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Prevalence of obesity among Portuguese children (6–8 years old) using three definition criteria: COSI Portugal, 2008

A. Rito[1], T. M. A. Wijnhoven[2], H. Rutter[3], M. A. Carvalho[4], E. Paixão[1], C. Ramos[4], D. Claudio[5], R. Espanca[6], T. Sancho[7], Z. Cerqueira[8], R. Carvalho[9], C. Faria[10], E. Feliciano[11] and J. Breda[2]

[1]National Institute of Health Dr Ricardo Jorge, Lisbon, Portugal; [2]Division of Noncommunicable Diseases and Health Promotion, World Health Organization Regional Office for Europe, Copenhagen, Denmark; [3]National Obesity Observatory, Oxford, England; [4]University Atlântica, Oeiras, Portugal; [5]Regional Health Directorate of North, Porto, Portugal; [6]Regional Health Directorate of Alentejo, Evora, Portugal; [7]Regional Health Directorate of Algarve, Faro, Portugal; [8]Regional Health Directorate of Centre, Coimbra, Portugal; [9]Regional Health Directorate of Azores, Ponta Delgada, Portugal; [10]Regional Health Directorate of Madeira, Funchal, Portugal; [11]Regional Health Directorate of Lisbon and Tagus Valley, Lisboa, Portugal

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What is already known about this subject?

- Obesity is at epidemic levels and presents a serious global public health challenge.
- Portugal is one of the European countries with the highest prevalence of childhood obesity.
- Childhood Obesity Surveillance Initiative (COSI) is a robust monitoring system covering similar age groups, using standardized methods that allows comparability with other WHO European Region Member States.

What this study adds?

- In Portugal, one in every three of 6- to 8-year-old children are overweight.
- Compared with other COSI national surveys, a similar trend was observed in other southern European countries, particularly Italy.
- The reference method used to define overweight and obesity is important as it provides different estimates.

Summary

Introduction: Previous studies place Portugal among the five countries with the highest prevalence of childhood obesity in Europe. This paper describes the prevalence of thinness, overweight and obesity in Portuguese children of 6–8 years of age, based on the first data collection from Childhood Obesity Surveillance Initiative Portugal, which took place during the 2007/2008 school year.

Methods: This study uses a semi-longitudinal design with repeated cross-sectional national representative samples. Specific prevalence of overweight (including obesity) and obesity was determined using three different diagnostic criteria. Across the seven geographic regions, 3765 children were enrolled from 181 schools; 50.3% of participants were males.

Results: Using the International Obesity Task Force reference, the prevalence of thinness, overweight and obesity were 4.8%, 28.1% and 8.9%, respectively; using the Center for Disease Control and Prevention reference they were 2.1%, 32.2% and 14.6%, respectively; and according to the World Health Organization reference, they were 1.0%, 37.9% and 15.3%, respectively. Univariate analysis showed a higher risk of obesity in older children, in boys and in the Azores region. The islands of Madeira and the Azores were the regions with the highest prevalence of overweight at 39.4% and 46.6%, respectively, and Algarve was the one with the lowest (21.4%).

Conclusion: These findings demonstrate the need for urgent action in Portugal and provide policy-makers with comprehensive and detailed information to assist with this.

Keywords: Children, obesity, COSI, Portugal.

Address for correspondence: Professor A Rito, National Institute of Health – Dr Ricardo Jorge I.P, Av. Padre Cruz, 1649-016 Lisboa, Portugal. E-mail: ana.rito@insa.min-saude.pt

Introduction

In the last 30 years, Portugal has undergone great socioeconomic improvements, raising living standards to a level comparable with the most developed European countries. This has been associated with major nutritional transition, alongside other lifestyle changes. Although there have been many benefits, this has also resulted in increases in mortality and morbidity related to non-communicable diseases, including obesity (1).

