



## ORIGINAL ARTICLE

# Prevalence of obesity and related factors in schoolchildren aged 3 to 4 years



Gemma Serral<sup>a,b,c,\*</sup>, Catalina Londoño-Cañola<sup>a,d</sup>, Xavier Continente<sup>a,b,c</sup>,  
Silvia Brugueras<sup>a,c</sup>, Francesca Sanchez-Martínez<sup>a,c</sup>, Carlos Ariza<sup>a,b,c</sup>

<sup>a</sup> Agència de Salut Pública de Barcelona, Barcelona, Spain

<sup>b</sup> Ciber de Epidemiología y Salud Pública (CIBERESP), Madrid, Spain

<sup>c</sup> Institut d'Investigació Biomèdica Sant Pau (IIB Sant Pau), Barcelona, Spain

<sup>d</sup> Departament de Ciències Experimentals i de la Salut (DCEXS), Universitat Pompeu Fabra, Barcelona, Spain

Received 24 October 2023; accepted 13 May 2024

Available online 9 July 2024

## KEYWORDS

Childhood obesity;  
Social inequalities;  
Weight perception

## Abstract

**Objective:** To describe the prevalence of obesity and analyse possible differences in it according to sociodemographic characteristics, diet, physical activity, screen use and family perception of the weight and dietary habits of schoolchildren aged 3 to 4 years in Barcelona.

**Methods:** We conducted a cross-sectional study in a representative sample of schools selected based on the socioeconomic status (SES) of the corresponding neighbourhood and school ownership. We selected 101 schools in Barcelona and recruited pupils aged 3 to 4 years during the 2016–17 academic year (n = 2936 children). Anthropometric measurements were taken in each participant. Family members completed a questionnaire on eating habits, physical activity, sleeping hours, screen use and the family's perception of the child's weight and diet. The primary variable was the body mass index (BMI) for age and sex, subsequently categorised as normal weight, overweight or obese.

**Results:** Approximately 7.0% of girls and 7.1% of boys aged 3 to 4 years presented obesity. The prevalence of obesity (8.3%) was higher in neighbourhoods of lower SES compared to those of higher SES (5.2%; p = .004). Parents of children with obesity reported that the child had some excess weight or excess weight in 46.9% of cases, 3.9% indicated the child's weight was appropriate and 0.9% that the child was a little underweight or underweight (p < .001).

**Discussion:** The prevalence of obesity in children aged 3 to 4 years is high. There are social and geographical inequalities, and obesity was more prevalent in areas of lower SES. A large percentage of the families of children with obesity do not consider that the child's weight is excessive.

© 2024 Asociación Española de Pediatría. Published by Elsevier España, S.L.U. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

DOI of original article: <https://doi.org/10.1016/j.anpede.2024.07.002>

\* Corresponding author.

E-mail address: [gserral@aspb.cat](mailto:gserral@aspb.cat) (G. Serral).

**PALABRAS CLAVE**

Obesidad infantil;  
Desigualdades  
sociales;  
Percepción del peso

**Prevalencia de obesidad y factores relacionados en escolares de 3 a 4 años****Resumen**

**Objetivo:** Describir la prevalencia de obesidad y analizar posibles diferencias según características sociodemográficas, alimentación, actividad física, visionado de pantallas y percepción familiar sobre el peso y alimentación de sus hijos/as en escolares de 3 a 4 años de Barcelona.

**Método:** Estudio transversal a una muestra representativa de escuelas según nivel socioeconómico (NSE) del barrio y titularidad. Se seleccionaron 101 escuelas de Barcelona y se reclutó al alumnado de 3 a 4 años en el curso 2016-17 (N = 2.936 niños/as). Se tomaron medidas antropométricas. Los familiares respondieron a un cuestionario de hábitos sobre alimentación, actividad física, horas de sueño, visionado de pantallas y percepción familiar sobre el peso y la alimentación de su hijo/a. La variable principal fue el Índice de Masa Corporal (IMC), calculado por edad y sexo, y categorizado en: normopeso, sobrepeso u obesidad.

**Resultados:** El 7,0% de las niñas y el 7,1% de los niños de 3-4 años presentaron obesidad. En los distritos de NSE desfavorecido hubo mayor obesidad (8,3%) que en los más favorecidos (5,2%;  $p = 0,004$ ). Los padres/madres de niños/as cuyo peso fue de obesidad declararon que el peso de su hijo/a era un poco excesivo o excesivo en un 46,9%, en un 3,9% indicaron que era adecuado y el 0,9% que era un poco bajo o bajo ( $p < 0,001$ ).

**Discusión:** La prevalencia de obesidad en niños y niñas de 3 a 4 años es elevada. Existen desigualdades sociales siendo superior en áreas de NSE más desfavorecidas. Un elevado porcentaje de familias de niños/as con obesidad no consideran que el peso de sus hijos/as sea excesivo.

© 2024 Asociación Española de Pediatría. Publicado por Elsevier España, S.L.U. Este es un artículo Open Access bajo la licencia CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

**Introduction**

Obesity is a chronic, non-communicable, complex and multifactorial disease usually with onset in childhood and/or adolescence.<sup>1</sup> In the past 25 to 30 years, the prevalence of obesity has increased significantly worldwide.<sup>2</sup> According to the report of the Organization for Economic Cooperation and Development (OECD) for year 2019, Spain, is among the countries with the highest rates of childhood obesity in the world, ranking fourth in Europe.<sup>3</sup> The nationwide Thao cohort study conducted in 2014 highlighted the problem of excess weight in Spain, as it found a prevalence of overweight of 20% in children aged 3 to 5 years.<sup>4</sup> In 2017, more than 1 in 10 children (10.3% in the group aged 2 to 17 years) had obesity in Spain, with a similar prevalence in boys (10.2%) and girls (10.4%).<sup>5</sup>

