Original Research Article

Socio-Demographic and Behavioral Risk Factors Associated with the High Prevalence of Overweight and Obesity in Portuguese Children

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ABSTRACT: Objectives: Childhood obesity is a public health concern in Portugal. Socio-demographic and behavioral factors are highly associated with obesity but are not clearly understood. This article aims to update the prevalence of overweight and obesity in Portuguese children and to explore the influence and risks of socio-demographic factors and behavioral factors.

Methods: A cross-sectional study of Portuguese children aged 3–10 years from all 18 mainland districts took place between March 2009 and January 2010. The sample was composed by 17,136 children, 3–10 years of age (8,455 boys; 8,681 girls). Height, weight, and other anthropometric measurements were obtained by trained technicians. Body mass index (BMI) was calculated along with other anthropometric variables. Data analyses took place between April and September 2012. The overweight/obesity classification was established by age-and sex-specific BMI cut-off points as defined by the International obesity task force (IOTF). Parents completed questionnaires about socio-demographic and behavioral characteristics of the family.

Results: Almost 28% of the Portuguese children were overweight or obese (19.7% overweight; 8.2% obese). Prevalence was greater in girls than in boys. Logistic regression models found that the odds of childhood obesity were significantly affected by biological, socio-demographic, and behavioral factors.

Conclusions: The protective factors against childhood overweight/obesity in this sample of Portuguese children are: (i) being male; (ii) having been breastfeed; (iii) having been born from mothers who did not smoke during pregnancy; (iv) engaging in little sedentary behaviors (TV, PC, and playing electronic games); (iv) performing at least 1 h of moderate physical activity every day; and (v) having parents with higher educational levels who also have their BMI within the healthy ranges. Am. J. Hum. Biol. 00:000–000, 2013. © 2013 Wiley Periodicals, Inc.

Overweight and obesity (OW/OB) have significantly increased over the last 25 years and have been described as a public health epidemic (World Health Organization, 1998). OW/OB are terms used to describe an excess of adiposity (fatness) above the ideal for good health (Waters et al., 2011). Obesity increases the risk of a number of non-communicable diseases such as cardiovascular disease (CVD) (Mokdad et al., 2003), type II diabetes (Hirani et al., 2008), cancer (Calle et al., 2003), respiratory disease (Barranco et al., 2012), high cholesterol (Ko et al., 2001; Mokdad et al., 2003) and high blood pressure (Mokdad et al., 2003). Populations in developed and in many developing nations are increasingly becoming obese, particularly children. The seriousness of childhood obesity is increased by past evidence reporting that once obesity has been established at a younger age, it is difficult to be reversed later in life (Field et al., 2005; Luttikhuis et al., 2009; Singh et al., 2008; Waters et al., 2011). The problem is aggravated due to the increasingly onset of type II diabetes mellitus occurring in younger ages when compared to 25 years ago, and obesity is stated as a major determinant (Rosenbloom et al., 2000). Obese children are also likely to experience negative stereotyping such as perceptions of poor health, academic and social uselessness, poor hygiene, and idleness (Hill and Silver, 1995; Thiel et al., 2008). Obese children may also experience negative emotional and psychological states such as nervousness, sadness, and loneliness (Strauss, 2000). Finally, they are more likely to become victims of bullying and to engage in unhealthy behaviors such as smoking tobacco and/or cannabis (Farhat et al., 2010).

Overweight/obesity occurs when there is a consistent positive energy imbalance over a sustained period of time. A review by Lobstein et al. (2004) describes that a variety of factors such as behavioral (physical activity, diet, sedentary lifestyle), cultural, genetic, environmental, and economic have been associated in obesity's development. These factors are interchangeable and therefore complex. Like in most developed countries, childhood OW/OB is a public health concern in Portugal. Padez et al. (2005) investigated the prevalence and risk factors for obesity of

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7- to 9.5-year-old children in a national representative sample and found alarming rates. More specifically, the prevalence of overweight, obesity and combined overweight + obesity were respectively, 20.3, 11.3, and 31.6%. It was found that parental obesity and educational levels were the most significant risk factors of children's obesity. In the same study, it was concluded that maternal obesity had a stronger link to OW/OB compared to paternal obesity and suggested that this is unsurprising due to the cultural factor of Portuguese mothers being the parent who is usually responsible for important lifestyle factors such as buying, preparing, and serving food for the family. Also, a review by Moreira (2007) found that the reported prevalence of obesity would differ from one region of the country to another. These findings are consistent with results from other studies in different ethnicities (Dannemann et al., 2011; Patterson et al., 1997; Xi et al., 2009).

Sedentary behavior is defined as any waking behavior characterized by energy expenditure below 1.5 MET while sitting or reclining posture (Sedentary Behavior Research Network, 2012). Padez et al. (2005) reported that TV viewing was a risk factor OW/OB in children. One reason is the low level of energy that is expended while watching TV (Hancox et al., 2004). However, it has also been shown that engaging in TV viewing could lead to increased snacking on unhealthy foods while abstaining from healthy foods (i.e., fruit and vegetables) (Liang et al., 2009; Re-lopez et al., 2011). Another possible reason for the link between TV viewing and obesity is that children could be subjected to the advertising of unhealthy products that could potentially lead to obesity (Boyland et al., 2011; Halford et al., 2008). Sedentary behaviors of children are, however, more than just TV viewing. With the increase popularity of electronic games and personal computers and laptops these are behaviors that are important to explore. Carvalhal et al. (2007) investigated the association between physical activity, TV, video games and obesity in 3,365 Portuguese children. The study found similar results of TV viewing to that of Padez et al. (2005), indicating that the longer children watched TV the greater the risk of obesity. Both boys and girls were found not to use computers very often. However, boys played electronic games for longer periods than girls and there was a moderate relationship between electronic games and obesity levels.