Obesity is at epidemic levels and presents a serious global public health challenge. The prevalence of obesity has risen rapidly, especially in children and adolescents, in recent years (2,3). Over the past decade, based on sub-nationally representative studies, Portugal has been found to have the highest prevalence of childhood overweight and obesity prevalence in the World Health Organization (WHO) European Region (3–5). The prevalence of overweight among primary school children across Europe varies from 15.2% (Slovakia 15.2% and France 18.1%) to over 30% (Spain 35.2% and Portugal 31.5%) (3).

A comprehensive and detailed assessment of the magnitude of the problem of obesity is an essential component of an effective response. While data were available from a small number of sub-national studies, it was not possible to compare data from these sources as they were based on different sample sizes, different methodological approaches, different response rates across age groups and different definitions of overweight and obesity (3,6). Therefore, a robust monitoring system covering similar age groups, and using standardized methods of surveillance and research, was needed.

In 2007, the WHO Regional Office for Europe established the Childhood Obesity Surveillance Initiative (COSI). Following this trend, Portugal then implemented a National Nutritional Surveillance System based on the COSI approach (7). This resulted in a system that assessed the same age groups as other European countries participating in the WHO COSI. Standardized data collection methods were used to provide an ongoing, systematic process of collection, analysis, interpretation and dissemination of descriptive information on the nutritional status of primary school children. The data are collected at regular intervals for use in programme planning and evaluation, and to measure trends in overweight and obesity in children.

This paper describes the prevalence of thinness, overweight and obesity in Portuguese children of 6–8 years of age, based on the first data collection from COSI Portugal, which took place during the 2007/2008 school year.

Methodology

The Portuguese National Nutritional Surveillance System (COSI Portugal) follows the WHO COSI protocol, which was jointly developed by the WHO Regional Office for Europe and the participating member states (7). It has a semi-longitudinal design with repeated cross-sectional samples targeting 6- to 8-year-old children. This age range was chosen because of its use for predicting the condition in adulthood, and it precedes the confounding effects of puberty. At the age of around 6 years, a process known as adiposity rebound begins, during which there is a period of rapid increase in body fat (8). The data were collected by the Regional Health Authorities in all seven Portuguese regions: North, Centre, Lisbon and Tagus Valley, Alentejo, Algarve, Azores and Madeira. Ethical approval was granted by the National Committee of Data Protection.

Sample

A full list of all Portuguese private and public primary schools ($n = 6810$) was provided by the Ministry of Education. A simple random two-stage cluster sampling was applied and a nationally representative sample (with no stratification) was drawn, with schools as the first unit of sampling. One hundred and eighty-nine schools were selected, giving a total of 378 classes included in the sample. Only 4.2% ($n = 8$) of the selected schools declined participation. Data from first and second graders (6.0–8.9 years old) were collected.

Data collection

Planning meetings were organized and attended by the appointed seven regional coordinators. Each selected school received official information about the COSI Portugal study from the Ministry of Health and the Ministry of Education, and was asked to enrol. In each selected school, a COSI school supervisor was appointed who had the responsibility to provide information about the COSI Portugal programme at the usual parents' meetings. The parents of the selected children received a letter with detailed information about the study, requesting their written informed consent.

Three-day training sessions were held in three different regions to train 74 examiners (nurses, physicians and nutritionists) in data collection. All three training sessions were delivered by the same trainer.

Trainees were informed about the background and objectives of the surveillance system and trained in administering the standardized questionnaire to the children, calibrating the anthropometric instruments, and the procedures to measure children's weight and height according to the standardized WHO measurement techniques (9).

In all regions, weight was measured once to the nearest 0.1 kg with an electronic scale (Seca® 840) and height was measured twice to the nearest 0.1 cm with a stadiometer (Seca® 214, Seca Deutchland, Hamburg, Gemany). This was done to reduce intra-observer bias, and the mean value of the two height measurements was used to calculate body mass index (BMI). Visits to the schools were scheduled by the regional coordinator and the school supervisor. Data collection took place during the months of May and June 2008, a period when the children were likely to wear light clothing, which would minimize the impact of this on their measured weights. The majority of the children (98.8%) were measured in underwear. In cases where this was not possible, children were asked to remove their shoes, as well as any heavy objects (such as wallet, mobile phone and key chain). A checklist was used to describe the type of clothing that the child was wearing. A separate and quiet room was provided in each school where the measurements were carried out. Most measurements were conducted during the morning (76.6%). The child's consent was obtained before the measurements took place. BMI was calculated using the formula weight (kg)/[height (m)] (2), where height was the mean of the two height measurements performed in every child.

