requires making healthier choices easier in children's and families' daily lives by removing obstacles that make healthy, affordable food less accessible, and at the same time ensuring communities have more safe and accessible places for kids to be physically active. However, it is important to mention that in this study all the analyses were controlled for socioeconomic status, highlighting the fact that the reasons for the differences in prevalence of childhood obesity among different ethnic groups are complex, likely involving genetics, physiology, culture and environment.

Lower scores in the CBQ attention focusing scale were associated with overweight at age 3 supporting studies

linking attention deficit with excess weight in childhood. Faith and Hittner (2010) found that among boys, poorer attention span at the age of 1 year-old predicted greater weight gain at 6 years of age. Results obtained in a previous study using the same sample showed that ADHD symptoms were associated with overweight as early as the preschool years (Perez-Bonaventura, Granero, & Ezpeleta, 2015). It might be that reduced attention span interferes in the development of self-regulatory eating and satiety recognition, leaving the child relatively inattentive to hunger and satiety cues. Interestingly, in our study, the scale attention focusing was only associated negatively with overweight at age 3, but not at age 4 and 5, suggesting that attention focusing is only one of the clinical features of ADHD and that boarder tests are needed to provide more insight into the relationship between ADHD and overweight.

Maternal smoking during pregnancy was associated with overweight at age 3. The relationship between maternal smoking and childhood obesity has been described as catch-up growth following low birth weight caused by smoking during pregnancy or the poorer eating habits of smoking mothers (Hui, Nelson, Yu, Li, & Fok, 2003).

In line with other reports (Kuhle, Allen, & Veugelers, 2010), excess television screen time, before the age of 3 years-old was associated with overweight at 4 years-old. Various mechanisms may explain this association; prolonged periods of inactivity, the opportunity to eat snacks, a decline in energy expenditure, and the influence of commercials on food choices and nutrition. Consequently the American Academy of Pediatrics (American Academy of Pediatrics, 2013) has recommended for over a decade that parents limit television viewing to no more than 2 h per day.

This study showed that when a child presented symptoms of DSM-IV feeding disorder of infancy before the age of 3 (a child's refusal to eat certain food groups, textures, solids or liquids or refusal to accept new foods), there was a negative association with overweight.

Some aspects of early parenting style were associated with later excess of body weight such as inconsistent discipline, fewer rules and corporal punishment. Whitaker, Philips, Orzol, and Burdette (2007) reported that the odds of obesity for 3-year-old children were 50 % higher for those who experienced neglect in the previous year. In another study, those adults who reported experiencing harsh physical punishment during childhood had a higher likelihood of obesity (Afifi, Mota, MacMillan, & Sareen, 2013). Moreover, lack of effective rules in families with obese children often interferes with the development of regulated eating patterns.

Among fathers, some psychological symptoms scales, such as externalizing symptoms and total number of symptoms, were associated with the child's weight. Adults with binge eating disorders describe their childhood environment and the parenting they received more negatively than healthy controls (Hodges, Cochrane, & Brewerton, 1998). During childhood, they might have used eating as a strategy to cope with negative feelings. The effect of father's psychopathology on the child's weight may also be mediated through parenting. Knowledge of the mechanisms involved may help us to modify dysfunctional associations and improve the child's adjustment.

On a community level, the only variable that showed a relationship with weight status was living near a traffic dense route (< 300 m), which was only associated with z-BMI at age 3. Growing evidence suggests air pollution as a risk factor for the development of obesity and overweight. Several epidemiological studies have reported an association between various ambient and indoor air pollutants and obesity (Limaye & Salvi, 2014). Evidence-based research to link children's health, physiology, and behavior to atmospheric extremes is an important area of future research.

This study indicates that greater understanding of the risk factors identified might help with early prevention and intervention programs. The fact that we included a community population of young children within a small age range specific to preschool age group adds to existing knowledge.

The main study strengths are the longitudinal assessment of risk factors of overweight in preschool children, the inclusion of a large set of potential predictors including

individual, family and community level factors and a large community sample (from the general population).

Some of the study's limitations should also be considered when interpreting the results. Had the data been available, additional relevant risk factors potentially contributing to weight gain in childhood could have been explored, such as, parental overweight, physical activity or energy expenditure. However, this study is the first to examine a broad variety of risk factors for overweight in Spanish preschoolers. Future studies should explore more detailed information on these risk factors. Another study limitation is that measurements of the children's weight and height were taken from medical records, although routine weight measurements have been found to be highly accurate, which supports their usefulness in both clinical practice and research (Howe, Tilling, & Lawlor, 2009). Another limitation is that few families of low socioeconomic status participated in our study, possibly families of higher socioeconomic status are overrepresented in the study. Finally, some scales of the Spanish version of the CBQ had low alphas in the current sample, although this must be interpreted with caution due to the small number of items and the CBQ scale Attention Focusing (which was the only scale that was statistically significant) had an alpha value of $\alpha = .69$ (almost .70 which is considered acceptable for a measurement scale).

The preschool years are a period of rapid growth and habit formation. Knowledge of the age at which the association between early specific risk factors and weight status becomes significant can provide avenues for early interventions.

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