Physical activity is defined as any bodily movement produced by skeletal muscles that result in energy expenditure (Caspersen et al., 1985). Low levels of physical activity have widely been documented as a major determinant of childhood OW/OB. Previous research including Portuguese studies have found evidence of an association between physical activity and obesity (Gonzalez-Suarez and Grimmer-Somers, 2011; Guerra et al., 2006; Hernandez et al., 1999; Pereira et al., 2010; Trost et al., 2001). However, other studies have found no association (Carvalhal et al., 2007; Martins et al., 2010; Padez et al., 2005). Past physical activity interventions have shown that although physical activity could possibly not reduce obesity levels, physical activity can maintain and delay the onset of obesity (Gonzalez-Saurez et al., 2009).The lack of clarity between the association of physical activity and obesity is because physical activity is a complex behavior; that has many different determinants and correlates that vary from gender, to age, to context and environment (Ferreira et al., 2007; Mota et al., 2002; Sallis et al., 2000; Van der horst et al., 2007).

This study builds upon the study published by Padez et al. (2005). It adds subjective measurements of activity and it covers a statistically representative sample of the Portuguese population stratified by sex, age, and districts. Therefore, the impact of socio-demographic factors (age, sex, parental factors, parental behaviors, birthweight, and maternal smoking during pregnancy), and behavioral factors (physical activity/active play, TV viewing, electronic games use, computer use) can be better contextualized.

This study has two short-term aims and one long-term aim.

The two short-term aims are:

a. To review and update the prevalence of OW/OB in Portuguese children nationally;
b. to explore the influence and risk that socio-demographic factors and behavioral factors have upon OW/OB in Portuguese children.

The long-term aim is:

a. to provide an accurate record of the basic health, nutritional status and living conditions of the Portuguese children and their children as of the beginning of 2010. The year of 2010 is of crucial importance because it marks the onset of the socio-economic and political crisis that has hit Portugal. According to PORDATA (The National Database of Portugal—http://www.pordata.pt/en/Home) most of the indicators on basic demography, health, living conditions, and unemployment rates have been declining steeply since 2010. These changes are expected to intensify and linger for the next decade. This fact makes this survey a reference that shows the biosocial status of the Portuguese population before the socio-political and economical changes start being reflected on the health of the people. Any survey conducted after this one should take this article in consideration and use the results presented here as the baseline results gathered at the beginning of a crisis that will have countless effects on the health and living conditions of the Portuguese people for decades to come. A personal observation by one of the co-authors shows the multiplication of "soup/kitchens" all over Portugal during 2012–2013. By mid-2013, several primary schools are starting to supply one hot/meal per day during the weekends.

METHODS

Participants and settings

The total number of children was 17,509. The children were from all mainland Portuguese districts but not from the Portuguese Archipelagos (Madeira and Azores). Data were collected between March 2009 and January 2010 in public and private Portuguese schools. The studied population was selected by means of proportionate stratified random sampling taking into account the district and the number of children by age and sex in each district. Participation rate was 57.4% (49.3% in preschool children and 63.6% in school children). Because of insufficient number of participations younger than 3 and older than 10 years, and for those missing data on body mass index (BMI), the final number of participations for data analyses was 17,136. The study protocol was approved by Direcção

Geral de Inovação e Desenvolvimento Curricular (DGIDC) and written informed consent was obtained from all the children's parents. Ethical approval was also granted for secondary data analyses by the Loughborough Universities Advisory Ethic Committee. Data analyses took place between May 2012 to September 2012

Measures

Trained technicians performed anthropometric measurements using standardized procedures (Lohman et al., 1988) within each of the schools. Height was measured using a stadiometer with the head positioned according to the Frankfort plane and weight was measured via an electronic scale with a precision of 100 g. BMI was calculated as weight/height^2 (kg m^{-2}). The definitions of OW/OB for children were based on average centiles in accordance to the IOTF's age-specific BMI cut-off points (Cole et al., 2000). For the adults (parents), overweight was defined as a BMIs of 25.0–29.9 kg m^{-2} (obesity as a BMI of 30 kg m^{-2} (obese) (World Health Organization, 1998).

Parents completed a mailed questionnaire about different characteristics of all members of the household including themselves. The questionnaire was designed and intended to collect information about factors that may have a potential influence on childhood OW/OB. Factors such as sex; birthweight; decimal age; breastfeeding (yes/no); district; parental occupation (professional and executives, management and technicians, administrative, service and sales, farmers, agricultural, skilled workers, unskilled workers); parental physical activity participation (yes/no); parental education [primary (4 years), 6, 9, 12 years, university (>12 years)]; parents self-reported height and weight; school conditions for physical activity classes (yes/no); mother smoked during pregnancy (yes/no); sport activity outside of school (yes/no); urbanization (urban, semi-urban, and rural); electronic games weekdays/weekends (none, <1, 1, 2, 3, 4, 5 h<); personal computer (PC) use weekdays/weekends (none, <1, 1, 2, 3, 4, 5 h<); television (TV) weekdays/weekends (none, <1, 1, 2, 3, 4, 5 h<); physical activity in school (0–30 min, 30–60 min, 60–90 min, 90–120 min, 120–150 min, 150 min<); watching TV during meal times (never, only at weekend, 1 to times/week, 2 to 3 times/week, every day); active play weekdays/weekends (none, <1, 1, 2, 3, 4, 5 h<). Active play was used as an umbrella term for all physical activity done by the child as reported by the parents.

