

Other Review

Overweight and obesity in infants and pre-school children in the European Union: a review of existing data

A. Cattaneo¹, L. Monasta¹, E. Stamatakis², S. Lioret³, K. Castetbon⁴, F. Frenken⁵, Y. Manios⁶, G. Moschonis⁶, S. Savva⁷, A. Zaborskis⁸, A. I. Rito⁹, M. Nanu¹⁰, J. Vignerová¹¹, M. Caroli¹², J. Ludvigsson¹³, F. S. Koch¹³, L. Serra-Majem¹⁴, L. Szponar¹⁵, F. van Lenthe¹⁶ and J. Brug¹⁷

¹Health Services Research, Epidemiology and International Health, Institute for Maternal and Child Health IRCCS Burlo Garofolo, Trieste, Italy; ²Department of Epidemiology and Public Health, Department of Epidemiology and Public Health, University College London, London, UK; ³Dietary Survey Unit – Nutritional Epidemiology, Office of Scientific Support for Risk Assessment, French Food Safety Agency, Paris, France; ⁴Nutritional Surveillance and Epidemiology Unit, National Institute for Health Surveillance, Université Paris 13, Bobigny, France; ⁵Division of Social and Spatial Statistics, Statistical Analysis Department, Statistics Netherlands, Herleen, The Netherlands; ⁶Department of Nutrition and Clinical Dietetics, Harokopio University, Athens, Greece; ⁷Research and Education Institute of Child Health, Nicosia, Cyprus; ⁸Institute for Biomedical Research, University of Medicine, Kaunas, Lithuania; ⁹Department of Food and Nutrition, National Institute of Health, Lisbon, Portugal; ¹⁰Alfred Rusescu Institute for Mother and Child Care, Bucharest, Romania; ¹¹Department of Children and Adolescents, National Institute of Public Health, Prague, The Czech Republic; ¹²Unità Operativa di Igiene della Nutrizione, Dipartimento di Prevenzione, Azienda Sanitaria Locale, Brindisi, Italy; ¹³Division of Pediatrics and Diabetes Research Centre, Department of Clinical and Experimental Medicine, Faculty of Health Sciences, Linköping University, Linköping, Sweden; ¹⁴Department of Clinical Sciences, University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain; ¹⁵National Food and Nutrition Institute, Warsaw, Poland; ¹⁶Department of Public Health, Erasmus Medical Center, Rotterdam, The Netherlands; ¹⁷EMGO Institute for Health and Care Research, VU University Medical Center, Amsterdam, The Netherlands

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Address for correspondence: Dr A Cattaneo, Health Services Research, Epidemiology and International Health, Institute for Maternal and Child Health IRCCS Burlo Garofolo, Via dell'Istria 65/1, 34137 Trieste, Italy. E-mail: cattaneo@burlo.trieste.it

Summary

The objective of this study was to synthesize available information on prevalence and time trends of overweight and obesity in pre-school children in the European Union. Retrieval and analysis or re-analysis of existing data were carried out. Data sources include WHO databases, Medline and Google, contact with authors of published and unpublished documents. Data were analysed using the International Obesity Task Force reference and cut-offs, and the WHO standard. Data were available from 18/27 countries. Comparisons were problematic because of different definitions and methods of data collection and analysis. The reported prevalence of overweight plus obesity at 4 years ranges from 11.8% in Romania (2004) to 32.3% in Spain (1998–2000). Countries in the Mediterranean region and the British islands report higher rates than those in middle, northern and eastern Europe. Rates are generally higher in girls than in boys. With the possible exception of England, there was no obvious trend towards increasing prevalence in the past 20–30 years in the five countries with data. The use of the WHO standard with cut-offs at 1, 2 and 3 standard deviations yields lower rates and removes gender differences. Data on overweight and obesity in pre-school children are scarce; their interpretation is difficult. Standard methods of surveillance, and research and policies on prevention and treatment, are urgently needed.

Keywords: Europe, obesity, pre-school children, review.