The children's questionnaire included questions on the child's date of birth, gender, geography of residence, school grade, clothes worn, school name and address. The questionnaires were completed by the examiners.

Definition of thinness, overweight and obesity

Three age- and sex-specific BMI-for-age references were used to describe the nutritional status of the children:

1. **Growth reference recommended by the International Obesity Task Force (IOTF)** (10) **and Cole *et al*.** (11) – thinness (referred to underweight by CDC), overweight and obesity are defined as BMI-for-age cut-off points that correspond to BMI of <18.5, ≥25 and ≥30 kg m^{-2} at the age of 18 years, respectively.
2. **2000 Centers for Disease Control and Prevention (CDC) Growth Reference** (12) – defines underweight, overweight and obesity as BMI-for-age <5th; ≥85th and <95th; ≥95th percentile, respectively. This growth reference was adopted by the Portuguese Ministry of Health.
3. **2007 WHO Growth Reference** (13) – thinness, overweight and obesity are defined as a BMI-for-age <–2 standarddeviation (SD), >+1 SD (equivalent to a BMI of 25 kg m^{-2} at 19 years) and >+2 SD (equivalent to a BMI of 30 kg m^{-2} at 19 years), respectively. The WHO Reference 2007 is a reconstruction of the 1977 National Center for Health Statistics (NCHS)/WHO reference. It uses NCHS dataset supplemented with data from the WHO child growth standard sample for children under 5.

Definition of urban, semi-urban and rural areas

The Portuguese National Institute of Statistics (14) criteria for administrative and geographical classification were used to ascribe participating schools to an urban/rural category. The following definitions were applied:

'Urban': an area with more than 5000 inhabitants characterized by a population density higher than 500 inhabitants km^{-2}.

'Semi-urban': an area with more than 2000 and less than 5000 inhabitants characterized by a population density higher than 100 inhabitants km^{-2}.

'Rural': an area with less than 2000 inhabitants characterized by a population density lower than 100 inhabitants km^{-2}.

Data management

Optical character recognition (OCR) software (Teleform™, Autonomy, Cambridge, UK) was used for the data entry system, which included built-in range (e.g. outliers, out-of-range values) and consistency checks for validation. In addition to the examiner carefully filling out the questionnaires, the regional coordinator double checked the data to provide quality assurance. After the data were cleaned and validated, they were exported to a database for statistical analysis using SPSS (version 18; SPSS Inc., IBM, New York, USA).

Eligibility for inclusion in the final dataset included informed consent from the parents and the child, and valid data for the child's date of birth, date of measurement, and weight and height measurements. A small proportion (1.2%) of children wore heavy clothes (coat, sweater and jacket), in which case their recorded weight was reduced by –0.6 kg to correct for this (done by weighing a sample and find that this was the average weight of clothes).

Descriptive analyses (mean values, standard deviations and percentages) of child characteristics and 95% confidence intervals were calculated.

Differences between groups (gender, geographic region, nutritional status and level of urbanization) were tested using Fisher's exact test, and chi-square test for categorical variables. The mean value between two independent samples was calculated using independent sample *t*-test after testing for normality. Variables were tested by gender and age for normality using normal quantile-quantile plots. Weight and BMI were found to be highly positively skewed. The non-parametric alternative was the Mann–Whitney test. ANOVA was used to compare the mean values between more than two independent samples after testing for normality and homogeneity. The non-parametric alternative test was the Kruskal–Wallis test. Post hoc comparison (Tukey's method and Dunnett's T3) was used when detected differences were statistically significant.

