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Original Research Article

Prevalence of Overweight and Obesity in 7–9-Year-Old Portuguese Children: Trends in Body Mass Index From 1970–2002

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ABSTRACT The aim of this study was to assess the prevalence of overweight and obesity in Portuguese children age 7–9 years and to analyze trends in body mass index (BMI) from 1970–2002. Data were collected from October 2002 to June 2003 in a random sample of Portuguese children. Height and weight were measured and BMI (Kg/m^2) was calculated. The International Obesity TaskForce (IOTF) cutoffs to define overweight and obesity were used. In the total sample we found 20.3% of overweight children and 11.3% of obese children. These results indicate a prevalence of overweight/obesity of 31.5%. Girls presented higher percentages of overweight than boys except at age 7.5. Girls also showed a higher percentages of obesity than boys except at age 9. From 1970 to 1992 and 1992 to 2002, height, weight, and BMI increased at different velocities: weight increased faster than height, and, consequently, BMI increased more in the last period than in the first one, leading to an increase in obesity values. Compared to published data by IOTF on other European countries, who applied the same methods to define overweight and obesity, Portuguese children showed the second-highest mean values in overweight/obesity. Italy showed the highest values (36%). The present study shows a very high prevalence of overweight/obesity (31.5%) in Portuguese children compared to other European countries. Portugal followed the trend of other Mediterranean countries like Spain (30%), Greece (31%), and Italy (36%). These high values require a national intervention program to control childhood obesity. Am. J. Hum. Biol. 16:670–678, 2004.

Childhood overweight and obesity seem to be increasing throughout the past two decades in developed nations and, to some degree, in other parts of the world (Frye and Heinrich, 2003; Reilly et al., 1999; Ogden et al., 2002; Magarey et al., 2001; Martorell et al., 2000; Bundred et al., 2001; Moreno et al., 2000; O'Loughlin et al., 2000; Rolland-Cachera et al., 2002). In 1998, the World Health Organization (WHO, 1998) recognized obesity as a major public health epidemic in developed as well as in some developing countries.

Childhood obesity is a major public health problem for two reasons: 1) obesity in childhood frequently tracks into adulthood (Whitaker, 1997; Guo, 2002; Goran, 2001; Kotani et al., 1997) and is linked with increased morbidity and mortality independently of adult obesity (Must et al., 1992); and 2) obesity in childhood is associated with adverse outcomes such as hypertension, dyslipidemia, chronic inflammation, hyperinsulinemia, and orthopedic problems (Freedman et al., 1999; Ford et al., 2001; Ferguson et al., 1998; Tounian et al., 2001; Srinivasan et al., 2002), as well as substantial psychosocial consequences. Obese children are stereotyped as unhealthy, academically unsuccessful, socially inept, and lazy (Hill and Silver, 1995). Low self esteem and behavioral problems were particularly commonly associated with obesity (Strauss, 2000).

Obesity is a multifactorial problem and its development is due to multiple interactions

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between genes and environment (Maffeis, 2000). Despite the effect that genetic factors can have (Hebebrand et al., 2000; Arner, 2000), the rising prevalence rates among genetically stable populations suggest that environmental factors and, perhaps, perinatal factors must underlie the childhood obesity epidemic (Hebebrand et al., 2000; Ebbeling et al., 2002; Hakala et al., 1999).

Obesity-related costs have been estimated at about 7% of the total health care expenditure in the US and at 1–5% in Europe (Colditz, 1999; Seidell, 1995). In a recent review, Reilly et al. (2003) concluded that pediatric obesity is likely to be a major cause of ill health in adulthood, but also contributes substantially to illness in childhood.

In contrast to many other European countries, which had important social and economic changes after World War II, the general improvement in living conditions of the Portuguese population took place late, during the 1960s. The health system showed large changes, with a strong increase in the number of physicians per 1,000 population and the percentage of newborns delivered at hospitals increased. Infant and postneonatal mortality rates decreased sharply and reached the current European values. There were also important changes in nutrition, with an increase in the total daily energy intake of some products such as milk (76–237 cal/day), meat (78–328 cal/day), fats (407–788 cal/day), and sugar (209–350 cal/day) (Barreto, 1996, 2000). These deep changes in social and economic structures led to a global improvement of living conditions during the past 40 years. Among many positive effects, we found a strong secular trend for increases in average stature and in decreases in the age at menarche in the Portuguese population (Padez, 2003; Padez and Rocha, 2003).