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Introduction

Overweight and obesity are a serious public health problem in Europe, with an estimated prevalence of overweight in children and adolescents of about 20%, one-third of these being considered as obese (1). Childhood obesity has adverse psychological, social and health consequences in childhood and later in life, especially as far as cardiovascular disease and metabolic syndrome, and associated mortality, are concerned (2–4). Moreover, prevalence levels have been rapidly increasing for more than two decades, in parallel with changes in dietary and physical activity patterns, with an unequal distribution across socioeconomic groups (4,5). Monitoring prevalence is therefore crucial for policies aiming at halting or reversing what has been termed ‘the obesity epidemic’. While several studies have reported time trends data on overweight and obesity in school-age children and adolescents (6), relatively little is known about infants and pre-school children (7). This is probably as a result of the difficulty of sampling and studying this age group. Moreover, comparisons are limited by the heterogeneity of available data in terms of obesity/overweight definitions, by the cut-offs and reference populations used and by the studied age ranges. Yet many researchers emphasize the importance of foetal and early life in the aetiology of overweight and obesity (8–19).

The objective of this review of existing data was to synthesize all available information on prevalence and time trends of overweight and obesity in infants and pre-school children in the 27 countries of the European Union (EU), in a way that will allow, as far as possible, to make comparisons and recommend standard methods for data collection and analysis in future studies. This review, with two concomitant reviews on determinants and potentially effective interventions, is part of the Health promotion through Obesity Prevention across Europe (HOPE) project (<http://www.hopeproject.eu>). The aim of the project is to help develop EU-wide policies for the prevention of overweight and obesity in infants and pre-school children.

Methods

The search for data on overweight and obesity in infants and pre-school children in EU countries started from two WHO databases: the Nutrition Policy Database (<http://data.euro.who.int/nutrition/>) and the Global Database on Child Growth and Malnutrition (<http://www.who.int/nutgrowthdb/en/>). A first list of references and researchers was set up using the entries of these two databases. This list allowed a further search on PubMed and Google (because many references referred to unpublished reports and grey literature), and through email contacts with the authors. All the articles and reports with anthropometric data retrieved in this way were read full text. This allowed to

extend the initial list of references and to get in touch with more researchers. Finally, the names of other potentially important researchers in this field were obtained from colleagues involved in other work packages within the HOPE project; these researchers were also contacted to inquire about reports that might have been previously missed. All first authors of articles reporting data gathered after the year 2000 were contacted with the aim of:

- inquiring about unpublished or published reports that may have escaped the initial search;
- obtaining additional methodological information about their studies;
- requesting raw data used in their articles or reports.

Having retrieved all available articles, reports and documents to be able to identify researchers and grey literature from all 27 countries, we decided, for comparability purposes, to apply filters before proceeding with the analyses. Articles, reports and documents with data prior to 1990 were excluded, except for those used to analyse time trends. Studies that did not clearly report the methods used to collect and analyse data were also excluded.

For analysis, we decided to use the 2000 reference and cut-offs recommended by the International Obesity Task Force (IOTF) (20), developed using data on more than 190 000 individuals aged 0–25 years from six countries; they provide sex-specific overweight and obesity cut-offs from 2 to 18 years, at 6-month intervals. The cut-offs are based on centile curves at 18 years of age passing through the adult overweight and obesity body mass index (BMI) cut-off points of 25 and 30 kg/m² (21). These tables have been widely used in Europe, and many of the studies selected for this review base their rates of overweight and obesity on them. However, we used for our analysis also the 2006 WHO child growth standard (22), as some of the data sets already use it and because we wanted to extend our analysis, when possible, to infants and children younger than 2 years. The WHO standard refers to children from 0 to 59 months of age and is based on a sample of 888 (longitudinal sample, birth to 24 months) plus 6697 (cross-sectional sample, 18–71 months of age) healthy breastfed infants and young children raised in environments that do not constrain growth (23). The WHO growth charts, designed to describe how children should grow under optimal conditions, do not have cut-offs for overweight and obesity. For this review, we decided to present prevalence rates as BMI-for-age ranges corresponding to $>1 \leq 2$, $>2 \leq 3$ and >3 standard deviations (SD). In its training course on assessment of child growth (Module C: Interpreting growth indicators) (24), WHO labels these groups of children as being ‘at risk of overweight’, ‘overweight’ and ‘obese’, respectively, warning readers that this cautious approach takes into account the fact that these children are still growing and that to date there are no data

on the functional significance of the cut-offs for the upper end of the BMI-for-age distribution. In the WHO growth charts only 0.13% of children fall above 3 SD, 2.14% between 2 and 3 SD, and 13.59% between 1 and 2 SD. For the IOTF reference and cut-offs, a routine developed by Nicolas Stettler at the Children's Hospital of Philadelphia, University of Pennsylvania School of Medicine (<http://stokes.chop.edu/web/stettler/>) was adapted by the second author to obtain four additional cut-offs between each of the 6-month BMI values by sex, using a simple linear interpolation. The routine was designed to be run with Intercooled Stata 9. For the WHO standard, we analysed raw data with the WHO Anthro software (Beta version 2.02, <http://www.who.int/childgrowth/software/en/>).