Data analyses

Pearson Chi-square χ^2 (β set at 0.05) difference tests were conducted to test the level of association between the different variables measured (birthweight, breastfeeding, district; parental occupation, parental physical activity participation, parental education, school physical activity, maternal smoking during pregnancy, sport activity outside of school, urbanization, active play weekdays/weekends, electronic games weekdays/weekends, personal computer use weekdays/weekends, television (TV) weekdays/weekends, watching TV during meal times) and children's overweight, obesity and OW/OB. Variables with a significant association with childhood overweight, obesity and OW/OB were further analyzed by backward logistic regression models. Sex and age were adjusted and the odds ratio (OR) and 95% confidence interval were calculated for each of the categorical variables within the regression models. Categorical factors with an OR statistically significantly ($P < 0.05$) and higher than 1.0 resulted as a risk factor and an increased likelihood of childhood OW/OB and an OR statistically significantly ($P < 0.05$) with a value below than 1.0 was taken as a protective factor. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS/PC-)-, version 19.0; SPSS, Chicago, IL).

RESULTS

Prevalence of overweight and obesity (OW/OB)

Table 1 presents the prevalence (%) of normal weight and OW/OB among a sample of 17,136 Portuguese children aged 3- to 10-year olds. As a whole, 72.1% of children were classified as having a normal weight status, 19.7% were classified as overweight and 8.2% were classified as obese. Thus, more than a quarter (27.9%) of the children were either overweight or obese.

Biological factors

Sex differences were found across all age groups, with girls being more OW/OB than boys. Chi-square (χ^2) difference tests shows that these sex differences were significant across the ages 3.5, 4.0, 4.5, 5.0, 5.5, 6.5, and 7.5 years. Tables (2–4) present results of the logistic regression models. Table 2 outlines the biological risk factors that were significantly associated with OW/OB of Portuguese children. It was found that age and sex (male = reference) were significant risks for being overweight and obese. This was found across all three logistic regression models (Tables 2–4).

Two other biological factors—"maternal smoking during pregnancy" and "breastfeeding"—were also significant predictors of OW/OB. Maternal smoking during pregnancy increased the odds of obesity among the children (OR 1.52 95%CI 1.30–1.78) and, in a smaller degree, also increased the odds of child overweight (OR 1.31 95%CI 1.16–146). Table 2 outlines that being older, female, with a mother who smoked during pregnancy, and not being breastfed increased the odds of being OW/OB.

Socio-demographic factors

Chi-square difference results of parental factors (father and mother) by weight status and sex found that normal weight (boys and girls) had parents with higher paid occupations. This was also found to be evident for educational level for parents. It was also clearly found that children who were OW/OB had parents with higher BMI's compared to normal BMI-children (Mother BMI: Boys OW/OB: $\chi^2 = 186.94$, $P \leq 0.01$; Girls OW/OB: $\chi^2 = 194.99$, $P \leq 0.01$; Father BMI: Boys OW/OB: $\chi^2 = 182.92$, $P \leq 0.05$; Girls OW/OB: $\chi^2 = 174.44$, $P \leq 0.05$).

Mother's education was a risk factor for childhood obesity with less educated mothers having an increased risk of having an obese child, but not in all children's age-groups. Significant odds ratios were found for 6 years (OR 1.34 95%CI 1.03–1.74); 9 years (OR 1.49 95%CI 1.29–248), and 12 years (OR 1.81 95%CI 1.04–2.40); Fathers' education was also associated with an increased likelihood for childhood obesity. Odds Ratios ranged from 1.35 to 1.79. Mother's education was not associated with an increased likelihood for children being overweight, however fathers education did, with those with lower education levels

TABLE 1. Prevalence of normal, overweight, and obese Portuguese children by age and sex