This study reports results from the first national survey in Portugal to evaluate the prevalence of childhood overweight and obesity and the influence of sociodemographic factors on it. The aim of this study was to assess the prevalence of obesity in Portuguese children and to document the trends of body mass index (BMI) from 1970–2002.

SUBJECTS AND METHODS

Subjects

The study was carried out from October 2002 to June 2003 and a sample of 7–9-year-old children was measured. This age range was chosen for practical and physiological reasons. By age 6 years the adiposity rebound occurs, following the nadir of the BMI curve (Rolland-Cachera et al., 1984). This age range is also likely to be a favorable period for prevention strategies.

Subjects were selected from the population of children attending public schools. Schools were randomly selected in the districts and from each of them the participating children were selected using stratified randomization for age, with the aid of a table of random numbers. A total of 4,511 subjects were included, comprising 2,274 girls and 2,237 boys. Some children were not included in our analysis (n = 336) because they were from Asian countries (n = 16), African countries (114), other European countries (n = 4), South America (10), three had Down syndrome, one had diabetes, and one had nanism. Finally, 187 were less than 6 years or more than 9 years old. The response rate was 70.6%.

The study protocol was approved by Direcção Regional de Educação (Portuguese Institution of the Ministry of Education) and informed consent was previously obtained from all the children's parents.

Mean BMI was compared to another national survey that took place in the 1970s that collected just height and weight (Rosa, 1983), and also to a another small study that was made in the 1990s in Lisbon (Fragoso, 1992).

Measurements

In each school two trained technicians performed anthropometric measurements using a standardized procedure (WHO, 1995a,b). Anthropometric measurements were performed with the children lightly dressed and without shoes. Height was measured using a stadiometer, with the head positioned according to the Frankfort plane; weight was measured using an electronic scale with a precision of 100 g. Upper arm circumference, triceps, and subscapular skinfolds were also obtained.

BMI was calculated as weight/height (Kg/m^2). The definitions of overweight and obesity were based on average centiles published by Cole et al. (2000). These cutoff points are linked to the widely accepted adult cutoff points of a BMI of 25 Kg/m^2 (overweight) and 30 Kg/m^2 (obesity).

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS/PC+, v. 11.0, Chicago, IL, 2003).

RESULTS

Anthropometric characteristics of the sample (height, weight, BMI, upper arm circumference, triceps and subscapular skinfolds) are presented in Table 1 by sex and age. In height, males show greater values than females except at age 9.5 years. In weight, BMI, upper arm circumference, triceps, and subscapular skinfolds female show greater values than males except at age 9 in weight and BMI.

Table 2 shows the prevalence of children classified as overweight and obese. In the total sample we found 20.3% of individuals overweight and 11.3% of children classified as obese. Therefore, the prevalence of overweight/obesity was 31.5%. Girls presented higher percentages of overweight than boys except at age 7.5. Girls also showed a higher percentages of obesity than boys except at age 9.

In Figures 1, 2, and 3, we compare height, weight, and BMI mean values of our sample with two other surveys. The first was a National Survey that took place in the 1970s conducted by the Ministry of Education in Portuguese schools in children age 7–17 years old (9,022 boys, 9,135 girls) (Rosa, 1983). The second was a study made in the 1990s in Lisboa, in 4,500 children age 3–12 years (Fragoso, 1992). In both studies only the mean values of the anthropometric variables (height and weight) were published and the prevalence of obesity was not calculated. It is obvious from each figure that height, weight, and BMI increased between 1970 and 2002 in both sexes and in all age groups. However, we should stress a different trend in height, weight, and consequently in BMI between 1970–1992 and 1992–2002 (Appendix). If we take into account the velocity for each anthropometric measure in each age group, we can see that for height (except at 9 years old, girls and boys) the velocity (cm/year) was lower in the second period (1992–2002) than in the first period (1970–1992), but on the other hand, the velocity in weight was always higher in the last period (1992–2002) than in the first one (1970–1992). Consequently, the velocity of BMI was also highest in the last period (1992–2002), which probably caused an increase in the prevalence of both overweight and obesity in the last 10 years.