Results

Reports with data on overweight and obesity in infants and pre-school children were found from all EU countries except for Austria, Denmark, Estonia, Finland, Latvia,

Luxembourg, Malta, Slovak Republic and Slovenia. The Appendix, available as supplemental web material, lists all the articles, reports and documents retrieved. Articles and reports selected for analysis and their characteristics, including sample size, are listed in Table 1. Raw data were provided by researchers from the Czech Republic, Italy, Poland, Portugal, Romania (only for 2004), Spain and Sweden. Additional analysis required to homogenize the information presented in this paper was carried out by researchers from Cyprus, England, France, Greece, Lithuania, the Netherlands and Scotland. If more than one study was available from a country, the ones with representative results for the whole country and with larger samples were preferred. For countries for which we had access to raw data, or for which additional analysis was carried out for HOPE by the original authors, prevalence rates are presented using both the IOTF reference and cut-offs and the WHO standard. For countries for which we had no access to raw data, or for which additional analysis by the original authors was not performed, prevalence rates are presented

Table 1 Articles and reports selected for analysis and their characteristics

Country	Survey year(s)	Sample size	National or subnational	Age range (years)	Measured or self-reported	Reference population	Access to raw data or analysis	Source
Belgium	1998–1999	1 014	Subnational	3–4	Measured	IOTF	No	(37,38)
	2004	218	National	2–4	Self-reported	IOTF	No	(39)
Bulgaria	2004	315	National	1–4	NA	WHO	No	(40)
Cyprus	2004	678	National	2–4	Measured	IOTF/WHO	Yes	(41,42)
The Czech Republic	2001	16 458	National	0–4	Measured	IOTF/WHO	Yes	(33,43)
France	1998–1999	170	National	3–4	Self-reported	IOTF	Yes	(44,45)
	2006–2007	191	National	3–4	Measured	IOTF	Yes	(46)
	2006–2007	92	National	3–4	Measured	IOTF	Yes	(47)
Greece	2003–2004	2 352	Subnational	1–4	Measured	IOTF/WHO	Yes	(48)
Ireland	2001–2002	1 352	National	4	Measured	IOTF	No	(49)
Italy	2005	2 997	Subnational	0–4	Measured	IOTF/WHO	Yes	(50)
Lithuania	1999–2000	451	Subnational	3–4	Measured	WHO	Yes	(51)
The Netherlands	2002–2004	1 781	National	4	Measured	IOTF	No	(52)
	2002–2006	1 878	National	2–4	Self-reported	IOTF/WHO	Yes	(53)
Poland	2000	175	National	1–4	Measured	IOTF/WHO	Yes	(54,55)
Portugal	2001	1 557	Subnational	3–4	Measured	IOTF/WHO	Yes	(56)
Romania	2004	3 971	National	0–4	Measured	IOTF/WHO	Yes	(57)
Spain	1998–2000	268	National	2–4	Measured	IOTF/WHO	Yes	(25,58)
	2006	2 701	National	0–4	Self-reported	IOTF/WHO	Yes	(59)
Sweden	1997–2004	10 438	Subnational	0–4*	Self-reported	IOTF/WHO	Yes	(60)
	2002	183	Subnational	4	Measured	IOTF	No	(61)
	2003	590	National	4	Self-reported	IOTF	No	(62)
UK	England	2001–2002	National	2–4	Measured	IOTF/WHO	Yes	(63)
	Northern Ireland	2001–2002	National	4	Measured	IOTF	No	(49)
	Scotland	2003	National	2–4	Measured	IOTF/WHO	Yes	(64)

*Infants less than 1 year of age include only those from 6 months onwards.
IOTF, the International Obesity Task Force; NA, not available.

as available in the original article or report. The data drawn from the Global Database on Child Growth and Malnutrition are always presented using the WHO standard. Prevalence rates using the IOTF reference and cut-offs are obviously restricted to children over 2 years of age. Prevalence rates using the WHO standard refer to children at 0–59 months of age. However, not all articles, reports and databases include these age groups; data referring to different age groups were also analysed, in an attempt to look at time trends for which data are scarce, and will be highlighted when presented.