The prevention of childhood obesity should begin in the early stages of life, and some experts even argue that the problem should be addressed from the period of gestation.<sup>6</sup> The family plays a key role, so the main modifiable determinants of the risk factors for overweight and obesity in the first years of life concern the family milieu. Parents make decisions regarding food choices, meal structure and the dietary pattern in the home and contribute to shaping physical activity and sedentary habits in the child (especially screen use).<sup>7</sup> Another factor to consider is socioeconomic status (SES). The prevalence of childhood obesity exhibits a heterogeneous distribution based on SES in societies at the global level. In developed countries, the prevalence of overweight and of obesity tends to be higher in socioeconomically disadvantaged groups.<sup>8</sup>

In addition, children of obese parents (mother, father or both) are at increased risk to develop obesity.<sup>9</sup> One of the potential factors at play in childhood obesity is the inaccurate perception of parents of the severity of excess weight in their children. A nationwide study in children of both sexes with excess weight aged 3 to 16 years found that approximately two thirds of parents did not perceive the weight of their children as problematic. Furthermore, even if parents are aware of the overweight or obesity of their children,<sup>10</sup> they may not make any changes to improve dietary, physical activity or screen use habits.<sup>11-13</sup>

Few studies have been conducted in Spain analysing the prevalence of childhood obesity in representative samples in children aged less than 6 years.<sup>14,15</sup> In addition, knowledge on how families perceive their children's weight and dietary habits is essential to be able to develop interventions at different levels with the ultimate goal of reducing the prevalence of childhood obesity at younger ages.<sup>16,17</sup> The aim of our study was to describe the prevalence of obesity and analyse possible differences based on sociodemographic characteristics, diet, physical activity, screen use and how the family perceives the weight and the diet of children aged 3 to 4 years in Barcelona.

**Methods**

We conducted a cross-sectional study in a representative sample based on the SES of the district where the early childhood education centre was located (socioeconomic [SE] advantage/disadvantage) and the type of centre (public/private or mixed [private centre receiving public

funding]) in pupils aged 3 to 4 years in the city of Barcelona during academic year 2016–2017. In the framework of the project for the Prevention of Childhood Obesity in Barcelona in Early Childhood Education (known as POIBIN, for its acronym in Spanish),<sup>18</sup> we selected 101 schools and selected the entire P3 class cohort (year 1 of early childhood education, starting from age 3 years:  $N = 3631$  children born in 2013). The study adhered to the principles of the Declaration of Helsinki and was approved by the Clinical Research Ethics Committee of Parc de Salut Mar (file 2016/6711/I). Anthropometric measurements (weight and height) were obtained for 2936 pupils aged 3 to 4 years whose families provided informed consent to participation (81%). Of this total, 55% of families completed a questionnaire on dietary habits, physical activity, hours of sleep, screen use and perception in the family of the child's weight and dietary intake. Thus, we obtained complete data for 1613 children, including the objective information collected through anthropometric measurement and the self-reported information provided by the parents regarding health care-related habits and beliefs.

The primary outcome of the study was the body mass index (BMI) z score for age and sex, using the World Health Organization (WHO) child growth standards for reference.<sup>19</sup> We classified BMI values as normal weight, overweight (BMI  $z > 1$ ) or obesity (BMI  $z > 2$ ). The school-related variables were: socioeconomic level of the school district based on household disposable income data (HDI, data from 2016)<sup>20</sup> categorised as SE advantage (HDI  $\geq 85$ ) vs SE disadvantage (HDI  $< 85$ ) and the type of school based on ownership (public vs private/mixed). Through the self-report questionnaire, we collected data on sociodemographic variables, including the country of origin (Spain vs foreign country), the SES of the family based on the Family Affluence Scale (FAS)<sup>21</sup> (categorised as high, medium or low) and educational attainment (recording the highest educational attainment in the household, categorised as university, secondary or primary education). We also collected data on the weight and height of the mother and father (as self-reported) and then categorised them as normal weight, overweight or obesity based on the WHO standards. The dietary habits and intake variables, based on current dietary recommendations, were the following: adequate breakfast including fruit, cereal and dairy; eating in the school canteen; screen use during supper; going to fast food restaurants; drinking water during meals; consumption of fruit and/or vegetables ( $\geq 5$  servings a day); consumption of dairy (twice or more a day); consumption of meat (twice or fewer times a week); consumption of fish ( $\geq 3$  times a week); consumption of sugary drinks ( $\leq 3$  times a month); consumption of pastries/baked goods ( $\leq 3$  times a month); consumption of sweets ( $\leq 3$  times a month); all classified as yes/no. The variables used to assess physical activity, sleep duration and screen time were as follows: participation in extracurricular athletic activities (yes/no), performance of physical activity as a family (never or seldom, some or all weekends, some or nearly every day of the week), means of transport used to commute to and back from school (walking, public transport, car/motorcycle; bicycle), hours of sleep on school nights ( $< 10$  hours vs  $\geq 10$  hours) screen time ( $< 2$  hours vs  $\geq 2$  hours) on weekdays and on the weekend.<sup>22</sup>

The questionnaire also collected data regarding the perception by the family of the child's weight and nutri-

tion through 14 items taken from the Child Feeding Questionnaire.<sup>23</sup> These items assess aspects concerning the perception of the child's weight and beliefs regarding the imposition or restriction of dietary habits and eating behaviours in their children. For the purposes of this study, we grouped responses in 3 categories: strongly disagree or disagree, neither agree nor disagree, agree or strongly agree.

We conducted a descriptive bivariate analysis to assess the correlation between the objective BMI measure in the child and the independent study outcomes ( $n = 2936$ ). We compared percentages by means of the  $\chi^2$  test, calculating the corresponding 95% confidence intervals (significance:  $P < .05$ ). In the case of variables related to nutrition ( $n = 1613$ , data from questionnaire completed by families), we calculated a global indicator that encompassed behavioural aspects (adequate breakfast including fruit, cereal and dairy; eating in the school canteen; screen use during supper and/or going to fast food restaurants) and aspects concerning adherence to dietary guidelines<sup>22</sup> (drinking water during meals; consumption of fruit and/or vegetables; consumption of dairy; consumption of meat; consumption of fish; consumption of sugary drinks; consumption of pastries/baked goods; consumption of sweets). We analysed the prevalence of adherence to recommended habits, classified as inadequate ( $\leq 1$  behaviour) vs adequate ( $> 1$  behaviour) and adherence to recommended food intake frequency, classified as inadequate (appropriate for  $\leq 2$  recommendations) vs adequate (appropriate for  $> 2$  recommendations). We set cut-off points at the intermediate value, both for habits and food frequency. The statistical analysis was performed with the statistical package Stata/SE, version 15.1.