Compared to other European countries (Table 3), Portugal has a high prevalence of overweight and obesity among children. In the total sample, 29.4% of boys and 33.7% of girls were overweight/obese. These values place Portugal virtually equal to Greece (33.1% for boys and 30% for girls) in childhood obesity. If we consider the IOTF data (www.iotf.org/childhood.euappendix.htm), Portugal is in second place after Italy (36%). More recent data published by Lobstein and

TABLE 1. Mean values of height, weight, BMI, upper arm circumference, triceps, and subscapular skinfolds of the study population age 7–9 years

Age	N	Height (cm) Mean ± SD	Weight (Kg) Mean ± SD	BMI (Kg/m^2) Mean ± SD	Upper arm circumference (cm) Mean ± SD	Triceps skinfold (mm) Mean ± SD	Subscapular skinfold (mm) Mean ± SD
Boys							
7	311	126.0 ± 4.9	27.1 ± 4.9	17.0 ± 2.5	19.4 ± 2.6	11.2 ± 4.4	7.4 ± 3.9
7.5	408	127.3 ± 5.2	28.2 ± 5.7	17.3 ± 2.7	19.8 ± 2.8	11.4 ± 4.6	7.9 ± 4.3
8	413	129.9 ± 5.3	30.2 ± 6.7	17.7 ± 2.9	20.4 ± 3.1	11.9 ± 5.2	8.6 ± 4.9
8.5	407	132.5 ± 5.5	32.0 ± 7.3	18.1 ± 3.2	20.8 ± 3.2	12.6 ± 5.6	9.2 ± 5.6
9	378	135.3 ± 5.6	33.9 ± 7.5	18.4 ± 3.2	21.4 ± 3.4	13.3 ± 5.6	9.6 ± 5.9
9.5	317	137.2 ± 5.8	34.9 ± 7.9	18.4 ± 3.2	21.4 ± 3.5	12.6 ± 5.9	9.4 ± 6.0
Total	2234	131.3 ± 6.6	31.0 ± 7.3	17.8 ± 3.0	20.5 ± 3.2	12.2 ± 5.3	8.7 ± 5.2
Girls							
7	310	124.9 ± 5.2	27.3 ± 5.9	17.4 ± 2.9	20.1 ± 2.9	13.6 ± 5.2	9.6 ± 5.3
7.5	421	126.8 ± 4.9	28.3 ± 6.2	17.5 ± 2.9	20.4 ± 3.0	14.1 ± 5.4	9.7 ± 5.6
8	397	129.4 ± 5.7	30.3 ± 7.1	17.9 ± 3.1	20.9 ± 3.0	14.7 ± 5.4	10.6 ± 6.3
8.5	421	132.1 ± 5.7	32.2 ± 7.3	18.3 ± 3.2	21.4 ± 3.3	15.0 ± 5.7	11.1 ± 6.4
9	411	134.7 ± 6.1	33.3 ± 7.5	18.2 ± 3.1	21.7 ± 3.1	15.0 ± 5.4	10.6 ± 6.0
9.5	314	137.6 ± 6.3	36.3 ± 8.6	18.9 ± 3.5	22.2 ± 3.4	15.6 ± 6.0	11.9 ± 7.0
Total	2274	130.9 ± 7.0	31.2 ± 7.7	18.0 ± 3.2	21.1 ± 3.2	14.7 ± 5.5	10.6 ± 6.2

TABLE 2. Prevalence of overweight and obesity at different ages in girls and boys according to the International Obesity TaskForce (IOTF) cutoffs of BMI