Prevalence rates of overweight and obesity according to IOTF reference and cut-offs, by age – at 2, 3 and 4 years – and by country, are reported in Table 2. All the results from surveys in which anthropometric data were self-reported are grouped at the bottom of the table. Among those with measured data, surveys in which it was impossible to disaggregate by age were also placed at the bottom. Among the remaining countries, listed in alphabetical order, Spain reports the highest prevalence at 4 years of age, followed by Ireland and Greece, while the Czech Republic and Romania report the lowest prevalence. The difference between Spain and Romania is almost threefold. However, the sample size in some of these surveys was so small (e.g. only 104 children in Northern Ireland in 2002) that some of the apparent differences may be as a result of the low precision of the

point estimates. In fact, many of these surveys were carried out to estimate prevalence in pre-school and school children together; restricting the analysis to the former age group led to a reduction of the sample size. Comparability may also be hampered by the different years covered by surveys in different countries.

Table 3 shows the prevalence rates of infants and children with BMI-for-age values higher than 1, 2 and 3 SD, based on the WHO standard, by age and by country. The raw data from Cyprus, Greece, Italy, the Netherlands, Poland, Portugal, Romania, Scotland, Spain, Sweden and England, used to calculate prevalence rates based on the WHO standard, are the same used in Table 2 for the IOTF reference and cut-offs. For some countries, age groups include also the first and second years of life.

The prevalence, by sex and by country, of overweight and obesity (IOTF reference and cut-offs) and of BMI-for-age higher than 1, 2 and 3 SD (WHO standard), respectively, in children at 24–59 months of age, is presented in Figs 1 and 2. In general, the rates in girls tend to be higher than those in boys using the IOTF reference and cut-offs, but not using the WHO standard. A breakdown by sex from birth to 5 years of age using the WHO standard is possible only for Spain, Italy, Romania and the Czech Republic (Fig. 3). Again, Spain reports by far the highest rates. Only countries with data for the whole age group,

Table 2 Prevalence rates (%) of overweight and obesity (IOTF reference and cut-offs) by age and by country

Country	Year(s)	Sample size	Measured or self-reported	Overweight			Obesity			Overweight and obesity		
				2 years	3 years	4 years	2 years	3 years	4 years	2 years	3 years	4 years
The Czech Republic	2001	5456	Measured	8.5	8.3	8.2	2.1	2.0	3.7	10.6	10.3	11.9
France	2006–2007	191	Measured		10.1	13.8		1.3	4.1		11.4	17.9
Greece	2003–2004	2154	Measured	15.1	16.6	16.2	5.8	7.2	11.1	20.9	23.8	27.3
Ireland	2001–2002	1352	Measured			20.5			7.0			27.5
Italy	2005	1230	Measured	10.2	13.5	14.4	3.1	4.5	7.8	13.3	18.0	22.2
The Netherlands	2002–2004	1781	Measured			12.2			2.8			15.0
Poland	2000	139	Measured	26.0	4.9	10.4	4.0	12.2	12.5	30.0	17.1	22.9
Portugal	2001	1557	Measured		15.4	16.9		5.1	6.2		20.5	23.1
Romania	2004	1826	Measured	9.2	6.8	6.7	4.5	4.6	5.1	13.7	11.4	11.8
Spain	1998–2000	268	Measured	8.9	16.7	24.7	6.3	11.5	7.5	15.2	18.1	32.3
Sweden	2002	183	Measured			19.0			6.0			25.0
UK England	2001–2002	1723	Measured	19.6	15.2	15.5	2.3	4.6	5.7	21.9	19.8	21.2
Northern Ireland	2001–2002	104	Measured			19.0			2.0			21.0
Scotland	2003	407	Measured	13.5	16.0	15.1	3.3	4.1	4.4	16.8	20.1	19.5
Belgium	1998–1999	970	Measured		4.8			2.2			7.0	
Cyprus	2004	647	Measured	7.7			2.9			10.6		
France	2006–2007	92	Measured		8.8			1.2			10.1	
Belgium	2004	218	Self-reported							7.0		
France	1998–1999	170	Self-reported		10.6			5.9			16.5	
The Netherlands	2002–2006	1878	Self-reported	8.2			5.9			14.1		
Spain	2006	1181	Self-reported	13.5	16.1	17.7	16.2	13.7	15.5	29.7	29.8	33.2
Sweden	1999–2004	8302	Self-reported	13.3	13.1	12.3	2.6	2.1	3.0	15.9	15.2	15.3
	2003	590	Self-reported			15.7			3.0			18.7

IOTF, the International Obesity Task Force.