## Results

The prevalence of obesity in children aged 3 to 4 years was 7.0% in girls and 7.1% in boys. There was a statistically significant difference in weight status based on sex ( $P = .019$ ), with a greater prevalence of overweight in girls (19.1%) compared to boys (15.2%). In districts with a lower HDI, there was a higher prevalence of obesity compared to districts with a higher HDI (8.3% vs 5.2%;  $P = .004$ ) (Table 1).

Table 2 presents the distribution of weight status in boys and girls based on sociodemographic variables. Children whose mother was born in a country other than Spain were more likely to be obese compared to those with mothers born in Spain, a difference that was statistically significant (9.3% vs 4.2%,  $p < .001$ ). Of the mothers who reported being obese themselves, 15.9% had children with obesity; in the case of fathers with obesity, the proportion of children with obesity was 14.5%. In families with SE disadvantage, there was a higher percentage of children with overweight (21.3%) or obesity (10.1%) ( $p < .001$ ).

Table 3 presents data on eating behaviours and food group intake frequency. We found a statistically significant difference in the intake of fish, with a higher prevalence of obesity among children who consumed less fish than recommended ( $P = .021$ ). On the other hand, when it came to the consumption of meat, the prevalence of obesity was greater in children who consumed the amount recommended (8.4%)

**Table 1** Distribution of weight category based on sex, socioeconomic level of school district and type of school (n = 2936). POIBIN, Barcelona (2017).

	Child's weight status						Total	P
	Normal weight		Overweight		Obesity			
	n	%	n	%	n	%		
<i>Child's sex</i>								
Male	1176	77.7	230	15.2	107	7.1	1513	.019
Female	1052	73.9	272	19.1	99	7.0	1423	
<i>Socioeconomic level of school (HDI)</i>								
SE advantage	938	76.9	218	17.9	63	5.2	1219	.004
SE disadvantage	1290	75.1	284	16.6	143	8.3	1717	
<i>Type of school</i>								
Private/mixed	1100	75.6	264	18.2	90	6.2	1454	.095
Public	1128	76.1	238	16.1	116	7.8	1482	

HDI, household disposable income; SE, socioeconomic. Statistical significance set at  $P < .05$ .

compared to children who did not adhere to meat intake recommendations (5.0%). We did not find significant differences in any other eating behaviours or dietary habits based on weight status categories.

As can be seen in Table 4, the proportion of children with obesity was lesser among children with screen times of less than 2 hours a day compared to children with screen times of 2 hours or greater on weekdays (4.3% vs 8.6%) or on weekends (3.2% vs 7.1%), differences that were statistically significant.

Table 5 summarises the data on the perception of families about the child's weight and eating by child weight status. Of the parents whose children's weight was in the obesity range, 46.9% reported that their child's weight was slightly excessive or excessive, 3.9% that their weight was average and 0.9%, that their weight was slightly low or low ( $P < .001$ ). When it came to parental control of the child's diet, 5.2% of the parents of children with obesity agreed with the statement "If I did not guide or regulate my child's eating, he/she would eat much less than he/she should", while 7.0% disagreed. Furthermore, 5.4% of parents of children with obesity agreed with the statement "I have to be especially careful to make sure my child eats enough" while 7.4% disagreed ( $P < .001$ ). As regards restricting intake, 7.4% of parents of children with obesity expressed agreement with the statement "If I did not guide or regulate my child's eating, he/she would eat too many junk foods", while 3.2% expressed disagreement ( $P = .047$ ).

## Discussion

Our study found a prevalence of obesity of 7% in children aged 3 to 4 years in the city of Barcelona, with a higher prevalence in schools in neighbourhoods with lower SES. In families of children with obesity, there was a greater proportion of parental obesity, of parents of foreign origin, of low SES and of a maximum household educational attainment of secondary or primary education. When it came to

dietary habits, a greater prevalence of obesity was associated with a fish intake below recommendations. In addition, a screen time of 2 hours a day or greater was also associated with a higher prevalence of obesity. When it came to the perception of families, nearly half of families of children with obesity perceived that the weight of their children was slightly excessive or excessive.

The prevalence of childhood obesity observed in our study had increased compared to previously reported data in this age group.<sup>4</sup> This increasing in the frequency of childhood obesity is consistent with the reports of the national health survey of Spain, which have shown a progressive increase in the prevalence of childhood obesity between 2003 and 2017.<sup>5</sup> Few studies offer data on the prevalence of obesity in children under 5 years.<sup>14,15,24</sup> In our study, we found a high prevalence of obesity in early childhood.<sup>2,25</sup>

In general, countries with a higher prevalence of childhood obesity are those in which there is greater social inequality.<sup>26</sup> In our study, we found that more disadvantaged areas had a higher prevalence of childhood obesity. Thus, factors like parental foreign origin (mother and/or father), low household SES or a highest educational attainment of primary or secondary school in the parents were associated with a greater proportion of excess weight in the children, as previously described in the domestic and international literature.<sup>27,28</sup>

Our study identified inadequate dietary habits in young children that are associated with weight problems. Nine in ten children did not have an adequate breakfast. A breakfast including dairy, fruit and cereal is a key factor that contributes to a healthy diet.<sup>29</sup> The literature shows that the consumption of healthy foods in school is associated with a decreased prevalence of obesity and overweight. In agreement with these findings, the results of our study were similar to those of the ALADINO study conducted in Spain in 2011,<sup>30</sup> in which the meals offered by schools adhered to Spanish dietary guidelines for healthy nutrition. This suggests that adherence to dietary recommendations may be associated with a reduction in the frequency of obesity and overweight in the preschoolers and schoolchildren. Other

**Table 2** Distribution of weight category based on sociodemographic characteristics. Data from self-report family questionnaire (n = 1613). POIBIN, Barcelona (2017).

