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ORIGINAL ARTICLE

Excess weight and abdominal obesity in Galician children and adolescents☆

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Abstract
Introduction and objectives: The excess of weight, mainly obesity, during childhood and adolescence increases morbimortality risk in adulthood. The aim of this article is to estimate both the overall prevalence, as well as according to age and gender, of underweight, overweight, obesity and abdominal obesity among schoolchildren aged between 6 and 15-years-old in the school year 2013–2014.
Material and methods: Data were taken from a cross-sectional community-based study carried out on a representative sample, by gender and age, of the Galician population aged between 6 and 15-years-old. The prevalence of underweight, overweight, and obese children (Cole's cut-off criteria) and abdominal obesity (Taylor's cut-off criteria) were estimated after performing objective measurements of height, weight and waist circumference at school.
Results: A total of 7438 students were weighed and measured in 137 schools. The prevalence of overweight and obese was 24.9% and 8.2%, respectively. The prevalence of abdominal obesity was 25.8%, with 4% of children with normal weight having abdominal obesity.
Conclusions: These data highlight the need to promote primary prevention measures at early ages in order to decrease the occurrence of premature onset of disease in the future. The prevalence of excess weight is underestimated if abdominal obesity is not taken into consideration.

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PALABRAS CLAVE
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Obesidad central;
Prevalencia;
Epidemiología

Exceso ponderal y obesidad abdominal en niños y adolescentes gallegos

Resumen
Introducción y objetivos: El exceso de peso, fundamentalmente la obesidad, en edad pediátrica aumenta el riesgo de morbimortalidad en la edad adulta. El objetivo de este trabajo es estimar la prevalencia, global y en función de la edad y del sexo, de bajo peso, normopeso, exceso ponderal y de obesidad abdominal en los escolares gallegos de 6 a 15 años en el curso escolar 2013-2014.
Material y métodos: Los datos proceden de un estudio transversal realizado en una muestra representativa por sexo y edad de escolares gallegos de 6 a 15 años. A partir de mediciones realizadas en los centros escolares se estimaron las prevalencias de bajo peso, normopeso, sobrepeso y obesidad, aplicando los puntos de corte propuestos por Cole, y la prevalencia de obesidad abdominal a partir de los puntos de corte de Taylor.
Resultados: Se pesaron y midieron 7.438 escolares en los 137 centros educativos participantes. La prevalencia de sobrepeso fue de 24,9% y la de obesidad, de 8,2%. El 25,8% presentaban obesidad abdominal. El 4% de los escolares con normopeso tenían obesidad abdominal.
Conclusiones: Estos datos ponen de manifiesto que se deben promover medidas de prevención primaria a edades tempranas encaminadas a disminuir la prevalencia de este factor de riesgo y a evitar complicaciones futuras. La prevalencia de exceso de peso, si no se tiene en cuenta la obesidad abdominal, se estaría infraestimando.

Introduction

The presence of excess weight (understood as overweight or obesity) in childhood and adolescence increases the risk of morbidity and mortality in adulthood. This, along with other reasons like impaired quality of life, increased health care costs and the importance of acquiring healthy lifestyle habits at an early age, make the fight against excess weight a key aspect of public health policy in developed countries.[1,2]

A necessary step ahead of designing and implementing local policies for prevention and control from a public health perspective is to obtain updated and accurate anthropometric data for the school-age population. The definition of excess weight in the school-age population based on body mass index (BMI) categories may not accurately reflect the impact or the burden of this problem, as the BMI slightly overestimates the prevalence of excess weight in children and adolescents with a high muscle mass and substantially underestimates it in children and adolescents with a low muscle mass. To correct this limitation, if only partially, it may be useful to estimate the prevalence of abdominal obesity.[3]

It is estimated that in 2013, 24% of the male and 23% of the female population aged 2–19 years in developed countries had excess weight.[4] When it comes to Galicia, there are no representative data by sex and age on the prevalence of overweight and obesity in the school-age population. Previous studies have been restricted to either specific age groups[5] or specific geographical areas,[6] or offer information that needs to be updated.[7]

The aim of the study was to determine the prevalence of underweight, normal weight, overweight, obesity and abdominal or central obesity in schoolchildren aged 6–15 years in Galicia during the 2013–2014 academic year, and to assess whether there were any differences based on age or sex.