Risk of being overweight is presented with odds ratios (OR) and 95% confidence interval (95% CI). A *P*-value <0.05 level was considered statistically significant.

Results

The study enrolled 4648 children from 181 schools. Of those, 299 children did not provide written parental consent and 477 children were not present on the scheduled school visit by the study team. Of the 3872 children present on the day of the measurements, 13 did not consent to the taking of anthropometric measurements and 94 did not meet the inclusion criteria for the analysis. Therefore, data on 3765 (81.0%) children between 6 and 8 years old were included in the final analysis. Madeira and North regions had the highest participation level (87.6% and 85.7%, respectively), whereas Lisbon and Tagus Valley were the regions with the lowest level of participation (75.3%). The final dataset included 1894 boys (50.3%) and 1871 girls (49.7%), with a mean age (±SD) of 7.0 years (±0.7).

Anthropometric characteristics (height, weight and BMI) are presented in Table 1, by gender and age. Mean height was significantly higher in boys than in girls in all age groups and in all regions ($P < 0.05$). At the age of 8, Azorean children showed higher mean height and weight values than children in other regions ($P < 0.05$), with girls weighing, on average, more than boys at all age groups. The highest mean BMI was found in the Azorean girls (18.3 kg m^{-2}) and the lowest in boys and girls from the Algarve region (16.2 kg m^{-2}) ($P < 0.05$).

Figure 1 shows the prevalence of thinness, overweight and obesity using the three used BMI-for-age references.

Using the WHO criteria to characterize the nutritional status of Portuguese children by region (Table 2), the study showed that prevalence of thinness was highest in the region of Alentejo (2.9%). Algarve was the region that showed the lowest prevalence of childhood obesity (9.7%) and overweight (21.4%), and Azores with the highest prevalence of obesity (22.7%) and overweight (46.6%). The differences between geographical regions were statistically significant ($P < 0.05$).

The prevalence of thinness, overweight and obesity categorized by gender, using IOTF, CDC and WHO criteria, is summarized in Table 3. There was a higher prevalence of thin girls than boys ($P < 0.05$) when using the IOTF criteria, but the opposite was found using the other two criteria. Regardless of the growth reference used, the prevalence of overweight was significantly higher in boys than girls in 7- and 8-year-old children ($P < 0.05$).

The Azores region was classified as semi-urban (95% CI: 51.9–59.2) and Alentejo (95% CI: 50.5–59.4) was the only rural region in Portugal. The rest of the five Portuguese regions were classified as typically urban. Based on the WHO criteria, there were no significant differences in the prevalence of overweight and obesity across the categories of urbanization: urban (39.0% and 15.4%), semi-urban (34.5% and 14.6%) and rural (37.0% and 15.7%), respectively.

The univariate analysis (Table 4) showed that geographic region was the only factor that was significantly associated with being overweight ($P < 0.05$).

Discussion

The National Nutritional Surveillance System – COSI Portugal provides data on the prevalence of overweight and obesity among primary school children in Portugal. This study, which followed the standardized COSI protocol from WHO Regional Office for Europe, had a high level of participation by children (81.0%).

In this first round of COSI Portugal, 2007/2008 (15), the results of the comparative analysis show that the absolute prevalence of overweight and obesity varies according to the reference used.

Data showed that 32.2% of children between 6 and 8 years old were overweight, 14.6% obese and 2.1% thin, according to the 2000 CDC criteria, which is the growth reference recommended by the Portuguese Ministry of Health. Using the WHO growth