Table 3 Prevalence rates (%) of BMI-for-age higher than 1, 2 and 3 SD (WHO standard) by age and by country

Country	Year(s)	Sample size	Measured or self-reported	>1 SD \leq 2 SD					>2 SD \leq 3 SD					>3 SD				
				0 year	1 year	2 years	3 years	4 years	0 year	1 year	2 years	3 years	4 years	0 year	1 year	2 years	3 years	4 years
Cyprus	2004	647	Measured			11.7	7.8	12.3			1.3	3.9	4.8			3.9	1.5	1.0
The Czech Republic	2001	16 457	Measured	9.8	21.1	18.2	16.4	14.5	1.8		6.6	4.4	3.9	0.3	1.3	1.1	1.1	1.5
Greece	2003–2004	2 348	Measured		22.3	23.3	28.7	25.2		9.5	10.1	9.4	11.6		3.2	3.4	4.2	4.1
Italy	2005	2 977	Measured	14.3	21.6	19.3	23.3	21.7	2.7	6.8	4.0	7.3	6.1	0.1	0.5	1.7	3.6	4.1
Lithuania	1999–2000	451	Measured				20.8	16.5				4.5	2.0				0.6	0.0
Poland	2000	175	Measured		17.1	30.6	19.5	17.4		20.0	14.3	0.0	4.4		8.6	0.0	12.2	4.3
Portugal	2001	1 546	Measured				27.5	26.7				9.6	9.1				1.2	1.4
Romania	2004	3 971	Measured	11.0	18.1	16.4	10.9	12.3	2.4	6.8	7.1	6.4	3.0	0.9	1.6	2.2	1.6	2.5
Spain	1998–2000	268	Measured			30.4	26.1	33.3			5.1	10.4	8.6			5.1	5.2	4.3
UK	2001–2002	1 903	Measured			33.5	29.6	26.6			10.1	8.3	7.7			1.6	2.8	2.6
Scotland	2003	407	Measured			26.1	37.3	30.4			9.1	6.5	6.2			1.6	2.9	2.2
Bulgaria	2004	315	NA		33.8	30.8	22.8	15.7		14.7	14.9	1.8	4.9		4.4	4.9	3.5	3.9
The Netherlands	2002–2006	1 878	Self-reported			14.9					5.0					4.0		
Spain	2006	2 701	Self-reported	12.9	19.3	18.2	21.6	25.7	9.2	7.4	11.5	10.5	10.5	7.6	5.4	6.9	6.6	6.7
Sweden	1997–2004	10 438	Self-reported	24.0	24.5	27.0	26.6	16.0	4.5	6.0	6.9	6.5	3.7	0.3	0.6	1.1	1.1	1.0

BMI, body mass index; NA, not applicable; SD, standard deviations.

24–59 months and 0–59 months, were included in these figures.

Data on trends over time in children at 24–59 months of age are available for four countries using the IOTF reference and cut-offs (the Czech Republic, France, the Netherlands and England) and for three using the WHO standard (the Czech Republic, the Netherlands and Romania). Tables 4 and 5 show these data broken down by sex to highlight the differences and the shifting of higher prevalence rates between boys and girls over time. Overall, these data do not seem to indicate an upward trend over time, except for England despite the drop in 2001, which was most likely a data irregularity because of the small sample size. The data from the Netherlands show ups and downs most likely because of the small sample sizes of the surveys.

Discussion

The aim of this review of existing data was to summarize current evidence about the prevalence of overweight and obesity in infants and pre-school children in EU countries. The main findings are that nine out of 27 EU countries do not possess nationally representative data, that those with data use different definitions and methods for collection and analysis, that obesity is already prevalent in this age group in many EU countries, and that there are wide differences in reported prevalence among countries. Another interesting, although not conclusive, finding is that there is no obvious trend towards increasing prevalence in this age group.