Age (y)	*n*	Normal % (*n*)	Overweight % (*n*)	Obese % (*n*)	Overweight + obese (*n*)
3					
Boys	256	83.2 (213)	13.3 (34)	3.5 (9)	16.8 (43)
Girls	247	82.2 (203)	15 (37)	2.8 (7)	17.8 (44)
Total	503	82.7 (416)	14.1 (71)	3.2 (16)	17.3 (87)
			$\chi^2 = 0.267, p = 0.61$	$\chi^2 = 0.190, P = 0.66$	$\chi^2 = 0.91, P = 0.76$
3.5					
Boys	427	54.1 (372)	9.6 (41)	3.3 (14)	12.9 (55)
Girls	406	77.6 (315)	16.3 (66)	6.2 (25)	22.6 (91)
Total	833	82.5 (687)	12.8 (107)	4.7 (39)	17.5 (146)
			$\chi^2 = 9.296, P \leq 0.05$	$\chi^2 = 3.865, P \leq 0.05$	$\chi^2 = 13.085, P \leq 0.01$
4					
Boys	510	82.2 (419)	14.3 (73)	3.5 (18)	17.8 (91)
Girls	504	73.8 (372)	19.4 (98)	6.7 (34)	26.2 (131)
Total	1,014	78 (791)	16.9 (171)	5.1 (52)	22.0 (223)
			$\chi^2 = 5.948, P \leq 0.05$	$\chi^2 = 5.391, P \leq 0.05$	$\chi^2 = 10.296, P \leq 0.01$
4.5					
Boys	546	81.9 (447)	12.6 (69)	5.5 (30)	18.1 (99)
Girls	510	71.4 (364)	22.7 (116)	5.9 (30)	28.6 (146)
Total	1,056	76.8 (811)	17.5 (185)	5.7 (60)	23.2 (245)
			$\chi^2 = 19.159, P \leq 0.01$	$\chi^2 = 0.074, P = 0.79$	$\chi^2 = 16.302, P \leq 0.01$
5					
Boys	570	77.9 (444)	14.9 (85)	7.2 (41)	22.1 (126)
Girls	587	69.7(409)	20.3 (119)	10.1 (59)	30.3 (178)
Total	1,157	73.7 (853)	17.6 (204)	8.6 (100)	26.3 (304)
			$\chi^2 = 7.102, P \leq 0.01$	$\chi^2 = 2.992, P = 0.08$	$\chi^2 = 10.083, P \leq 0.01$
5.5 years					
Boys	586	77.0 (451)	16.6 (97)	6.5 (38)	23.1 (135)
Girls	610	70.7 (431)	18.2 (111)	11.1 (68)	29.3 (179)
Total	1,196	73.7 (882)	17.4 (208)	8.9 (106)	26.3 (314)
			$\chi^2 = 1.363, P = 0.24$	$\chi^2 = 8.045, P \leq 0.01$	$\chi^2 = 6.140, P \leq 0.05$
6					
Boys	528	76.3 (403)	15.3 (81)	8.3 (44)	23.7 (125)
Girls	493	71.0 (350)	20.1 (99)	8.9 (44)	29.0 (143)
Total	1,021	73.8 (753)	17.6(180)	8.6 (88)	26.2 (268)
			$\chi^2 = 4.223, P \leq 0.05$	$\chi^2 = 0.113, P = 0.74$	$\chi^2 = 3.744, P = 0.53$
6.5 years					
Boys	603	75.8 (457)	16.7 (101)	7.5 (45)	24.1 (146)
Girls	700	67.9 (475)	21.6 (151)	10.6 (74)	32.2 (225)
Total	1,303	71.5 (932)	19.3 (252)	9.1 (119)	28.5 (371)
			$\chi^2 = 6.384, P \leq 0.05$	$\chi^2 = 3.773, P = 0.052$	$\chi^2 = 10.004, P \leq 0.01$
7					
Boys	708	73.3 (519)	18.6 (132)	8.1 (57)	26.7 (189)
Girls	696	70 (487)	20.3 (141)	9.8 (68)	30.0 (209)
Total	1,404	71.7 (1,006)	19.4 (273)	8.9 (125)	28.3 (398)
			$\chi^2 = 0.901, P = 0.34$	$\chi^2 = 1.279, P = 0.26$	$\chi^2 = 1.920, P = 0.17$
7.5 years					
Boys	676	73.7 (498)	17.5 (118)	8.9 (60)	26.4 (178)
Girls	659	66.5 (438)	22.8 (150)	10.8 (71)	33.5 (221)
Total	1,335	70.1 (936)	20.1 (268)	9.8 (131)	25.4 (339)
			$\chi^2 = 7.020, P \leq 0.01$	$\chi^2 = 1.359, P = 0.24$	$\chi^2 = 8.265, P \leq 0.01$
8					
Boys	643	70.5 (453)	19.9 (128)	9.6 (62)	29.5 (190)
Girls	650	67.5 (439)	23.8 (155)	8.6 (56)	32.5 (211)
Total	1,293	69 (892)	21.9 (283)	9.1 (118)	31.0 (401)
			$\chi^2 = 2.652, P = 0.10$	$\chi^2 = 0.411, P = 0.52$	$\chi^2 = 1.282, P = 0.26$
8.5 years					
Boys	717	66.8 (479)	25.2 (181)	7.9 (57)	33.2 (238)
Girls	720	63.1 (454)	26.9 (194)	10 (72)	36.9 (268)
Total	1,437	64.9 (933)	26.1 (375)	9 (129)	35.1 (504)
			$\chi^2 = 1.011, P = 0.32$	$\chi^2 = 1.848, P = 0.17$	$c^2 = 2.219, P = 0.14$
9					
Boys	705	67.9 (479)	22.8 (161)	9.2 (65)	32.1 (226)
Girls	817	65.0 (531)	26.2 (214)	8.8 (72)	35.0 (286)
Total	1,522	66.4 (1,010)	24.6 (375)	9 (137)	33.6 (512)
			$\chi^2 = 2.220, P = 0.136$	$\chi^2 = 0.077, P = 0.78$	$\chi^2 = 1.475, P = 0.23$
9.5					
Boys	597	69.7 (416)	19.9 (119)	10.4 (62)	30.3 (181)
Girls	709	69.3 (491)	21.3 (151)	9.4 (67)	30.7 (218)
Total	1,306	69.4 (907)	20.7 (270)	9.9 (129)	30.5 (399)
			$\chi^2 = 0.269, P = 0.60$	$\chi^2 = 0.319, P = 0.57$	$\chi^2 = 0.28, P = 0.87$
10					
Boys	383	72.1 (276)	20.4 (78)	7.6 (29)	27.9 (107)
Girls	373	71 (265)	22 (82)	7 (26)	29.0 (108)
Total	756	71.6 (541)	21.2 (160)	7.3 (55)	28.4 (215)
			$\chi^2 = 0.269, P = 0.61$	$\chi^2 = 0.101, P = 0.75$	$\chi^2 = 0.096, P = 0.76$
Boys total	8,455	74.8 (6,326)	17.7 (1,498)	7.5 (631)	25.2 (2,129)
Girls total	8,681	69.4 (6,024)	21.7 (1,884)	8.9 (773)	30.6 (2,657)
Total	17,136	72.1 (12,350)	19.7 (3,382)	8.2 (1,404)	27.9 (4,786)

having the likelihood (6 years = OR 1.20 95%CI 1.02–1.42, 4 years 1.25 95%CI 1.06–1.49).

Portuguese children are also at greater risk of being overweight or obese if their mothers and/or fathers are OW/OB themselves. This likelihood increased as the weight of the parents increased, with the greater likelihood found within obese fathers (OR 4.50 95%CI 3.51–5.77) compared to obese mothers (OR 4.10 95%CI 3.19–5.25). Table 3 outlines that there was an increased likelihood of childhood obesity if mothers did not take part in regular physical activity (OR 1.30 95%CI 1.04–1.61).