	Child's weight status						Total	P
	Normal weight		Overweight		Obesity			
	n	%	n	%	n	%		
<i>Child's country of birth</i>								
Spain	1169	76.8	265	17.4	89	5.8	1523	.471
Other	53	71.6	17	23.0	4	5.4	74	
NA	13	81.2	2	12.5	1	6.3	16	
<i>Mother's country of birth</i>								
Spain	855	78.5	188	17.3	46	4.2	1089	< .001
Other	373	72.6	93	18.1	48	9.3	514	
NA	7	70.0	3	30.0	0	0.0	10	
<i>Father's country of birth</i>								
Spain	826	78.2	185	17.5	45	4.3	1056	.002
Other	353	72.6	91	18.7	42	8.7	486	
NA	56	78.9	8	11.2	7	9.9	71	
<i>Maternal weight status</i>								
Normal weight	854	81.5	159	15.2	35	3.3	1048	< .001
Overweight	234	68.2	79	23.0	30	8.8	343	
Obesity	71	62.8	24	21.3	18	15.9	113	
NA	76	69.7	22	20.2	11	10.1	109	
<i>Paternal weight status</i>								
Normal weight	530	81.8	100	15.4	18	2.8	648	< .001
Overweight	449	75.8	108	18.3	35	5.9	592	
Obesity	84	60.9	34	24.6	20	14.5	138	
NA	172	73.2	42	17.9	21	8.9	235	
<i>Socioeconomic level of household (FAS)</i>								
High	483	78.8	104	17.0	26	4.2	613	< .001
Medium	461	80.2	89	15.5	25	4.3	575	
Low	271	68.6	84	21.3	40	10.1	395	
NA	20	66.7	7	23.3	3	10.0	30	
<i>Educational attainment (highest in mother/father)</i>								
University	816	78.0	189	18.1	41	3.9	1046	.001
Secondary	320	73.1	76	17.3	42	9.6	438	
Primary	34	77.3	8	18.2	2	4.5	44	
NA	65	76.5	11	12.9	9	10.6	85	

NA, no answer FAS, Family Affluence Scale.

P value calculated with self-reported data in the subset of the sample that answered the item (excluding unanswered items [NA]). Statistical significance set at  $P < .05$ .

analysed aspects, such as using screens during mealtimes or consuming fast food, are associated with an increased risk of weight problems.<sup>31</sup> However, our study did not yield evidence of these associations. We ought to highlight that there is little evidence of a direct association between the prevalence of obesity in the age group under study and the exposure to fast food restaurants. In our study, we found significant differences in the consumption of meat and fish. Specifically, we found that consumption of fish seemed to have a protective effect while the results for meat were contradictory. We found an increased prevalence of obesity in children who consumed meat with appropriate frequency.<sup>22</sup> A possible explanation is that even if the frequency of meat intake adhered to recommendations, other components of

the diet could be unhealthy or foods could be eaten in excessive amounts.<sup>32–34</sup>

The WHO recommends moderate consumption of red meat due to its association with chronic degenerative diseases found in epidemiological studies.<sup>35</sup>

As regards screen use, the increasing trend in screen time has led to a decrease in the time devoted to healthier activities. According to the WHO guidelines, screen time (television, mobile phones, computers, gaming consoles etc.) should not exceed 2 hours a day.<sup>36</sup> The data showed that a high percentage of children of either sex aged 3 to 4 years spent more than 2 hours using screens on weekdays (1 in 3) and weekends (2 in 3). In our study, we found that the prevalence of obesity doubled in children with screen

**Table 3** Distribution of weight category based on eating behaviours and food intake frequency (n = 1613). POIBIN, Barcelona (2017).

	Child's weight status						Total	P
	Normal weight		Overweight		Obesity			
	n	%	n	%	n	%		
<i>Adequate breakfast (fruit, cereal and dairy)</i>								
Yes	120	77.9	27	17.5	7	4.6	154	.790
No	1079	76.5	249	17.6	83	5.9	1411	
NA	36	75.0	8	16.7	4	8.3	48	
<i>Eating in school canteen</i>								
Yes	1000	76.6	236	18.1	70	5.3	1306	.374
No	231	77.3	47	15.7	21	7.0	299	
NA	4	50.0	1	12.5	3	37.5	8	
<i>Screen use during meals</i>								
Never/sometimes	842	76.3	199	18.1	62	5.6	1103	.839
Often/always	387	77.6	84	16.8	28	5.6	499	
NA	6	54.5	1	9.1	4	36.4	11	
<i>Fast food restaurants</i>								
Never/sometimes	1177	76.3	277	17.9	89	5.8	1543	.130
Once or twice a week	45	88.2	4	7.9	2	3.9	51	
NA	13	68.4	3	15.8	3	15.8	19	
<i>Global dietary indicator<sup>a</sup></i>								
Adequate habits (> 1 habit)	1129	76.4	267	18.1	82	5.5	1478	.103
Inadequate habits (≤1 habit)	106	78.5	17	12.6	12	8.9	135	
<i>Drinking water with meals</i>								
Yes	997	77.5	221	17.2	69	5.3	1287	.220
No	227	73.0	62	19.9	22	7.1	311	
NA	11	73.3	1	6.7	3	20.0	15	
<i>Consumption of fruits/vegetables (5 or more servings/day)</i>								
Yes	93	79.5	17	14.5	7	6.0	117	.641
No	1129	76.3	266	18.0	84	5.7	1479	
NA	13	76.5	1	5.9	3	17.6	17	
<i>Consumption of dairy (twice or more a day)</i>								
Yes	700	75.8	175	18.9	49	5.3	924	.250
No	521	77.7	107	16.0	42	6.3	670	
NA	14	73.7	2	10.5	3	15.8	19	
<i>Consumption of meat (Twice or less a week)</i>								
Yes	243	72.5	64	19.1	28	8.4	335	.034
No	973	77.6	218	17.4	62	5.0	1253	
NA	19	76.0	2	8.0	4	16.0	25	
<i>Consumption of fish (≥ 3 times a week)</i>								
Yes	414	75.8	111	20.3	21	3.9	546	.021
No	803	77.1	171	16.4	68	6.5	1042	
NA	18	72.0	2	8.0	5	20.0	25	
<i>Consumption of sugary drinks (≤ 3 times a month)</i>								
Yes	1091	77.4	238	16.9	80	5.7	1409	.071
No	121	69.9	41	23.7	11	6.4	173	
NA	23	74.2	5	16.1	3	9.7	31	
<i>Consumption of pastries (≤ 3 times a month)</i>								
Yes	347	73.7	91	19.3	33	7.0	471	.153
No	866	77.8	190	17.1	57	5.1	1113	
NA	22	75.9	3	10.3	4	13.8	29	