Table 1 Portuguese children's height, weight and BMI by gender and age

	Gender	Age (years)	*n*	Mean	SD	*P*-value*	*P*-value†
Height (cm)	Boys	6	450	122.6	6.1	0.001‡	<0.001¶
		7	980	126.0	6.0		
		8	462	129.6	5.9		
		Total	1892	126.1	6.5		
	Girls	6	450	122.3	6.4		<0.001**
		7	967	125.3	6.2		
		8	454	128.5	6.1		
		Total	1871	125.3	6.6		
Weight (kg)	Boys	6	450	25.5	5.5	0.061§	<0.001¶
		7	980	27.6	5.9		
		8	462	29.7	6.3		
		Total	1892	27.6	6.1		
	Girls	6	450	26.0	5.9		<0.001¶
		7	967	27.1	6.1		
		8	454	29.1	6.4		
		Total	1871	27.3	6.2		
BMI (kg m^{-2})	Boys	6	450	16.8	2.5	0.961§	<0.001¶
		7	980	17.3	2.7		
		8	462	17.6	2.8		
		Total	1892	17.2	2.7		
	Girls	6	450	17.2	2.7		0.040¶
		7	967	17.1	2.7		
		8	454	17.5	2.8		
		Total	1871	17.2	2.8		

*Differences between boys and girls.
†Differences between age in boys and girls.
‡Independent *t*-test.
§Mann–Whitney test.
¶Kruskal–Wallis test.
**One-way ANOVA.
BMI, body mass index; SD, standard deviation.

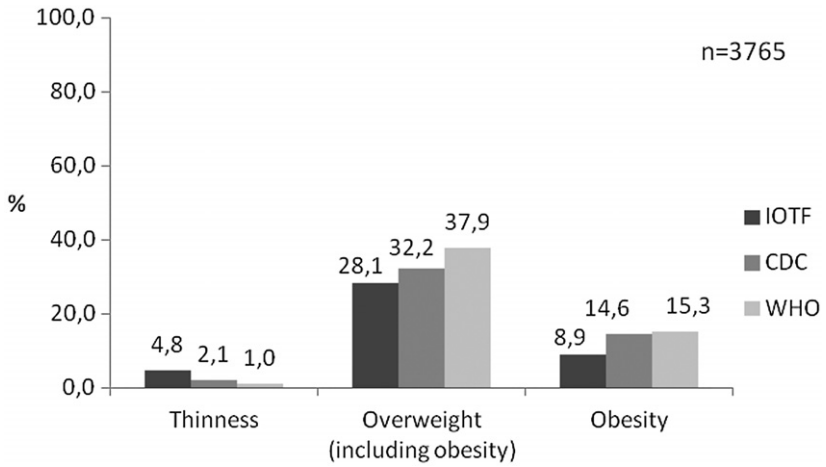

Figure 1 Portuguese children's nutritional status defined by International Obesity Task Force, Center for Disease Control and Prevention, and World Health Organization criteria.

Table 2 Portuguese children's nutritional status by geographical region using IOTF, CDC and WHO criteria

Geographic region	IOTF						CDC						WHO					
	Thinness		Overweight (including obesity)		Obesity		Thinness		Overweight (including obesity)		Obesity		Thinness		Overweight (including obesity)		Obesity	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
North	4.3	1.4–7.3	28.2	25.5–30.9	7.8	5.0–10.7	1.9	0–4.9	33.0	30.4–35.7	13.7	10.8–16.6	1.1	0–4.3	38.6	36.1–41.2	14.4	11.5–17.3
Centre	5.0	1.8–8.2	27.8	25.1–30.5	9.0	6.0–12.1	2.1	0–5.2	31.9	29.3–34.6	14.9	12.0–18.0	0.7	0–3.5	38.1	35.6–40.6	16.0	13.0–19.0
Lisbon and Tagus Valley	3.8	1.0–6.6	28.2	25.4–30.9	10.7	7.4–14.0	1.7	0–4.6	32.0	29.4–34.7	15.6	12.6–18.7	1.0	0–4.3	38.3	35.8–40.8	16.0	13.0–19.0
Alentejo	7.2	3.4–11.0	25.9	23.3–28.5	8.6	5.6–11.6	5.0	0.2–9.8	27.3	24.8–29.8	12.9	10.1–15.8	2.9	0–8.3	31.6	29.2–34.1	13.0	10.2–15.7
Algarve	14.6	9.4–19.7	15.6	13.4–17.7	4.9	2.6–7.2	5.8	0.7–11.0	19.4	17.2–21.6	8.7	6.4–11.1	0	NA	21.4	19.2–23.5	9.7	7.3–12.1
Azores	4.6	1.5–7.6	36.3	33.5–39.3	10.2	7.0–13.5	2.3	0–5.5	42.0	39.3–44.8	22.7	19.2–26.2	1.1	0–4.6	46.6	44.0–49.2	22.7	19.3–26.2
Madeira	4.1	1.2–7.0	32.9	30.1–35.8	10.0	6.8–13.2	1.8	0–4.6	35.3	32.6–38.0	15.9	12.8–18.9	0.6	0–3.1	39.4	36.9–41.9	16.5	13.4–19.5
Total	4.8	1.6–7.9	28.1	25.4–30.8	8.9	5.9–12.0	2.1	0–5.3	32.2	29.6–34.9	14.6	11.7–17.6	1.0	0–4.2	37.9	35.4–40.4	15.3	12.3–18.2