Behavioral factors

Differences between levels of active play during weekdays were found to be significant ($P \leq 0.01$) in overweight and obese girls compared to normal-BMI girls (OW: $\chi^2 = 28.09$; OB: $\chi^2 = 26.63$; OW/OB: $\chi^2 = 39.80$) ($P \leq 0.01$). When viewing the chi-square differences of all the selected sedentary behavior variables the differences were all found to be statistically significant for obese boys; the only significant P values for girls were for TV viewing ($\chi^2 = 15.17$, $P \leq 0.05$). Although not all differences between overweight and normal weight boys were significant across sedentary behaviors and a significant difference was found across all sedentary behaviors for obese boys. It was found that overweight and obese boys engaged in larger periods of time playing electronic games compared to girls during weekdays (39.7% vs. 14.4%). Boys were found to play more electronic games than girls across all weight categories. Weekends were also found to be periods of the week where more active play, TV viewing, PC viewing, and electronic games took place for both sexes. It was found that 70.6% of OW/OB boys played some kind of electronic games compared to 62% of their normal weight peers ($\chi^2 = 26.79$, $P \leq 0.01$). Obese girls played more electronic games than overweight and normal weighted girls; however it was clear that overweight and obese boys played with electronic games for greater

TABLE 2. Biological predictors of overweight and obesity of Portuguese children aged 3–10 years

Model	Overweight			Obese			OW/OB		
Factors	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*
Decimal age	1.11	1.10–1.13	≤0.01	1.10	1.07–1.14	≤0.01	1.10	1.08–1.13	≤0.01
Sex									
Male (Reference)	1.00			1.00			1.00		
Female	1.32	1.22–1.43	≤0.01	1.40	1.24–1.58	≤0.01	1.35	1.25–1.45	≤0.01
Smoke									
No (Reference)	1.00			1.00			1.00		
Yes	1.31	1.16–1.46	≤0.01	1.52	1.30–1.78	≤0.01	1.36	1.23–1.51	≤0.01
Breastfeed									
Yes (Reference)	1.00			1.00			1.00		
No	1.06	0.94–1.20	ns	1.49	1.27–1.75	≤0.01	1.18	1.06–1.31	≤0.01

TABLE 3. Parental predictors of overweight and obesity of Portuguese Children aged 3–10 years

Model	Overweight			Obese			OW/OB		
Factors	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*
Decimal age	1.12	1.10–1.16	≤0.01	1.11	1.07–1.16	≤0.01	1.12	1.10–1.15	≤0.01
Sex									
Male (reference)	1.00			1.00			1.00		
Female	1.27	1.14–1.41	≤0.01	1.28	1.09–1.52	≤0.01	1.28	1.16–1.41	≤0.01
Mother education									
University (Reference)	1.00			1.00			1.00		
12 Years	1.03	0.69–1.53	ns	1.81	1.15–2.84	≤0.01	1.20	0.85–1.69	ns
9 Years	0.93	0.6–1.25	ns	1.49	1.08–2.07	≤0.05	1.60	0.81–1.37	ns
6 Years	0.94	0.74–1.20	ns	1.34	1.03–1.74	≤0.05	1.02	0.82–1.26	ns
4 Years (Primary)	0.91	0.73–1.13	ns	1.22	0.94–1.59	ns	0.97	0.80–1.17	ns
Father education									
University (Reference)	1.00			1.00			1.00		
12 Years	1.26	0.95–1.67	ns	1.58	1.04–2.40	≤0.05	1.43	1.11–1.83	≤0.01
9 Years	1.08	0.87–1.33	ns	1.79	1.29–2.48	≤0.01	1.29	1.07–1.55	≤0.01
6 Years	1.20	1.02–1.42	≤0.01	1.35	1.1–1.79	≤0.05	1.24	1.07–1.44	≤0.01
4 Years (Primary)	1.25	1.06–1.49	≤0.01	1.51	1.13–2.02	≤0.01	1.31	1.12–1.52	≤0.01
Mother obesity (BMI)									
Normal (Reference)	1.00			1.00			1.00		
Underweight	0.44	0.28–0.70	≤0.01	0.62	0.30–1.28	ns	0.48	0.32–0.71	≤0.01
Overweight	1.43	1.26–1.62	≤0.01	1.93	1.60–2.34	≤0.01	1.54	1.38–1.73	≤0.01
Obese	1.65	1.33–20.5	≤0.01	4.10	3.19–5.25	≤0.01	2.24	1.87–2.69	≤0.01
Father obesity (BMI)									
Normal (Reference)	1.00			1.00			1.00		
Underweight	1.32	0.43–4.01	ns	na	na	na	1.04	0.34–3.17	ns
Overweight	1.53	1.36–1.72	≤0.01	2.17	1.76–2.66	≤0.01	1.65	1.49–1.84	≤0.01
Obese	2.02	1.69–2.41	≤0.01	4.50	3.51–5.77	≤0.01	2.55	2.19–2.98	≤0.01
Mother physical activity									
Yes (Reference)	1.00			1.00			1.00		
No	1.08	0.95–1.23	ns	1.30	1.04–1.61	≤0.05	1.12	0.10–1.26	ns

quantities of time than girls. Watching TV during mealtimes was found to occur most frequently for obese boys than overweight and normal weight boys and girls.