Age (years)	N	Overweight % (N)	Obese % (N)	Overweight + obese %
7				
Boys	311	17.4 (54)	7.7 (24)	25
Girls	310	19.7 (61)	14.2 (44)	33.9
Total	621	18.5 (115)	10.9 (68)	29.5
7.5				
Boys	409	17.6 (72)	10.0 (41)	27.6
Girls	421	17.6 (74)	12.1 (51)	29.7
Total	830	17.6 (146)	11.1 (92)	28.7
8				
Boys	414	18.6 (77)	10.9 (45)	29.5
Girls	397	21.4 (85)	11.8 (47)	33.2
Total	811	19.9 (162)	11.3 (92)	31.3
8.5				
Boys	407	20.4 (83)	11.8 (48)	32.2
Girls	421	21.6 (91)	15.2 (64)	36.8
Total	828	21.0 (174)	13.5 (112)	34.5
9				
Boys	379	21.1 (80)	11.3 (43)	32.4
Girls	411	24.1 (99)	8.7 (36)	32.8
Total	790	22.7 (179)	10.0 (79)	32.6
9.5				
Boys	317	19.5 (62)	9.1 (29)	28.7
Girls	314	24.2 (76)	12.1 (38)	36.3
Total	631	21.9 (138)	10.6 (67)	32.5
Total	4,511	20.3 (914)	11.3 (510)	31.5

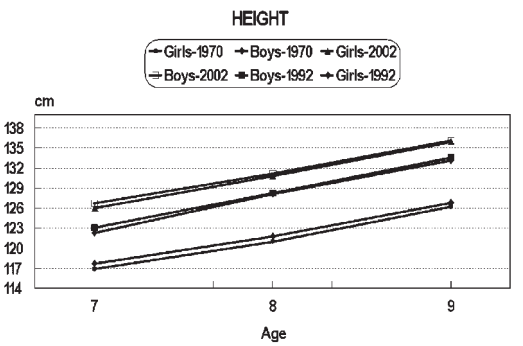

Fig. 1. Mean values of height, in both sexes, in 1970, 1992, and in the present study (2002).

Fig. 2. Mean values of weight, in both sexes, in 1970, 1992, and in the present study (2002).

Frelut (2003) also show high values in southern Europe.

DISCUSSION

This study carried out from 2002 to 2003 with 4,511 Portuguese children, in a nationwide representative sample, age 7–9 years, found very high percentages of obesity, similar to other South European countries.

Comparisons among countries are difficult, because different reference values for the definition of overweight and obesity have been used. Only more recent studies used the same reference values used in this study (Cole et al., 2000). There have been concerns about the use of BMI in a standar-

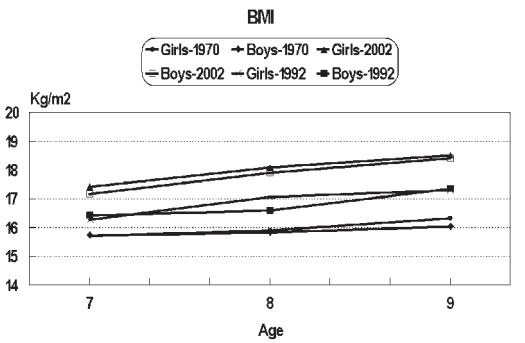

Fig. 3. Mean values of BMI, in both sexes, in 1970, 1992, and in the present study (2002).

dized form as an index of fatness in children from different populations and with different ages for the onset of puberty. However, in a workshop held in Dublin in 1997 the participants concluded that the BMI offered a reasonable measure with which to assess fatness in children and adolescents and that the standards used to identify overweight and obesity in children and adolescents should agree with the standards used to identify Grade 1 and Grade 2 overweight (BMI of 25 and 30, respectively) in adults (Dietz and Bellizi, 1999). Later, Reilly et al. (2000) assessed the sensitivity and specificity of the IOTF BMI cutoff points for overweight and obesity, using UK data and body impedance measures of total fat. In that work, they showed that there was excellent specificity and sensitivity for the overweight cutoff points, but somewhat lower sensitivity for the higher obesity cutoff point.