95% CI, 95% confidence interval; CDC, Center for Diseases Control and Prevention; IOTF, International Obesity Task Force; WHO, World Health Organization.

Table 3 Portuguese children's nutritional status by gender using IOTF, CDC and WHO criteria

Gender	IOTF						*P*-value*	CDC						*P*-value*	WHO						*P*-value*
	Thinness		Overweight (including obesity)		Obesity			Thinness		Overweight (including obesity)		Obesity			Thinness		Overweight (including obesity)		Obesity		
	%	95% CI	%	95% CI	%	95% CI		%	95% CI	%	95% CI	%	95% CI		%	95% CI	%	95% CI	%	95% CI	
Boys	3.9	1.1–6.6	30.0	27.2–32.8	9.7	6.6–12.9	0.005	2.3	0–5.6	34.1	31.4–36.7	15.6	12.6–18.7	0.065	1.2	0–4.5	39.2	36.7–41.7	16.8	13.7–19.8	0.037
Girls	5.7	2.4–9.1	26.1	23.5–28.7	8.1	5.2–11.0		1.9	0–4.9	30.4	27.7–32.8	13.6	10.7–16.4		0.8	0–3.7	36.6	34.1–39.1	13.7	10.9–16.5	
Total	4.8	1.6–7.9	28.1	25.4–30.8	8.9	5.9–12.0		2.1	0–5.3	32.2	29.5–34.8	14.6	11.7–17.6		1.0	0–4.2	37.9	35.4–40.4	15.3	12.3–18.2	

*Differences between boys and girls (chi-square test).
95% CI, 95% confidence interval; CDC, Center for Diseases Control and Prevention; IOTF, International Obesity Task Force; WHO, World Health Organization.

Table 4 Odds ratio of Portuguese overweight based on WHO criteria by age, gender, geographic region and level of urbanization of the parishes of participating schools

	n	Overweight prevalence (%)	*P*-value*	Unadjusted odds ratio (95% CI)	*P*-value†
	3765				
Age (years)			0.802‡		0.802
6	900	37.0		Reference group	–
7	1949	38.1		1.05 (0.89–1.23)	0.584
8	916	38.4		1.06 (0.88–1.29)	0.530
Gender			0.093§		0.091
Boys	1894	39.2		1.12 (0.98–1.28)	
Girls	1871	36.6		Reference group	–
Geographical region			0.007‡		0.009
Algarve	103	21.4		Reference group	–
North	1431	38.6		2.32 (1.43–3.76)	*0.001*
Centre	964	38.1		2.26 (1.39–3.69)	*0.001*
LVT	870	38.3		2.28 (1.4–3.73)	*0.001*
Alentejo	139	31.7		1.71 (0.94–3.08)	0.077
Azores	88	46.6		3.21 (1.71–6.03)	<0.001
Madeira	170	39.4		2.39 (1.36–4.2)	*0.002*
Level of urbanization			0.085‡		0.085
Urban	2569	39.0		1.21 (1.02–1.44)	*0.030*
Semi-urban	718	34.5		Reference group	–
Rural	478	37.0		1.11 (0.88–1.42)	0.378