Table 4 outlines the statistically significant odds ratios for the logistic models conducted for overweight, obesity and OW/OB and the influence of physical activity and sedentary behaviors. Key findings were that the likelihood of childhood obesity was significantly increased (OR 3.81 95%CI 1.15–12.66) if the children played on electronic games for more than 4 h during weekdays, however within this statistic there were only 13 children within the category so this result should be interpreted with caution. This was also found to be true for electronic games during weekends but the increased likelihood was significant for overweight only, not obesity (OR 1.32 95%CI 1.06–1.64). Watching TV during the weekdays was associated with a greater likelihood for children to be overweight and the likelihood increased as daily hours watching TV increased (1 h, OR 1.43 95%CI 1.05–1.96; 2 h, OR 1.60 95%CI 1.16–2.20). This was evident for the group category of OW/OB and there was additional significance for watching TV for 3 h during a weekday (OR 1.52 95%CI 1.06–2.16). Obesity had an increased risk to occur when children watched TV while eating meals. This was found for all number of times a child watched TV while eating, but significant values were found for two meals (OR 1.47 95%CI 1.07–2.01) and four meals (OR 1.41 95%CI 1.04–1.91).

Table 4 illustrates the reduced likelihood of obesity if a child takes part in more active play during weekdays (<1 h = OR 0.70 95%CI 0.54–0.90; 1 h = OR 0.68 95%CI 0.51–0.90; 2 h = OR 0.67 95%CI 0.49–0.91; 3 h = 0.39 95%CI 0.23–0.66). The protective effect of 1 h of active play was found to be greater on weekends compared to weekdays for obese children (1 h = 0.51 95%CI 0.30–0.86). Three hours of active play at weekends was also found not to have a higher significant protection from obesity than 3 h in weekdays (3 h = OR 0.40 95%CI 0.21–0.76).

DISCUSSION

There are very few national surveys about the health and nutritional status of children in Portugal. The previous survey by Padez et al. (2004) showed an alarming trend on OW/OB of Portuguese children that will have heavy health and economic repercussions. The importance and novelty of this current study, is that it took into account childhood and juvenile stages of growth and was conducted immediately before the economic/financial crisis hit Portugal and most of Europe which has affected the lives of thousands of Portuguese families. This fact makes this study a reference that shows the biological and social status before the economic and final changes have been reflected on the health of the Portuguese people. Any survey conducted after this one should take this article in consideration and use these results as the baseline gathered at the beginning of a crisis that will have countless effects on the health and living conditions of the Portuguese people for decades to come.

The results of this Portuguese national representative study show that the prevalence of OW/OB children was high (27.9%), with girls having greater prevalence of OW/OB than boys (30.6% vs. 25.2%). However, the prevalence changed slightly when compared with the values obtained in 2004 (31.6%; boys 29.3%, girls 33.8%) (Padez et al., 2005). Socio-demographic variables (i.e., parents BMI and education level) have a significant risk upon childhood OW/OB. Fathers have as just an important role in a child's likelihood of OW/OB as mothers. Sedentary behaviors, such as screen time viewing and the amount of time children spend engaging in these behaviors, and while eating meals are significant factors. Physical activity during weekdays and weekends were significant protective factors of obesity.

Prevalence of overweight and obesity

Comparing the results of this study with others outlines a clear consensus that the prevalence of OW/OB of Portuguese children is clearly high. The international association for the study of obesity (IASO, 2013) reports that 28.1% of Portuguese children aged 6–8 years are OW/OB. The finding of the IASO (2013) is similar to the prevalence found within this study, 27.9%. Results from the previous survey by Padez et al. (2005) (31.6%) could suggest that OW/OB prevalence is lowering or possibility stabilizing. However discrepancy occurs when viewing results of the organization for economic co-operation and development (OECD, 2011) of who reported a prevalence of 22.6% of children aged 5–17 years were OW/OB. Reasons for difference could be the different age ranges of surveyed of previous studies in comparison to this study. However, it is clear that OW/OB is high in Portugal and across Europe particularly in other Mediterranean countries (Italy, Spain, and Greece). Children's OW/OB levels of Italy (31.7%), Spain (24.8–27.9%), and Greece (41.1%) along with Portugal are all consistently found to be among the highest of childhood obese nations in Europe and globally (IASO, 2013; OECD, 2011).

Biological factors

We found statistically significant sex differences for OW/OB. Girls across all ages (3–10 years) were more overweight than boys and generally found to be more obese than boys. This finding is interesting when comparing to other national data sets, with some reports stating that Portuguese boys have greater prevalence of OW/OB than girls (IASO, 2013; OECD, 2011). However, sex differences between previously published Portuguese works have shown to differ between studies (Moreira et al., 2007). The findings of the current study are in agreement with Wiisneieski et al. (2009) who concluded that sex difference existed between boys and girls' rates of OW/OB (Girls OW/OB > Boys OW/OB). Reasons for this could be due to girls biologically having greater fat mass, fat distribution and being found to be less physically active than boys (Mota et al., 2002; Baptista et al., 2012). However, Guerra and colleagues found no significant relationships between Portuguese Girls physical activity and obesity, but did find that inactive Portuguese boys had twice the likelihood of being obese than active Portuguese boys (Guerra et al., 2006). Therefore more research is required to understand in more depth sex differences of risk factors of OW/OB in Portuguese children. The relationship between other moderators of OW/OB such as ethnicity and culture should also be investigated in greater depth and frequency as studies are small in numbers (Owen et al., 2005). Another well-established risk factor of OW/OB that this study found was age which is a well-documented factor across the literature with higher OW/OB being more

TABLE 4. Behavioural predictors of overweight and obesity of Portuguese Children aged 3–10 years