Despite efforts to select the best sets of data, it is clear that comparability among and even within countries is a problem: data are not always representative at national level; sample sizes vary from small to large (with obvious consequences on the precision of the estimates); age groups and dates of surveys are different; weight and length/height are not always measured (and there are concerns about the accuracy of self-reported data); methods of measurement may also differ. Moreover, prevalence rates are not calculated based on the same reference population and using the same cut-offs. Whenever possible, we used the IOTF reference and cut-offs to present prevalence rates. In many of the original reports, however, the authors used data from their own or from other countries as reference (the 1977 NCHS/WHO reference being widely used, followed by the CDC 2000, UK and Dutch data) and different percentiles as cut-offs (most often the 85th and 95th or 97th percentile). Using different reference populations and cut-offs yields different results. In Spain, for example, the prevalence of obesity from 2 to 24 years was two to three times higher using the Spanish reference population with the 97th percentile as cut-off than using the IOTF cut-offs, while the rates of overweight were similar (25,26).

The recent launch of the WHO standard, which we used whenever possible to complement our analysis, has

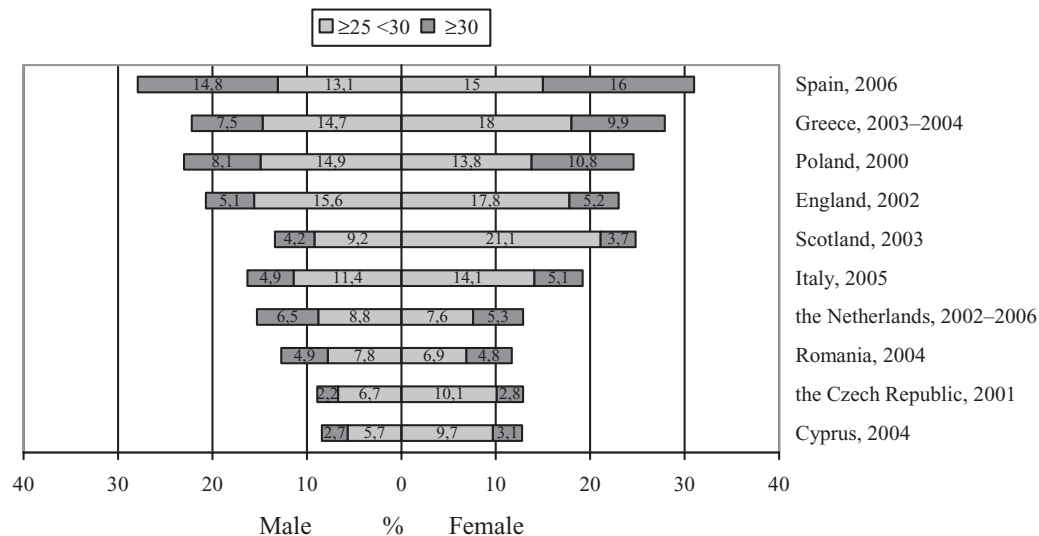


Figure 1 Rates of overweight and obesity (the International Obesity Task Force reference and cut-offs) in children at 24–59 months of age, by sex and country.

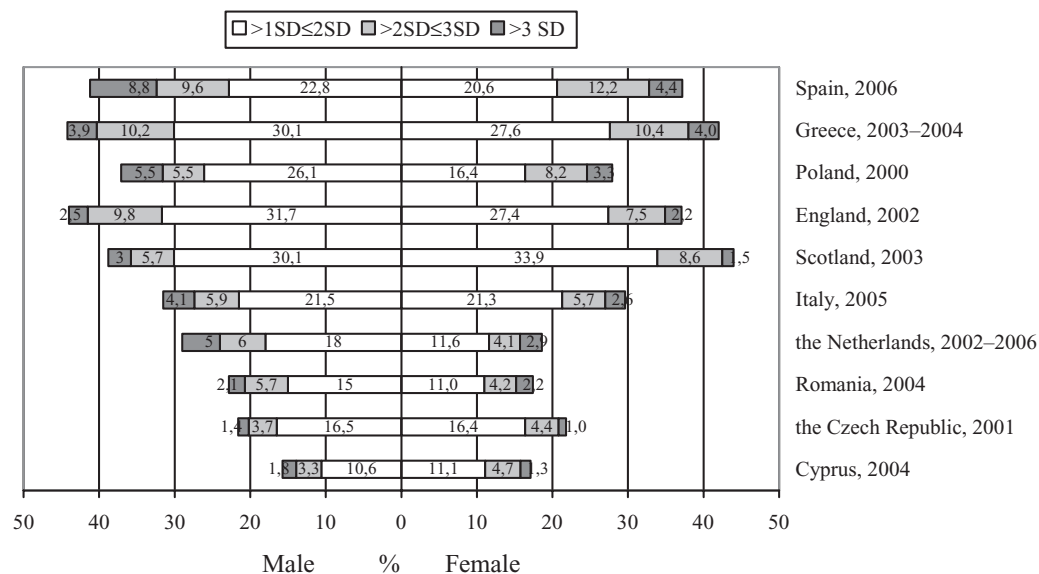


Figure 2 Rates of children at 24–59 months of age with BMI-for-age higher than 1, 2 and 3 SD (WHO standard), by sex and country. BMI, body mass index; SD, standard deviations.