Materials and methods

In order to characterise Galician children and adolescents in terms of various anthropometric variables, we designed a cross-sectional study focused on the population of children enrolled in the 6 years of primary education (PE) and the 4 years of mandatory secondary education (Educación Secundaria Obligatoria [ESO]) in public, private and state-funded privately-managed schools in Galicia in the 2013–2014 academic year. We selected students by multistage stratified sampling, selecting schools in the first stage and classrooms in the second: 3 in each primary school and 2 in each secondary school. We included all students in the selected classrooms aged 6–15 years in the study. The sampling frame was the total of schools operating in Galicia, which amounted to 1063 in 2013. The criterion used for stratification was the degree of urbanisation of the municipality where the school was located, which we established based on data of the Instituto Gallego de Estadística.

We calculated the students sample size separately for each school year assuming a simple random survey. We assumed a mean size of 22 000 students per school year and estimated the size for a 95% level of confidence with a design effect of 1.5. We increased the obtained sample sizes by 10% in PE and 15% in ESO to compensate for potential refusals to participate in the study. We established final target sizes of 4500 PE students and 3200 ESO students. After contacting the selected schools, we requested the written informed consent of parents to include the students in the study.

Nine teams consisting of 2 previously trained members travelled to the schools during school hours to perform the measurements. Weight was measured to the nearest 0.1 g with the student in light clothing and without shoes with an EC type-approved Seca scale. Height was measured to the nearest 0.1 cm with the student standing barefoot

Table 1 Prevalence of underweight, normal weight, overweight, obesity and abdominal obesity overall and by age group and sex, with the corresponding 95% confidence interval. Galicia 2013–2014.

	Boys			Girls			Overall		
	%	95% CI		%	95% CI		%	95% CI	
Overall (6–15 years)									
Underweight	3.3	2.6	4.0	3.7	3.0	4.3	3.5	3.0	4.0
Normal weight	63.6	61.9	65.2	63.3	61.3	65.2	63.4	62.1	64.8
Overweight	24.0	22.5	25.5	25.8	24.2	27.5	24.9	23.7	26.1
Obesity	9.2	8.2	10.2	7.3	6.1	8.4	8.2	7.5	9.0
Abdominal obesity	26.4	24.6	28.2	25.3	23.3	27.2	25.8	24.4	27.3
6–11 years									
Underweight	3.5	2.6	4.4	3.1	2.4	3.9	3.3	2.7	3.9
Normal weight	61.9	59.9	63.9	61.5	59.2	63.9	61.7	60.0	63.4
Overweight	24.6	22.7	26.4	26.6	24.4	28.9	25.6	24.0	27.1
Obesity	10.1	8.8	11.4	8.7	7.1	10.3	9.4	8.4	10.5
Abdominal obesity	25.6	23.3	28.0	26.3	23.8	28.7	25.9	24.0	27.8
12–15 years									
Underweight	3.0	2.0	4.1	4.6	3.3	5.8	3.8	2.9	4.6
Normal weight	66.3	63.5	69.1	66.0	62.7	69.3	66.2	64.0	68.3
Overweight	23.1	20.5	25.6	24.6	22.0	27.1	23.8	22.0	25.6
Obesity	7.6	6.2	9.1	4.9	3.5	6.2	6.3	5.3	7.3
Abdominal obesity	27.6	25.0	30.3	23.7	20.4	26.9	25.7	23.6	27.8

CI, confidence interval.

with the head positioned in the Frankfurt plane with an EC type-approved portable Tanita stadiometer with a fixed base. Waist circumference was measured with an inelastic tape to the nearest 0.1 cm at a point equidistant between the lowest rib and the iliac crest, having the student stand with the feet together, a relaxed abdomen and the arms hanging at the sides. All the data were entered in portable electronic devices (tablets) keeping subjects anonymous. We conducted the fieldwork between October and November of 2013.