**Table 3** (Continued)

	Child's weight status						Total	P
	Normal weight		Overweight		Obesity			
	n	%	n	%	n	%		
<i>Consumption of sweets (≤ 3 times a month)</i>								
Yes	635	76.5	144	17.4	51	6.1	830	.709
No	584	76.6	138	18.1	40	5.3	762	
NA	16	76.2	2	9.5	3	14.3	21	
<i>Global food frequency indicator<sup>b</sup></i>								
Adequate intake (> 2 food groups)	1012	76.5	238	18.0	72	5.5	1322	.289
Inadequate intake (≤ 2 food groups)	223	76.6	46	15.8	22	7.6	291	

P value calculated with self-reported data in the subset of the sample that answered the item (excluding unanswered items [NA]). Statistical significance set at  $P < .05$ .

<sup>a</sup> Habits: adequate breakfast, eating in school canteen, use of screens during meals, dining in fast food restaurants.

<sup>b</sup> Food intake frequency: drinking water with meals, consumption of fruit/vegetables, consumption of dairy, consumption of meat, consumption of fish, consumption of sugary drinks, consumption of pastries, consumption of sweets.

**Table 4** Distribution of weight category based on physical activity, hours of sleep and screen time (n = 1613). POIBIN, Barcelona (2017).

	Child's weight status						Total	P
	Normal weight		Overweight		Obesity			
	n	%	n	%	n	%		
<i>Extracurricular physical activity</i>								
Yes	199	71.6	59	21.2	20	7.2	278	.088
No	1017	77.7	222	17.0	70	5.4	1309	
NA	19	73.1	3	11.5	4	15.4	26	
<i>Physical activity as a family</i>								
Never or seldom	30	75.0	9	22.5	1	2.5	40	.396
Some or all weekends	706	75.5	174	18.6	55	5.9	935	
Some or every day of the week	481	78.9	94	15.4	35	5.7	610	
NA	18	64.3	7	25.0	3	10.7	28	
<i>Commute to school from home</i>								
Walking	853	76.6	194	17.4	67	6.0	1114	.187
Public transport	161	76.3	33	15.6	17	8.1	211	
Car/motorcycle	178	76.4	48	20.6	7	3.0	233	
Bicycle	23	85.2	4	14.8	0	0.0	27	
NA	20	71.4	5	17.9	3	10.7	28	
<i>Commute home from school</i>								
Walking	904	76.9	205	17.4	67	5.7	1176	.208
Public transport	157	73.0	40	18.6	18	8.4	215	
Car/motorcycle	134	77.5	33	19.1	6	3.5	173	
Bicycle	18	94.7	1	5.3	0	0.0	19	
NA	22	73.3	5	16.7	3	10.0	30	
<i>Sleep duration (school nights)</i>								
< 10 hours	224	75.4	49	16.5	24	8.1	297	.146
≥ 10 hours	972	77.2	222	17.6	65	5.2	1259	
NA	39	68.4	13	22.8	5	8.8	57	
<i>Screen time (weekdays)</i>								
< 2 hours	826	78.2	185	17.5	45	4.3	1056	.002
≥ 2 hours	392	73.6	95	17.8	46	8.6	533	
NA	17	70.8	4	16.7	3	12.5	24	

**Table 4** (Continued)

	Child's weight status						Total	P
	Normal weight		Overweight		Obesity			
	n	%	n	%	n	%		
<i>Screen time (weekend)</i>								
< 2 hours	458	80.4	94	16.5	18	3.2	570	.002
≥ 2 hours	751	74.6	185	18.4	71	7.1	1007	
NA	26	72.2	5	13.9	5	13.9	36	

P value calculated with self-reported data in the subset of the sample that answered the item (excluding unanswered items [NA]). Statistical significance set at  $P < .05$ .

times greater than 2 hours. The use of screens is associated with a decrease in the time spent resting and/or engaging in physical activity.<sup>37</sup>

The findings of our study were consistent with those of the previous literature, as most parents of children with obesity underestimated the weight of their children.<sup>38</sup> Similarly, a study conducted in Portugal between 2013 and 2014 identified different factors associated with the frequency of underestimating weight status in families based on the weight status of the child. Families were more likely to underestimate weight in children of either sex who were overweight.<sup>39</sup>

The limitations of the study included those intrinsic to cross-sectional designs, which preclude the establishment of causality. Another limitation was the collection of data through a self-report questionnaire, which carries a risk of information bias.

Among the strengths of the study, we should highlight that it is the first to collect data on childhood overweight and obesity in very young children for the city of Barcelona. The sample size was large enough to estimate the population prevalence of overweight and obesity. Lastly, we collected information on how families perceived the weight of their children in a representative sample in the city of Barcelona.

**Table 5** Distribution of weight category based on perception of family of the child's weight and diet (n = 1613). POIBIN, Barcelona (2017).