Model Factors	Overweight			Obese			OW/OB		
	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*
Decimal Age	1.12	1.08–1.16	≤0.01	1.12	1.06–1.16	≤0.01	1.13	1.09–1.16	$p \leq 0.01$
Sex									
Male (reference)	1.00			1.00			1.00		
Female	1.30	1.14–1.47	≤0.01	1.10	0.91–1.33	ns	1.25	1.12–1.39	≤0.01
Electronic weekdays									
None (reference)	1.00			1.00			1.00		
<1 hr	1.06	0.88–1.28	ns	1.09	0.87–1.37	ns	1.14	0.96–1.35	ns
1 hr	1.05	0.74–1.49	ns	1.22	0.81–1.83	ns	1.20	0.88–1.63	ns
2 hr	0.83	0.41–1.67	ns	1.79	0.89–3.63	ns	1.21	0.68–2.14	ns
3 hr	1.38	0.39–4.85	ns	3.81	1.15–12.66	≤0.05	2.11	0.75–5.93	ns
4 hr <	1.83	0.17–20.20	ns	na	na	na	2.40	0.24–24.28	ns
Electronic weekends									
None (reference)	1.00			1.00			1.00		
<1 hr	0.97	0.73–1.29	ns	0.67	0.41–1.10	ns	0.89	0.68–1.15	ns
1 hr	1.07	0.92–1.25	ns	0.83	0.64–1.07	ns	1.05	0.91–1.20	ns
2 hr	0.86	0.70–1.07	ns	0.70	0.50–0.98	ns	0.88	0.72–1.06	ns
3 hr	1.48	0.97–2.27	ns	0.55	0.25–1.24	ns	1.29	0.87–1.92	ns
4 hr <	1.32	1.06–1.64	≤0.05	0.71	0.48–1.05	ns	1.26	1.03–1.53	≤0.05
TV weekdays									
None (reference)	1.00			1.00			1.00		
<1 hr	1.27	0.93–1.72	ns	1.01	0.61–1.67	ns	1.22	0.93–1.60	ns
1 hr	1.43	1.05–1.96	≤0.05	1.24	0.73–2.11	ns	1.46	1.10–1.92	≤0.05
2 hr	1.60	1.16–2.20	≤0.01	1.34	0.77–2.32	ns	1.67	1.26–2.21	≤0.01
3 hr	1.43	0.96–2.14	ns	1.18	0.61–2.28	ns	1.52	1.06–2.16	≤0.05
4 hr	1.03	0.50–2.13	ns	1.58	0.63–3.95	ns	1.42	0.79–2.57	ns
5 hr <	0.86	0.27–2.74	ns	1.85	0.51–6.71	ns	1.31	0.54–3.21	ns
TV meal time									
Never (reference)	1.00			1.00			1.00		
One meal	1.07	0.86–1.33	ns	1.33	0.94–1.89	ns	1.13	0.93–1.37	ns
Two meal	1.07	0.88–1.30	ns	1.47	1.07–2.01	≤0.05	1.16	0.97–1.38	ns
Three meal	1.13	0.93–1.39	ns	1.20	0.86–1.67	ns	1.15	0.96–1.38	ns
Four meal	1.07	0.88–1.30	ns	1.41	1.04–1.91	≤0.05	1.15	1.36	ns
PC weekdays									
None (reference)	1.00			1.00			1.00		
<1 hr	0.90	0.80–1.03	ns	0.78	0.63–0.97	ns	0.89	0.79–1.00	ns
1 hr	0.67	0.52–0.88	≤0.01	0.77	0.52–1.22	ns	0.73	0.58–0.92	≤0.01
2 hr	0.76	0.48–1.21	ns	0.64	0.32–1.27	ns	0.80	0.53–1.20	ns
3 hr	0.75	0.16–3.63	ns	1.47	0.33–6.54	ns	1.24	0.39–3.92	ns
4 hr <	2.04	0.55–7.57	ns	na	na	na	1.27	0.35–4.68	ns
Active play weekdays									
None (reference)	1.00			1.00			1.00		
<1 hr	0.9	0.75–1.08	ns	0.70	0.54–0.90	≤0.01	0.83	0.72–0.96	≤0.01
1 hr	0.84	0.69–1.03	ns	0.68	0.51–0.90	≤0.01	0.77	0.66–0.90	≤0.01
2 hr	0.95	0.77–1.17	ns	0.67	0.49–0.91	≤0.05	0.85	0.72–1.00	≤0.05
3 hr	0.76	0.56–1.04	ns	0.39	0.23–0.66	≤0.01	0.63	0.49–0.80	≤0.01
4 hr	0.71	0.41–1.12	ns	0.71	0.33–1.52	ns	0.62	0.42–0.93	≤0.05
5 hr<	0.91	0.58–1.42	ns	0.95	0.53–1.69	ns	0.91	0.65–1.38	ns
Active play weekends									
None (reference)	1.00			1.00			1.00		
<1 hr	1.15	0.60–2.19	ns	0.80	0.36–1.78	ns	0.79	0.49–1.29	ns
1 hr	1.19	0.76–1.88	ns	0.51	0.30–0.86	≤0.01	0.81	0.59–1.11	ns
2 hr	1.25	0.79–1.97	ns	0.71	0.42–1.20	ns	0.96	0.70–1.31	ns
3 hr	1.33	0.81–2.16	ns	0.40	0.21–0.76	≤0.01	0.83	0.58–1.19	ns
4 hr	1.23	0.79–1.93	ns	0.65	0.39–1.07	ns	0.88	0.65–1.20	ns
5 hr <	1.37	0.88–2.12	ns	0.65	0.39–1.06	ns	0.92	0.68–1.25	ns

ns = nonsignificant ($P > 0.05$); na = not available (small frequency of variable).

likely as age increases (Gonzalez-Suarez, 2011; Hernandez et al., 1999; Pereira et al., 2010).