We calculated the BMI from the objective measures of weight and height and categorised it as underweight, normal weight, overweight or obesity applying the cut-off points for age and sex proposed by Cole and Lobstein.[8] We calculated the prevalence of abdominal obesity based on the cut-off points for age and sex proposed by Taylor et al.[9]

We present the obtained prevalences accompanied by the corresponding 95% confidence intervals, and the results of comparing proportions by means of the chi square test. We defined statistical significance as a *p*-value less than 0.05. When we performed the statistical analysis, for which we used Stata version 12, we weighed the data taking into account the sample design and the age and sex distribution of the Galician population aged 6–15 years according to the Municipal Inhabitant Census of year 2015. We present our estimates by sex, age in years and age group (6–11 years and 12–15 years).

Results

We obtained information from 7438 out of the 8140 children aged 6–15 years enrolled in the 137 selected schools. Of these students, 4434 were aged 6–11 years, 4548 were enrolled in PE and 2890 in ESO. The rate of participation in the study was 91.4%.

The prevalence of excess weight, defined as overweight or obesity, was 33.1% (31.7%–34.5%), and we found no significant differences between sexes ($P > .05$), although we found significant differences between age groups ($P < .05$). The prevalence of excess weight was 6% greater in students aged 6–11 years (Table 1). In girls, the prevalence of excess weight peaked at age 8 years (42.3%; 37.2%–47.4%) compared to 10 years in boys (39.7%; 34.7%–44.8%). The minimum prevalence of excess weight occurred at age 15 in girls (21.2%; 15.3%–27.0%) and age 6 in boys (24.8%; 20.3%–29.3%).

In all ages under study, the prevalence of overweight was greater than the prevalence of obesity. Overall, 24.9% of the students were overweight and 8.2% were obese (Table 1). The prevalence of overweight did not differ significantly between sexes ($P > .05$), but there were significant differences between age groups, with the highest prevalence found in the group aged 6–11 years (25.6% vs 23.8%; $P < .05$). Overall, the prevalence of overweight peaked at age 10 years (31.5%; 27.5%–35.4%); with peaks at 12 years in boys (31.8%; 26.3%–37.3%) and 10 years in girls (32.5%; 27.4%–37.6%) (Fig. 1). The prevalence of obesity was greater in boys (9.2% vs 7.3%; $P < .05$) and in students aged 6–11 years (9.4% vs 6.3%; $P < .05$). By age, the prevalence of obesity peaked at age 9 years (11.2%; 8.8%–13.5%), in boys as well as girls (10.9% [7.6%–14.3%] and 11.4% [7.2%–15.5%], respectively) (Fig. 2). The prevalence of underweight, which was 3.5% overall, did not vary significantly between sexes ($P > .05$) or age groups ($P > .05$).

Based on the measurements of waist circumference, we estimated that 1 in 4 students had abdominal obesity, a prevalence that did not vary based on sex ($P > .05$) or age

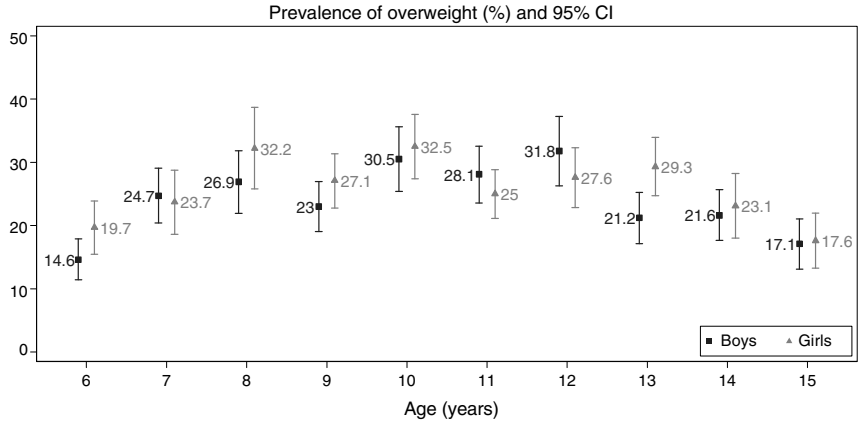

Figure 1 Prevalence of overweight by age and sex with the corresponding 95% confidence intervals (95% CI). Galicia 2013–2014. Cut-off points proposed by Cole and Lobstein.[8]