further complicated the estimates of prevalence. Compared with the UK 1990 reference, for example, the WHO standard with a cut-off at the 98th percentile increased the risk of classifying as obese the 4–5-year-old children of two British cohorts by 35% (95% CI, 2% to 78%) (27). In the USA, the application of the 95th percentile of the WHO standard to a representative sample of children at 24–59 months of age produced a higher prevalence of overweight (12.8%) compared with the results obtained with the CDC 2000 growth charts (9.6%); however, applying the two or more z-score cut-

off value of the WHO standard, corresponding to the 97.7th percentile, the difference was smaller (28). In Canada, the WHO standard and the CDC 2000 reference were used on 547 children less than 2 years old admitted to a tertiary care hospital; the WHO standard identified more children as at risk of overweight and obesity compared with the CDC reference (21.0% vs. 16.6%) using the 85th weight-for-length percentile as cut-off; for about 9% of all children and about 16% of those aged less than 6 months, the BMI-for-age and weight-for-length percentiles differed by more than 25 percentile points (29).

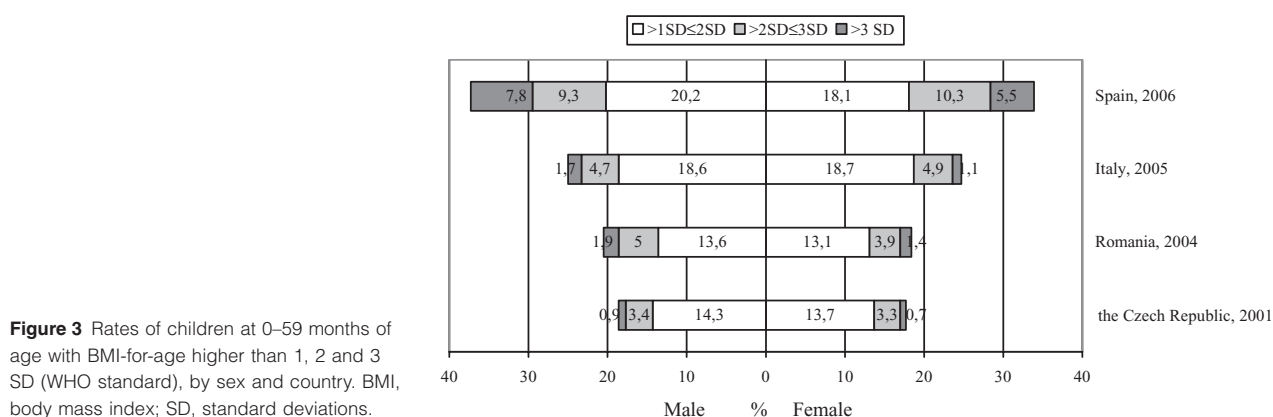


Figure 3 Rates of children at 0–59 months of age with BMI-for-age higher than 1, 2 and 3 SD (WHO standard), by sex and country. BMI, body mass index; SD, standard deviations.

Table 4 Trends in the prevalence rates (%) of overweight and obesity (IOTF reference and cut-offs) in children at 24–59 months of age, by sex and by country