	Child's weight status						Total	P
	Normal weight		Overweight		Obesity			
	n	%	n	%	n	%		
<i>Your child's weight is...</i>								
Average	971	76.6	248	19.6	49	3.9	1268	< .001
Slightly excessive/excessive	19	23.5	24	29.6	38	46.9	81	
Slightly low/low	222	96.1	7	3.0	2	0.9	231	
NA	23	69.7	5	15.2	5	15.2	33	
<i>How concerned are you about your child eating too much when you are not around him/her?</i>								
Unconcerned/slightly unconcerned	767	79.6	144	15.0	52	5.4	963	.001
Concerned/slightly concerned	437	71.8	135	22.2	37	6.1	609	
NA	31	75.6	5	12.2	5	12.2	41	
<i>How concerned are you about your child having to diet to maintain a desirable weight?</i>								
Unconcerned/slightly unconcerned	436	76.2	98	17.1	38	6.6	572	.376
Concerned/slightly concerned	772	77.0	180	18.0	50	5.0	1002	
NA	27	69.2	6	15.4	6	15.4	39	
<i>How concerned are you about your child becoming overweight?</i>								
Unconcerned/slightly unconcerned	422	74.6	115	20.3	29	5.1	566	.124
Concerned/slightly concerned	786	77.7	165	16.3	60	5.9	1011	
NA	27	75.0	4	11.1	5	13.9	36	
<i>If I did not guide or regulate my child's eating, he/she would eat much less than he/she should.</i>								
Disagree/strongly disagree	399	70.2	129	22.7	40	7.0	568	< .001
Neither agree nor disagree	267	75.2	71	20.0	17	4.8	355	
Agree/strongly agree	534	83.7	71	11.1	33	5.2	638	
NA	35	67.3	13	25.0	4	7.7	52	



**Table 5** (Continued)

	Child's weight status							P
	Normal weight		Overweight		Obesity		Total n	
	n	%	n	%	n	%		
<i>I have to be especially careful to make sure my child eats enough.</i>								
Disagree/strongly disagree	300	69.1	102	23.5	32	7.4	434	< .001
Neither agree nor disagree	193	75.7	50	19.6	12	4.7	255	
Agree/strongly agree	720	80.5	126	14.1	48	5.4	894	
NA	22	73.3	6	20.0	2	6.7	30	
<i>If my child says I'm not hungry, I try to get him/her to eat anyway</i>								
Disagree/strongly disagree	362	72.5	107	21.4	30	6.0	499	.028
Neither agree nor disagree	240	75.7	59	18.6	18	5.7	317	
Agree/strongly agree	612	79.9	111	14.5	43	5.6	766	
NA	21	67.7	7	22.6	3	9.7	31	
<i>My child should always eat all of the food on his/her plate</i>								
Disagree/strongly disagree	360	77.8	88	19.0	15	3.2	463	.057
Neither agree nor disagree	270	75.2	61	17.0	28	7.8	359	
Agree/strongly agree	583	76.6	129	17.0	49	6.4	761	
NA	22	73.3	6	20.0	2	6.7	30	
<i>I intentionally keep some foods out of my child's reach</i>								
Disagree/strongly disagree	467	79.3	95	16.1	27	4.6	589	.037
Neither agree nor disagree	198	78.9	35	13.9	18	7.2	251	
Agree/strongly agree	540	73.4	151	20.5	45	6.1	736	
NA	30	81.1	3	8.1	4	10.8	37	
<i>I offer my child his/her favourite foods in exchange for good behaviour</i>								
Disagree/strongly disagree	512	79.4	102	15.8	31	4.8	645	.072
Neither agree nor disagree	324	77.1	72	17.1	24	5.7	420	
Agree/strongly agree	370	72.1	108	21.1	35	6.8	513	
NA	29	82.9	2	5.7	4	11.4	35	
<i>If I did not guide or regulate my child's eating, he/she would eat too many junk foods</i>								
Disagree/strongly disagree	377	80.7	75	16.1	15	3.2	467	.047
Neither agree nor disagree	227	77.2	50	17.0	17	5.8	294	
Agree/strongly agree	601	74.2	149	18.4	60	7.4	810	
NA	30	71.4	10	23.8	2	4.8	42	
<i>I offer sweets to my child as a reward for good behaviour</i>								
Disagree/strongly disagree	647	78.6	139	16.9	37	4.5	823	.132
Neither agree nor disagree	272	75.3	66	18.3	23	6.4	361	
Agree/strongly agree	287	73.0	76	19.3	30	7.6	393	
NA	29	80.6	3	8.3	4	11.1	36	
<i>If I did not guide or regulate my child's eating, he/she would eat too much of his/her favourite foods</i>								
Disagree/strongly disagree	190	78.2	46	18.9	7	2.9	243	.307
Neither agree nor disagree	191	77.3	42	17.0	14	5.7	247	
Agree/strongly agree	832	76.4	187	17.2	70	6.4	1089	
NA	22	64.7	9	26.5	3	8.8	34	
<i>I think my child eats well</i>								
Disagree/strongly disagree	99	84.6	13	11.1	5	4.3	117	.192
Neither agree nor disagree	165	78.9	32	15.3	12	5.7	209	
Agree/strongly agree	948	75.4	235	18.7	74	5.9	1257	
NA	23	76.7	4	13.3	3	10.0	30	

NA, no answer.

Data from self-report family questionnaire (n = 1613).

P value calculated with self-reported data in the subset of the sample that answered the item (excluding unanswered items [NA]).

Statistical significance set at  $P < .05$ .

In conclusion, the prevalence of obesity is very high in children of both sexes aged 3 to 4 years, and there are social and geographical inequalities, with a higher prevalence in socioeconomically disadvantaged areas. In addition, the sociodemographic characteristics of the household, parental nutritional status and screen time were determinants associated with weight in children.

## Funding

This research did not receive any external funding.

## Conflicts of interest

The authors have no conflicts of interest to declare.