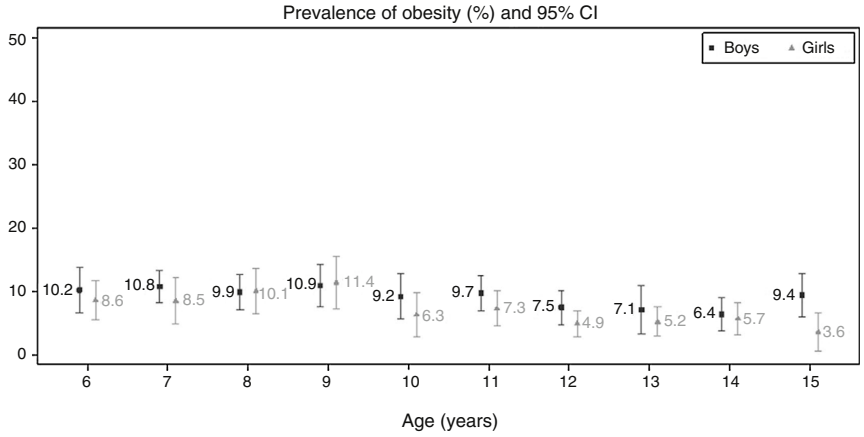

Figure 2 Prevalence of obesity by age and sex with the corresponding 95% confidence intervals (95% CI). Galicia 2013–2014. Cut-off points proposed by Cole and Lobstein.[8]

group ($P > .05$), although it was higher in boys compared to girls in the group of students aged 12–15 years (27.6% vs 23.7%; $P = .029$) (Table 1). By age, the overall prevalence of abdominal obesity peaked at 12 years (29.9%; 26.1%–33.8%), with peaks at 12 years in boys (33.0%; 28.1%–37.8%) and 8 years in girls (31.0%; 23.6%–38.4%) (Fig. 3).

Prevalence of excess weight or abdominal obesity was 35.9% (34.4%-37.4%) in Galician students, and 23.1% (21.8%–24.1%) had both features. Of the students with normal weight, 4.1% (3.3%–4.9%) had abdominal obesity.

Discussion

Approximately 25 out of 100 Galician schoolchildren aged 6–15 years had overweight, and 8 out of 100 obesity. The prevalence of excess weight in girls peaked nearly 2 years earlier compared to boys (10 vs 12 years), coinciding with the onset of puberty in both sexes, which is a key time point in the increase in body fat and therefore in disease development. We also ought to highlight that 4 out of every 100 schoolchildren with normal weight had abdominal obesity, and that 23% of schoolchildren had excess weight combined with abdominal obesity.

The prevalences of excess weight in Galicia calculated in this study were similar to those obtained for Spain overall applying the same reference criteria.[10,11] In a study conducted in 2012 in a sample of 978 children aged 8–17 years, Sanchez-Cruz et al. estimated the prevalence of overweight and obesity in Spain in the 8-to-13 years age group at 25.3% and 9.6%, respectively.[10] The prevalence of overweight found in our study for the same age group in Galicia based on data obtained from 4784 schoolchildren was 27.9% (26.3%–29.4%), and the prevalence of obesity was 8.4% (7.3%-9.4%). The ALADINO study,[12] conducted in 2011 in a sample of 7659 schoolchildren aged 6–9 years, concluded that the prevalence of excess weight had not varied significantly in the past 10 years,[13] and estimated that 24.2% (23.2%–25.2%) of schoolchildren aged 6–9 years had overweight and 11.0% (10.3%–11.7%) had obesity at that point. This study placed Galicia, along with the Balearic Islands and Extremadura, in the tercile comprising