*Differences between age, gender, geographical region, and level of urbanization and overweight.
†*P*-value of odds ratio.
‡Chi-square test.
§Fisher's exact test.
95% CI, 95% confidence interval; LVT, Lisbon and Tagus Valley; WHO, World Health Organization.

reference, the prevalence of obesity (15.3%) was nearly twice as high as that using the IOTF criteria (8.9%). The opposite was found for the prevalence of thinness: using the IOTF reference (4.8%), it was four times less than when calculated using the WHO reference (Fig. 1).

Although this variation might be disconcerting for programme planners and the general public, the option to present data using different criteria to evaluate children's nutritional status creates the potential to compare and interpret data from different countries. As discussed elsewhere (6,16), different criteria will present different estimates of childhood overweight and obesity, but until a single international reference is adopted, the discussion, using more than one criterion, will provide the opportunity to compare between studies.

This was the first time that the prevalence of overweight and obesity among children from the seven geographical regions of Portugal was obtained in a nationally representative sample. It provides information for policy-makers, especially for Regional Health Authorities where appropriate action can be taken. Geographical differences were found, showing higher levels of prevalence of overweight and obesity among the islands: Azores and Madeira showed overweight prevalence rates twice as high (36.3% and 32.9%, respectively) as in the southern Algarve (15.6%), using the IOTF criteria (Table 2). Some of the highest levels of obesity in the world are found in island populations (17–21). This has been ascribed to a range of factors, including low levels of physical activity and a decrease in the consumption of the traditional foods of the islands, such as fresh fish, meat, and local fruits and vegetables, which have been replaced with a high-energy-dense diet (17,22). Data from 6- to 10-year-old children from the nine islands of the archipelago of Azores (23) showed similar results to the present study, as the prevalence of overweight in girls was 36.0% and in boys was 29.9% (IOTF criteria), which was associated with low levels of physical activity, particularly in girls. In Madeira island, Gouveia *et al*. (24) reported children's overweight prevalence of 17.8% and 23.4% in boys and 15.0% and 11.4% in girls of 7 and 8 years, respectively, using the IOTF criteria, i.e. showing

lower levels than the COSI study in Portugal. However, more recent data from the Madeira growth study (25) revealed that the prevalence of overweight had increased during a 7.2-year follow-up, varying from 8.2–20.0% at baseline to 20.4–40.0% in boys, and the corresponding percentages for girls were 10.6–12.0% and 13.2–18.0%. As well as reported in the Azores study (23), boys were more physically active than girls, and more active children were less likely to be overweight and obese.

Compared with other COSI national surveys, a similar trend is observed in other southern European countries. Using the IOTF criteria, the Italian study (26) revealed that 35.9% of 8-to 9-year-old children were overweight (including obesity), showing a higher prevalence compared with the Portuguese children (28.1%). The same was found for obesity prevalence as in Italy: 12.3 % of the 8- to 9-year-old children were obese and Portugal showed 8.4% of children with obesity. In both countries, boys had a higher prevalence of obesity than girls, i.e. in Italy, 13.3% of boys and 11.4% girls were obese and, in Portugal for the same age group (8 years), 10.4% of boys and 6.4% of girls were obese, according to the IOTF criteria. These changes in the prevalence of obesity among children aged 6–10 years, where males have become more obese than females, concurs with the projections of the Foresight report (27). The Italian survey showed southern children to have a higher prevalence of obesity (16.6%) than in the northern region (7.5%), which is the opposite of what was found in Portugal where the southern region (Algarve) presented the lowest prevalence of obesity (4.9%), whereas the North Region showed 7.8% (Table 2), using the IOTF criteria.