Worldwide, the prevalence of overweight and obesity in children has increased dramatically during the last two decades (WHO, 2000a). The reported prevalence data for overweight/obesity vary between 16% in the Czech Republic (Vignerová and Bláha, 2003) and 33% in Greece (Krassas et al., 2001). Other countries, such as Canada, present high values. In a recent work, Tremblay and Willms (2000) reported that from 1981 to 1996 the prevalence of overweight increased by 92% in boys and by 57% in girls. Moreover, during the same time period the prevalence of obesity has more than doubled in both boys and girls. These values are similar to those reported in the United States (Troiano et al., 1995). In other parts of the world, like Australia (Magarey et al., 2001) and Japan (Matsushita et al., 2004), the values are lower, with percentages ranging from 10–20%. On the other hand, in New Zealand (Tyrrell et al., 2001), especially in some ethnic groups, such as the Maori, the prevalences of obesity are very high. The same problem is now occurring in some Pacific Island countries. In a workshop held in 2000 it was concluded that obesity is a serious health problem throughout the Pacific region (WHO, 2000b). Paradoxically, childhood obesity is not restricted to the industrialized countries. In a recent work, De Onis and Blossner (2000) reported a fast increase in the prevalence of overweight and obesity among preschool children in developing countries.

Our results followed the general trend in Europe, showing that South European countries such as Spain, Italy, and Greece report the highest prevalences of obesity when compared to North European countries (Lobstein and Freulut, 2003). These results concur with others found in a recent publication on adolescent obesity in 13 European countries, Israel, and the United States, where the highest prevalences of overweight were found in the United States, Ireland, Greece, and Portugal (Lissau et al., 2004).

The results of our study provide further evidence that there were strong increases in BMI among Portuguese children between 1970 and 2002, especially between 1992 and 2002, when the changes in weight were higher than those of height. This is probably a consequence of nutritional changes that the Portuguese population experienced, especially after the 1960s. There was an increase in milk, meat, and eggs, but also in fats and sugar consumption (Barreto, 1996, 2000). The deep changes in the social and economic structures in the last three decades led to a global improvement of living conditions and had many positive effects on our population. An example of these improvements translated into the positive secular trend in stature (Padez, 2003) and in the decrease of age at menarche (Padez and Rocha, 2003). However, these changes also had some negative effects. Portugal shows the highest percentage of sedentary lifestyle for adults in the European Union (87.8%) according to a study by Varo et al. (2003). It is possible that Portuguese children are also highly sedentary, contributing to their increase in overweight/obesity.

TABLE 3. Some recent published studies of prevalences rates for obesity and overweight children in some European countries, Canada, USA, Australia, New Zealand, and Japan

Reference	Country	Age (years)	Method	Prevalence of overweight, %		Prevalence of obesity, %		Over + obesity	
				Males	Females	Males	Females	Males	Females
Rolland-Cachera et al., 2002	France	7–9	IOTF	14.7	14.3	3.6	3.8	18.3	18.1
Frye and Heinrich, 2003	East Germany	8–10	IOTF	19.9	22.3	6.9	4.2	26.8	26.5
Krassas et al., 2001	Greece	6–10	IOTF	26.6	25	6.5	5	33.1	30
Lobstein et al., 2003	UK	7–11	IOTF			17.0*	23.6*	17	23.6
Celi et al., 2003	Italy	3–17.5	IOTF	20.9	18.9	6.7	6.2	27.6	25.1
Vignerová and Bláha, 2003	Czech Rep	–	90–97th; >97th	12.1	9.8	2.4	1.4	14.5	11.2
Malecka-Tendera et al., 2003	Poland	7–9	–	6.6	8.4	3.1	2.8	9.7	11.2
Marild et al., 2003	Sweden	10	IOTF	18.2		2.9		21.1	
Rios et al., 1999	Spain (Northwestern)	6–10	85 and 95th	16.2	18.4	6.6	6.9	23.2	25.3
Moreno et al., 2000	Spain (Aragon)	6–7	95th	14.2		17.7			
Present study	Portugal	7–9	IOTF	19.13	21.4	10.28	12.32	29.41	33.71
Magarey et al., 2001	Australia	2–18	IOTF	15	15.8	4.5	5.3	19.5	21.1
Tyrrell et al., 2001	New Zealand	5–10.9	95th	15.3 (all)		13.2 (all)			
				Pacific Island, 24.1; Maori, 15.8%; European, 8.6%					
Tremblay and Willms, 2000	Canada	7–13	85th; 95th	28.8	23.6	13.5	11.8	42.3	35.4
www.cdc.gov.nchs 2003	USA	6–11	95th	16.6		14.5			
Matsushita et al., 2004	Japan	6–14	IOTF	15.3	14.6	4.6	4.6		

*Overweight and obesity.