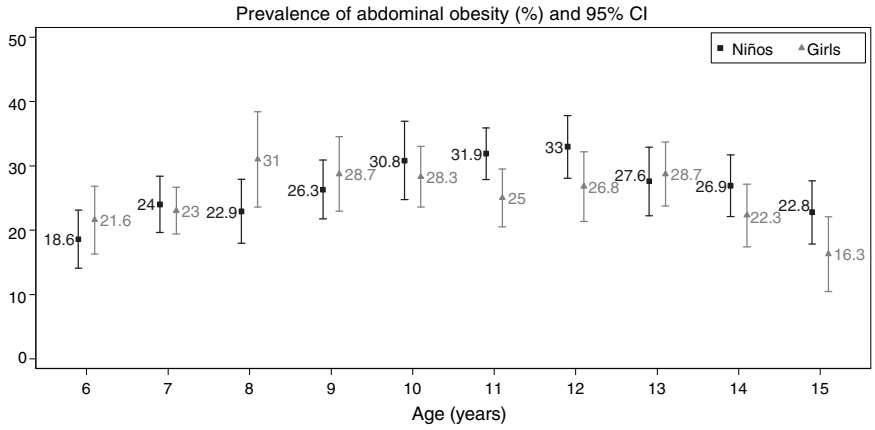

Figure 3 Prevalence of abdominal obesity by age and sex with the corresponding 95% confidence intervals (95% CI). Galicia 2013–2014. Cut-off points proposed by Taylor et al.[9]

the autonomous communities with the highest prevalences of excess weight. The results we present here do not support this information, as the estimates of prevalence we obtained in the Galician schoolchildren of the same ages included in our study ($n = 3050$) were 23.9% (22.1%–25.9%) for overweight and 10.0% (8.8%–11.2%) for obesity, both very similar to the overall prevalence for Spain found by the ALADINO study. These discrepancies may be due to variability in the prevalence of excess weight between the different provinces in Galicia, as the ALADINO study selected a single province for each autonomous community in Spain that had more than one province to conduct the study. Although we did not find statistically significant or relevant differences in the prevalence of excess weight in the different provinces of Galicia, we found the lowest prevalence of excess weight in Lugo (31.9%; 28.8%–35.0%) and the highest in Pontevedra (34.0%; 32.0%–36.1%). Another possible explanation of this discrepancy could be that the ALADINO study, whose design ensured that the sample was representative for Spain overall, may not have had sufficient power to estimate prevalences at the autonomous community level.

The prevalence of overweight and obesity in schoolchildren in Galicia also did not differ from those estimated for other autonomous communities within a similar time frame and applying the same reference criteria. Thus, the prevalences of overweight and obesity estimated in schoolchildren aged 9–10 years in Asturias for the 2011–2012 period[14] were 28.2% and 15.8%, respectively, while the ones we found in Galicia were 28.2% (25.6%–30.7%) and 9.5% (7.6%–11.4%). When we compared the estimates of overweight and obesity we obtained for Galicia in the 2013–2014 academic year with those reported by other studies that applied the same reference criteria conducted a decade before in other autonomous communities, such as the one in the Community of Madrid in schoolchildren aged 6–12 years in 1999–2000[15] or the one conduced in the Canary Islands in schoolchildren aged 12–15 years in 2004–2005,[11] we found relevant differences in the central estimates of the prevalence of obesity in schoolchildren aged 6–12 years (Madrid, 6% in boys and 5.9% in girls versus Galicia, 9.8% [8.6%–10.9] in boys and 8.2% [6.8%–9.6%] in girls) and the prevalence of overweight at ages 12–15 years (Canary Islands, 21% in boys and 22.2% in girls versus Galicia, 25.1% [22.2%–28.0%] in boys and 26.7% [23.8%–29.6%] in girls).

Another important aspect we wanted to consider in this study was how the prevalence of excess weight had evolved in Galicia. Few resources are available to do this. Thus, to date, that we know of, only 3 studies have been performed in the school-aged population outside the health care context based on objective measures and applying the same reference standards, and one of them was restricted to the province of Pontevedra.[6] The most recent estimates of excess weight for Galicia came from a study conducted between 2007 and 2008 in 2305 students aged 10–12 years.[5] This study calculated a prevalence of overweight of 29.9%, higher in boys (31.0% vs 28.8%), and a prevalence of obesity of 8.9%, also higher in boys (9.2% vs 8.6%). If we compare these results with the prevalences obtained for Galicia in our study, there seem to have barely changed, as in the 2013–2014 school year, in the 2595 students in the same age group, the prevalence of overweight was 29.3% (27.1%–31.4%) and the prevalence of obesity was 7.5% (6.2%–8.8%), which was consistent with the rest of Spain.[16,17] The only salient difference was the 2% decline in the prevalence of obesity in girls aged 10–12 years, which is now estimated at 6.1% (4.5%–7.8%), compared to 8.6% in the previous study.