Data presented by Farrugia Sant'Angelo and Grech (22), from 2008, also showed similar results to Portugal, where boys presented higher prevalence than girls. The prevalence of overweight (including obesity), using the WHO criteria, in 7-year-old Maltese children was 34.5% for boys and 29.8% for girls compared with 39.2% and 36.6% for Portuguese boys and girls, respectively (Table 3).

In contrast, when one compares the Portuguese COSI data, where 30.0% of boys and 26.1% of girls are overweight (IOTF criteria) (Table 3), with data from COSI studies in the Czech Republic (CZH) (28) and Sweden (29), children's prevalence of overweight was lower than that found in Portugal.

In the Czech Republic, Kunesová *et al*. (28) found that 15.8% of boys and 14.1% of girls (7 years old) were overweight (including obesity), using the IOTF criteria. Anthropometric characteristics also revealed that 7-year-old boys from the Czech Republic showed slightly lower mean values of height (125.3 cm), weight (25.5 kg) and BMI (16.2 kg m^{-2}) than those found in the present study for the same age (mean values of height: 126.0 cm; weight: 27.6 kg; BMI: 17.3 kg m^{-2}) and the same was shown for girls (mean values of height in the Czech Republic 124.0 cm; Portugal: 125.3 cm; mean values of weight in the Czech Republic 27.8 kg; Portugal: 27.1 kg and mean values of BMI in the Czech Republic 15.8 kg m^{-2}; Portugal: 17.1 kg).

Data from Sjoberg *et al*. (29) showed opposite trends by gender when compared with Portuguese children. Swedish girls of 7–9 years old demonstrate a higher prevalence of overweight (including obesity) (17.2%) than boys (16.1%) of the same age. In terms of the urban-rural gradient, Sweden showed a 1.61 increased risk of overweight in rural areas compared with urban areas. This was opposite to that found in the present study where children from urban areas had higher odds of being overweight (1.21) (Table 4). Nevertheless, the Swedish urban-rural gradient was attenuated when area education level was accounted for; therefore, further analysis of Portuguese educational level data would contribute to a better understanding of the level of urbanization, which was not considered here and presents a limitation. Another limitation of the COSI Portugal was linked with the sampling design. In 2008, the list of private and public primary schools provided by the Ministry of Education was not fully updated, namely regarding children's registration by class and grade. Moreover, although this study followed the WHO/COSI methodological protocol, a complex cluster design should have been done preferably. The relative high costs of equipment as well as staff time also constitute a threat to the sustainability of the project. On the other hand, this study is particularly strong as a result of its robust data resulting from the remarkable level of school engagement and participation rate of more than 95%, the controlled and standardized data collection, mainly achieved by the highly trained and specialized field workers, which provided high quality data, allowing intra- and inter-comparability between regions. The method based on installed local health authorities capacity and involvement also assures sustainability to the surveillance initiative.

In conclusion, the COSI study demonstrated that Portugal remains one of the countries with the highest magnitude of childhood obesity, with one in every three of 6- to 8-year-old children being overweight. It was also evident that the reference method used to define overweight and obesity is important as it provides different estimates. The new surveillance system in Portugal is a vital tool to monitor

childhood nutritional status, measure trends in overweight and obesity, and allow comparability with other WHO European Region Member States. As obesity became in recent years one of the most important child health problems in high-income as well as middle- and low-income countries where it increases in parallel, with persistent micronutrient deficiencies and other nutritional problems, inter-country comparisons and social determinants stratification is advisable for the present and other identical surveillance mechanisms. This type of surveillance system should be able to confirm if vulnerable groups are at elevated risks of overweight. This would provide governments and policy-makers with data in order to develop approaches that tackle the double burden of malnutrition using the lens of inequalities within the framework of inter-sectoral actions and a health in all policies approach. Monitoring mechanisms, like the one described in this article, provide policy-makers with comprehensive and detailed information to allow evidence-based decision-making triggering decisive action to prevent and tackle childhood obesity.

Conflict of Interest Statement

No conflict of interest was declared.

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