## References

- Rivero Urgell M, Moreno Aznar LA, Dalmau Serra J, Moreno Vilares JM, Aliaga Pérez A, García Perea A, et al. Libro Blanco de La Nutrición Infantil en España. 2015th ed. Zaragoza: Prensas de la Universidad de Zaragoza; 2015.
- Bentham J, Di Cesare M, Bilano V, Bixby H, Zhou B, Stevens GA, et al. Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults. *Lancet*. 2017;390:2627–42, [http://dx.doi.org/10.1016/S0140-6736\(17\)32129-3](http://dx.doi.org/10.1016/S0140-6736(17)32129-3).
- Ministerio de Sanidad, Consumo y Bienestar Social; Agencia Española de Seguridad Alimentaria y Nutrición. Prevalencia de Sobrepeso y Obesidad En España En El Informe "The Heavy Burden of Obesity" (OCDE 2019) y En Otras Fuentes de Datos. Observatorio de la Nutrición y de Estudio de la Obesidad 2019.
- Felipe S, Santos G, Santiago RE, Palacios Gil-Antuñano N, Rosaura M, Trabazo L, et al. Thao-child health programme: community based intervention for healthy lifestyles promotion to children and families: results of a cohort study. *Nutr Hosp*. 2015;32:2584–7, <http://dx.doi.org/10.3305/nh.2015.32.6.9736>.
- Ministerio de Sanidad - Portal Estadístico Del SNS - Encuesta Nacional de Salud de España 2017. Available from: <https://www.sanidad.gob.es/estadEstudios/estadisticas/encuestaNacional/encuesta2017.htm>. (Accessed on 7 May 2023).
- Dutton H, Borengasser SJ, Gaudet LM, Barbour LA, Keely EJ. Obesity in pregnancy: optimizing outcomes for mom and baby. *Med Clin North Am*. 2018;102:87–106, <http://dx.doi.org/10.1016/J.MCNA.2017.08.008>.
- Lindsay AC, Sussner KM, Kim J, Gortmaker S. The role of parents in preventing childhood obesity. *Future Child*. 2006;16:169–86, <http://dx.doi.org/10.1353/FOC.2006.0006>.
- Sánchez-Martínez F, Torres Capcha P, Serral Cano G, Valmayor Safont S, Castell Abat C, Ariza Cardenal C, Grupo de Evaluación del Proyecto POIBA. Factores Asociados al Sobrepeso y La Obesidad En Escolares de 8 a 9 Años de Barcelona. *Rev Esp Salud Publica*. 2016;90:1–11.
- Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med*. 1997;337:204, <http://dx.doi.org/10.1056/NEJM199709253371301>.
- Zamudio-Solorio O, Muñoz-Arenillas RM. Percepción de Los Padres Respecto al Sobrepeso y Obesidad de Sus Hijos. *Rev Enferm Inst Mex Seguro Soc*. 2016;24:61–4.
- Gauthier KI, Gance-Cleveland B. Hispanic parental perceptions of child weight in preschool-aged children: an integrated review. *Child Obes*. 2015;11:549–59, <http://dx.doi.org/10.1089/CHI.2014.0152>.
- Gauthier KI, Gance-Cleveland B. Hispanic parents' perceptions of their preschool children's weight status. *J Spec Pediatr Nurs*. 2016;21:84–93, <http://dx.doi.org/10.1111/JSPN.12143>.
- Rodríguez Martín A, Novalbos Ruiz JP, Villagran Pérez S, Martínez Nieto JM, Lechuga Campoy JL. La Percepción Del Sobrepeso y La Obesidad Infantil Por Parte de Los Progenitores. Available from: [https://scielo.isciii.es/scielo.php?script=sci\\_arttext&pid=S1135-57272012000500003](https://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1135-57272012000500003). (Accessed on 20 March 2023).
- Lasarte-Velillas JJ, Hernández-Aguilar MT, Martínez-Boyero T, Soria-Cabeza G, Soria-Ruiz D, Bastarós-García JC, et al. Overweight and obesity prevalence estimates in a population from Zaragoza by using different growth references. *An Pediatr (Barc)*. 2015;82:152–8, <http://dx.doi.org/10.1016/J.ANPEDI.2014.03.005>.
- Lasarte-Velillas JJ, Lamiquiz-Moneo I, Lasarte-Sanz I, Sala-Fernández L, Marín-Andrés M, Rubio-Sánchez P, et al. Prevalencia de Sobrepeso y Obesidad En Aragón y Variaciones Según Condicionantes de Salud. *An Pediatr (Engl Ed)*. 2023;98:157–64, <http://dx.doi.org/10.1016/J.ANPEDI.2022.09.009>.
- Ariza C, Ortega-Rodríguez E, Sánchez-Martínez F, Valmayor S, Juárez O, Pasarín MI. La Prevención de La Obesidad Infantil Desde Una Perspectiva Comunitaria. *Aten Primaria*. 2015;47:246, <http://dx.doi.org/10.1016/J.APRIM.2014.11.006>.
- Ek A, Sorjonen K, Eli K, Lindberg L, Nyman J, Marcus C, et al. Associations between parental concerns about preschoolers' weight and eating and parental feeding practices: results from analyses of the child eating behavior questionnaire, the child feeding questionnaire, and the lifestyle behavior checklist. *PLoS One*. 2016;11, <http://dx.doi.org/10.1371/JOURNAL.PONE.0147257>.
- Serral G, Sánchez F, Ariza C. Programa de Prevenció de l'Obesitat Infantil de Barcelona (Projecte POIBIN). Agència de Salut Pública de Barcelona; 2019. Available from: <https://www.aspb.cat/documents/poibin-obesitat-infantil/>. (Accessed on 20 March 2023).
- World Health Organization. Body Mass Index-for-Age (BMI-for-Age) Available from: <https://www.who.int/toolkits/child-growth-standards/standards/body-mass-index-for-age-bmi-for-age>. (Accessed on 20 March 2023).
- Gabinet Tècnic de Programació. Ajuntament de Barcelona. Distribució territorial de la renda familiar disponible per càpita a Barcelona (2016). Available from: <https://www.idescat.cat/serveis/biblioteca/docs/bib/pec/paae2017/a07882016.pdf>.
- Currie C, Molcho M, Boyce W, Holstein B, Torsheim T, Richter M. Researching health inequalities in adolescents: the development of the health behaviour in school-aged children (HBSC) family affluence scale. *Soc Sci Med*. 2008;66:1429–36, <http://dx.doi.org/10.1016/J.SOCSCIMED.2007.11.024>.
- Bartrina JA, Arijia Val V, Maíz Aldalur E, Martínez De Victoria Muñoz E, Ortega Anta RM, Pérez-Rodrigo C, et al. Guías Alimentarias Para La Población Española (SENC, Diciembre 2016); La Nueva Pirámide de La Alimentación Saludable. *Nutr Hosp*. 2016;33, <http://dx.doi.org/10.20960/NH.827>.
- Birch LL, Fisher JO, Grimm-Thomas K, Markey CN, Sawyer R, Johnson SL. Confirmatory factor analysis of the child feeding questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. *Appetite*. 2001;36:201–10, <http://dx.doi.org/10.1006/APPE.2001.0398>.
- Serra Majem L, Ribas Barba L, Pérez Rodrigo C, Roman Viñas B, Aranceta Bartrina J. Hábitos Alimentarios y Consumo de Alimentos En La Población Infantil y Juvenil Española (1998-2000): Variables Socioeconómicas y Geográficas. *Med Clin (Barc)*. 2003;121:126–31, <http://dx.doi.org/10.1157/13049799>.
- World Health Organization. Tenfold Increase in Childhood and Adolescent Obesity in Four Decades: New Study