Epidemiological studies rarely estimate the prevalence of abdominal or central obesity, especially in the paediatric population, despite the evidence from various studies suggesting that children or adolescents with excess abdominal fat are more likely to have an atherogenic lipid profile, a higher blood pressure, a higher carotid intima-media thickness and even metabolic syndrome.[18,19] The waist circumference, which we used to estimate the prevalence of abdominal obesity, seems to be a good indicator of abdominal fat and has the additional advantage that it is not affected by height or muscle mass.[20] In Spain, the prevalence of abdominal obesity in children aged 6–11 years between 1998 and 2000 was estimated at 26.8%,[21] a value that was similar to the one obtained in Galicia in our study in the same age group (25.9%) and applying the same cut-off points. In Galicia, the prevalence of abdominal obesity is similar in boys and girls, although in adolescence (12–15 years), as observed in previous studies,[21] it is higher in boys,

which is an early manifestation of sexual dimorphism. The prevalence of abdominal obesity complements the information contributed by the BMI. Thus, 4% of the students classified as not having excess weight based on the BMI had abdominal obesity, which suggests that the BMI underestimates the impact of this risk factor on the population.

There are several limitations in this study. We obtained the results presented here in a cross-sectional study where each student was measured only once, and we have no follow-up data on the longitudinal changes in weight and height. Therefore, our results are point estimates of different parameters in different age groups, which does not allow an accurate assessment of the evolution of these parameters based on age. Another limitation is the potential for selection bias due to differential participation, as students deviating from the average in weight or height might have been less likely to participate. The participation rate in this study was 91.4%, and a specially designed analysis allowed us to verify that the impact of non-participants in the estimates of prevalence was very low,[22] as the changes found in the prevalences of overweight and obesity when we included information reported by teachers on the weight status of the students that did not participate were not significant. Due to its cross-sectional design, this study did not allow us to identify the variables causally related to excess weight, but it allowed us to describe the correlations between them.

Although this was not an aspect under consideration in our study, we ought to note that there is no consensus in epidemiological research when it comes to the classification of children based on the BMI. In consequence, the prevalences reported in specific populations may vary significantly depending on the cut-off points applied. The main reason for using the criteria proposed by Cole and Lobstein in this study is that it is an international reference that is not based on percentiles but rather on calculating the cut-off points for overweight and obesity by age and sex that would correspond to the cut-off points in adulthood (25 and 30, respectively).

There are several strengths to the study. The large sample size is one of them, as it was calculated to guarantee highly accurate estimations by school year and therefore by age. The age distribution of the final sample met expectations, with a mean sample size of 744 students per age, a minimum of 592 at age 8 years and a maximum of 909 at age 6 years. This guarantees that the results are representative for each age and sex. The estimates we calculated were based on objective measurements obtained by previously trained interviewers, which guarantees the quality of the data and reduces variability between teams. We chose schools as the sampling frame, as it guaranteed access to the universe of children aged 6–15 years, as schooling is compulsory in this age range. Furthermore, characterising the sample based on both the BMI and abdominal obesity corrects, if only partially, the drawbacks associated with the use of the BMI.

Conclusions

The prevalence of excess weight and abdominal obesity in the population aged 6–15 years in Galicia is of 36%, which makes this risk factor a significant public health problem. If we did not take into account abdominal obesity, we would be underestimating the level of risk and even the morbidity in Galician schoolchildren. These results are a good starting point for the periodic monitoring, at 5-year intervals at most, of the prevalence of excess weight and abdominal obesity in schoolchildren in Galicia.

Conflicts of interest

The authors have no conflicts of interest to declare.

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