Behaviors of mothers and the choice to smoke during pregnancy and to breastfeed or not, were clearly significant risk factors of childhood obesity. These finding has been documented elsewhere (Owen et al., 2005). This study only included a two choice answer to breastfeeding (yes/no) so therefore a more detailed description and risk association on duration of breastfeeding could not be found like in previous studies (Padez et al., 2005; Ryan, 2007). Clear guidance and promotion of anti-smoking and the encouragement of breastfeeding should be implemented by health professionals to mothers in order to combat many health outcomes associated including childhood obesity.

Socio-demographic factors

This study found that OW/OB was associated with parental obesity and educational levels. An obese child was more likely to have parents who were obese and had a lower level of education. This finding has been found previously (Dannemann et al., 2011; Patterson et al., 1997; Xi et al., 2009) however; Padez et al. (2005)

concluded that although parental obesity and educational levels were important associations of Portuguese children's OW/OB, mother's obesity, and educational levels had a greater risk on children's OW/OB than fathers. This conclusion of maternal superiority has previously been well documented in previous work (Whitaker et al., 2010) but this study found that fathers with high BMI and low education had a greater risk upon children's OW/OB than mothers BMI and education. The importance of parental demographics (BMI and educational level) and their risk association to children's OW/OB, reinforces the idea of future interventions targeting the whole family. Previous lifestyle interventions targeted within a family environment have found positive results (Luttikhuis et al., 2009). A major conclusion of this study is that although mothers in Portuguese families are culturally seen to be the parent who takes the role for buying, preparing and serving the food, (Padez et al., 2005) fathers have a significant link to childhood obesity. Future research should seek to confirm this finding, and fathers may need to be included in future interventions.

Behavioral factors

Portuguese children watching 1 and 2 h of TV during weekdays were found to have an increased risk of being overweight. This finding is similar to previous Portuguese research (Padez et al., 2005). This study did not find the same effects for childhood obesity, which is different to previous Portuguese studies which concluded that an increase of TV viewing leads to a greater likelihood of obesity (Carvalhal et al., 2007; Hernandez et al., 1999). Much of previous research has mainly concentrated upon TV viewing. This study furthered the scope of sedentary behaviors within a Portuguese sample by measuring personal computer use and electronic games use over weekdays and weekends. Playing electronic games for long periods of time during weekdays (3 h) was associated to childhood obesity, and playing on electronic games for long periods of time (4 h<) during the weekend was associated with childhood overweight and obesity. Previous research found similar results (Boyland et al., 2011; IASO, 2013). TV viewing during meal times is reportedly a common behavior among Portuguese families (Carvalhal et al., 2007). Possible reasons for the link between TV (screen) viewing and obesity are low levels of energy expenditure (Hancox et al., 2004), along with an increase snacking of unhealthy foods (Liang et al., 2009; Rey-Lopez et al., 2011). Children also being subjected to advertising of unhealthy products while TV (Boyland et al., 2011; Halford et al., 2008) could well be factors especially as this findings of this study adds strength to the argument as watching TV while consuming food during meal times was a significant factor to childhood obesity.

Physical activity in the form of active play was found to be a protective behavior against childhood obesity. The more active the child, the greater the protection against obesity. Similar findings have been previously reported (Gonzalez-Suarez and Grimmer-Somers, 2011; Guerra et al., 2006; Hernandez et al., 1999; Pereira et al., 2010; Trost et al., 2001). Taking part in 1 h of active play at weekends had a greater protective effect than 1 h of active play during weekdays. This finding is of interest as the current international physical activity guidelines for children is to take part in 1 h of moderate to vigorous physical activity every day (World Health Organization, 2010). With the added protection of physical activity taking place during weekends, which do not have time restraints for physical activity found during weekdays (school), along with the observed increase in prevalence of sedentary behaviors during weekends, this study supports the view of previous research. For example, weekends offer an opportunity for future physical activity promotions/interventions to take place (Aznar et al., 2010). Engaging in active play will help combat the epidemic of childhood obesity while also providing other health benefits (World Health Organization, 2010).

Like all investigations this study has limitations, self-reported data is well established to have problems of bias, reliability and validity especially within complex behaviors such as physical activity and sedentary behavior (Shephard, 2003).The nature of the questionnaire being sent home and filled out by parents could lead to one parent completing the questionnaire on behalf of both parents, this could well lead to bias and inaccuracies. The questionnaire also asked about individual screen time behavior therefore multiscreen use data was not available, such as using a laptop or games device while watching the television (Jago et al., 2012). Although the large sample of participants it cannot be ruled out that there could be differences and bias in the results effected by non-responders (42.6%), therefore the results reported in this study could well be under or over-estimated, and when viewing the results of this study this issue should be taken into account. A final limitation is the term "active play." Active play has no standard definition across academics (Brockman et al., 2011) therefore it could be suggested that parents who completed the questionnaires and reported the level of active play for children, could well have a different definition of active play to another parent and family, therefore results of active play/physical activity should be viewed with caution. Even with the discussed limitations, this study has strong statistical strength because it is a nationally stratified representative study of Portugal with large numbers of children within all 18 districts of mainland Portugal.

In conclusion, this study found that childhood OW/OB in Portugal is high, with the prevalence being higher in girls than in boys. Child's age, maternal smoking during pregnancy and no breastfeeding are significant biological risk factors. Both mothers and fathers education level and BMI are risk factors for childhood OW/OB along with sedentary behaviors such as TV, PC use and, especially for boys playing electronic games. Physical activity (active play) was found to have a protective dose response to obesity, with greater protection found during weekends. Future research should investigate the sex differences between different districts and look to implement the use of objective measures of physical activity and sedentary behaviors. Future interventions should take note of the importance of breastfeeding, mothers not smoking during pregnancy, maternal and paternal weight status, education level, physical activity levels and the importance of sedentary behaviors especially while eating meals and the increase use of electronic games during weekends, particularly in boys.

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