- by Imperial College London and WHO. Available from: <https://www.who.int/es/news/item/11-10-2017-tenfold-increase-in-childhood-and-adolescent-obesity-in-four-decades-new-study-by-imperial-college-london-and-who>. (Accessed on 21 March 2023).
26. Mekonnen T, Havdal HH, Lien N, O'Halloran SA, Arah OA, Papadopoulou E, et al. Mediators of socioeconomic inequalities in dietary behaviours among youth: a systematic review. *Obes Rev.* 2020;21, <http://dx.doi.org/10.1111/OBR.13016>.
  27. Bammann K, Gwozdz W, Lanfer A, Barba G, De Henauw S, Eiben G, et al. Socioeconomic factors and childhood overweight in Europe: results from the multi-centre IDEFICS study. *Pediatr Obes.* 2013;8:1–12, <http://dx.doi.org/10.1111/J.2047-6310.2012.00075.X>.
  28. Newton S, Braithwaite D, Akinyemiju TF. Socio-economic status over the life course and obesity: systematic review and meta-analysis. *PLoS One.* 2017;12, <http://dx.doi.org/10.1371/JOURNAL.PONE.0177151>.
  29. Health Sponsorship Council (HSC). *Encouraging Children to Eat Breakfast. New Zealand: The Health Sponsorship Council's Breakfast-Eaters Promotion; 2011.*
  30. Estudio ALADINO: Estudio de Vigilancia Del Crecimiento, Alimentación, Actividad Física, Desarrollo Infantil y Obesidad En España 2011. Agencia Española de Seguridad Alimentaria y Nutrición. Madrid: Ministerio de Sanidad, Servicios Sociales e Igualdad; 2013.
  31. Avery A, Anderson C, McCullough F. Associations between children's diet quality and watching television during meal or snack consumption: a systematic review. *Matern Child Nutr.* 2017;13, <http://dx.doi.org/10.1111/MCN.12428>.
  32. Mascarenhas P, Furtado JM, Almeida SM, Ferraz ME, Ferraz FP, Oliveira P. Pediatric overweight, fatness and risk for dyslipidemia are related to diet: a cross-sectional study in 9-year-old children. *Nutrients.* 2023;15:329, <http://dx.doi.org/10.3390/NU15020329/S1>.
  33. Alzate Yepes T, Alzate Yepes T. Consumo de Carnes Rojas y Procesadas. La Controversia Está Servida. *Perspect Nutr Humana.* 2019;21:137–42, <http://dx.doi.org/10.17533/UDEA.PENH.V21N2A01>.
  34. WHO European Childhood Obesity Surveillance Initiative (COSI): Report on the Fourth Round of Data Collection 2015-2017; 2021. Available from: <https://iris.who.int/handle/10665/341189>
  35. Pan A, Sun Q, Bernstein AM, Schulze MB, Manson JAE, Stampfer MJ, et al. Red meat consumption and mortality: results from 2 prospective cohort studies. *Arch Intern Med.* 2012;172:555–63, <http://dx.doi.org/10.1001/ARCHINTERNMED.2011.2287>.
  36. World Health Organization. *Guidelines on Physical Activity, Sedentary Behaviour and Sleep for Children under 5 Years of Age.* World Health Organization; 2019. Available from: <https://apps.who.int/iris/handle/10665/311664>. (Accessed on 22 March 2023).
  37. Cartanyà-Hueso À, Lidón-Moyano C, Martín-Sánchez JC, González-Marrón A, Pérez-Martín H, Martínez-Sánchez JM. Association between recreational screen time and excess weight and obesity assessed with three sets of criteria in Spanish residents aged 2–14 years. *An Pediatr (Engl Ed).* 2022;97:333–41, <http://dx.doi.org/10.1016/J.ANPEDI.2021.09.012>.
  38. Esteban-Vasallo MD, Galán I, Ortiz-Pinto MA, Astray San Martín A, Cabrero López EM, Morales San José MT, et al. Accuracy of anthropometric measurements and weight status perceptions reported by parents of 4-year-old children. *Public Health Nutr.* 2020;23:589–98, <http://dx.doi.org/10.1017/S1368980019003008>.
  39. Rodrigues D, Machado-Rodrigues AM, Padez C. Parental misperception of their child's weight status and how weight underestimation is associated with childhood obesity. *Am J Hum Biol.* 2020;32, <http://dx.doi.org/10.1002/AJHB.23393>.