A similar trend in childhood fatness occurred in other populations, such as the Maya American children studied by Bogin et al. (2002) and Smith et al. (2002). The Maya Americans, age 5–12 years old, are the children of immigrants from Guatemala. Living in the United States the Maya American children have greater access to clean water, food, medical care, and education. They also have reduced work loads. Their growth responds to the new environmental conditions by showing a significant increase in stature and leg length (Bogin et al., 2002), but also a high risk of being overweight or obese (Smith et al., 2002).

These findings for a worldwide trend toward greater childhood overweight/obesity are remarkable in their magnitude and consistency and draw serious attention to the escalating problem of pediatric obesity in Portugal. Because clinical evidence of obesity-related disease in children is generally absent, the health consequences of having a high BMI during childhood are less obvious than for adults. However, cases of diabetes mellitus type 2, hyperlipidemia, and hypertension are becoming more common in overweight children (Hill and Trowbridge, 1998). Excessive body mass during childhood and adolescence is associated with an increased risk of becoming overweight in adulthood (Whitaker et al., 1997) and with higher morbidity and mortality rates in adulthood.

More attention to the promotion of healthy nutrition and physical activity throughout childhood and adolescence is urgent in the Portuguese population.

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APPENDIX

TABLE A1. Presents mean values of height, weight and body mass index in 1970, 1992, and in the present study (2002), differences and velocities in each period and each age group represented

	1970[a]	1992[b]	2002[c]	Difference 1970–1992 (velocity)	Difference 1992–2002 (velocity)
Girls					
Height (cm)	Mean	Mean	Mean		
7 years	116.9	122.3	126.0	5.4 (0.24 cm/y)	3.7 (0.37 cm/y)
8 years	121.0	128.0	130.8	7.0 (0.32 (cm/y))	2.8 (0.28 cm/y)
9 years	126.2	133.1	135.9	6.9 (0.31 cm/y))	2.8 (0.28 cm/y)
Weight (Kg)					
7 years	21.5	24.3	27.8	2.8 (0.12 Kg/y)	3.5 (0.35 Kg/y)
8 years	23.3	28.1	31.2	4.8 (0.21 Kg/y)	3.1 (0.31 Kg/y)
9 years	26.0	30.6	34.5	4.6 (0.21 Kg/y)	3.9 (0.39 Kg/y)
BMI (Kg/m^2)					
7 years	15.7	16.3	17.4	0.6 (0.027)	1.1 (0.11)
8 years	15.9	17.0	18.1	1.1 (0.05)	1.0 (0.1)
9 years	16.3	17.3	18.5	1.0 (0.045)	1.2 (0.12)
Boys					
Height (cm)					
7 years	117.7	123.1	126.7	5.4 (0.24 cm/y)	3.6 (0.36 cm/y)
8 years	121.8	128.9	131.2	7.1 (0.32 cm/y)	2.3 (0.23 cm/y)
9 years	126.8	133.5	136.1	6.7 (0.30 cm/y)	2.6 (0.26 cm/y)
Weight (Kg)					
7 years	21.8	24.9	27.7	3.1 (0.14 Kg/y)	2.8 (0.28 Kg/y)
8 years	23.5	27.4	31.1	3.9 (0.17 Kg/y)	3.7 (0.37 Kg/y)
9 years	25.8	30.9	34.3	5.1 (0.23 Kg/y)	3.4 (0.34 Kg/y)
BMI (Kg/m^2)					
7 years	15.7	16.4	17.2	0.7 (0.03)	0.8 (0.08)
8 years	15.8	16.6	17.9	0.8 (0.03)	1.3 (0.13)
9 years	16.0	17.3	18.4	1.3 (0.06)	1.1 (0.1)

[a]National Survey (Rosa, 1983).
[b]Study done in Lisbon (Fragoso, 1992).
[c]Present study.