Country	Year(s)	Sample size	Measured or self-reported	Overweight			Obesity			Overweight and obesity		
				Male	Female	Total	Male	Female	Total	Male	Female	Total
The Czech Republic	1981	24 788	Measured	8.0	8.8	8.4	1.5	1.8	1.7	9.5	10.6	10.1
	1991	15 546	Measured	7.5	8.3	8.0	1.7	1.4	1.5	9.2	9.7	9.5
	2001	5 455	Measured	6.7	10.1	8.4	2.2	2.8	2.5	8.9	13.9	10.9
England*	1995	1 000	Measured	13.7	15.3	14.5	2.9	4.4	3.7	16.6	19.7	18.2
	1996	1 040	Measured	13.4	14.4	13.9	4.3	5.7	5.0	17.7	20.1	18.9
	1997	1 873	Measured	12.9	17.0	15.0	3.6	5.7	4.7	16.5	22.7	19.7
	1998	979	Measured	14.9	14.5	14.7	2.0	5.4	3.6	16.9	19.9	18.3
	1999–2000	932	Measured	15.0	15.4	15.2	6.0	5.4	5.7	21.0	20.8	20.9
	2001	800	Measured	13.5	13.3	13.4	3.8	3.8	3.8	17.3	17.1	17.2
	2002	1 590	Measured	16.0	18.4	17.2	5.7	6.7	6.2	21.7	24.6	23.4
France†	1998–1999	170	Self-reported			10.6			5.9			16.5
	2006–2007	92	Measured			8.8			1.2			10.1
The Netherlands‡	1982–1986	1 630	Self-reported	8.0	9.4	8.6	5.1	8.6	6.8	13.1	18.0	15.5
	1987–1991	1 334	Self-reported	8.6	8.8	8.7	6.8	5.8	6.3	15.4	14.6	15.0
	1992–1996	1 651	Self-reported	8.0	10.9	9.4	7.7	6.9	7.3	15.7	17.9	16.7
	1997–2001	1 701	Self-reported	9.8	8.8	9.3	5.8	5.0	5.4	15.7	13.8	14.8
	2002–2006	1 878	Self-reported	8.8	7.6	8.2	6.5	5.3	5.9	15.4	12.9	14.1

*24–71 months of age.

†36–59 months of age.

‡Surveys carried out every year, sample size being the sum for 5 years. IOTF, the International Obesity Task Force.

It is unfortunately very difficult to decide which reference population should be used and, most importantly, what cut-offs for overweight and obesity lead to the most valid assessment. To date, all cut-offs have been established in an arbitrary way, not based on clinical research on related health outcomes, and further research is therefore necessary. Non-arbitrary cut-off values need to be established also to assess benefits and risks involved in the treatment of infant and early childhood overweight and obesity. Further efforts are also required to develop a set of standard procedures for sampling and for anthropometric measurements; for the latter, the procedures recommended by the

manual WHO has developed to train health workers on the use of its growth standard may be useful (24).

Despite all these limitations, this review provides useful information that was not yet available. First, the countries in the Mediterranean region and the British islands report the highest rates of overweight and obesity in pre-school children, while countries in middle, eastern and northern Europe report the lowest. This is consistent with reports in older children (6). Second, no clear age trend was observed, the rates do not seem to increase or decrease with age. Using the IOTF reference and cut-offs, girls appear to have higher rates than boys, but this difference is not observed

Table 5 Trends in the prevalence rates (%) of BMI-for-age higher than 1, 2 and 3 SD (WHO standards) in children at 24–59 months of age, by sex and by country

Country	Year(s)	Sample size	Measured or self-reported	>1 SD ≤2 SD			>2 SD ≤3 SD			>3 SD		
				Male	Female	Total	Male	Female	Total	Male	Female	Total
The Czech Republic	1981	24 788	Measured	18.5	16.1	17.3	3.1	4.5	3.7	0.8	0.7	0.7
	1991	15 546	Measured	16.7	15.2	16.0	4.5	2.9	3.7	1.0	0.3	0.6
	2001	5 455	Measured	16.5	16.4	16.5	3.7	4.4	4.0	1.4	1.0	1.2
Romania	1999	7 304	Measured	21.0	19.9	20.5	12.3	10.2	11.3	4.7	3.5	4.2
	2000	7 179	Measured	19.6	19.3	19.4	10.9	9.9	10.5	5.2	4.1	4.7
	2001	6 821	Measured	20.2	20.0	20.1	10.0	10.2	10.1	4.9	3.8	4.4
	2002	5 058	Measured	23.1	20.5	21.9	8.9	9.0	8.9	3.3	2.6	3.0
The Netherlands*	2004	1 817	Measured	15.0	11.0	13.0	5.7	4.2	4.9	2.1	2.2	2.2
	1982–1986	1 630	Self-reported	14.7	14.9	14.8	4.3	6.4	5.3	4.8	4.8	4.8
	1987–1991	1 334	Self-reported	16.4	13.5	14.9	5.5	3.9	4.7	5.6	3.8	4.7
	1992–1996	1 651	Self-reported	14.9	13.8	14.4	5.5	6.6	6.1	6.8	3.7	5.3
	1997–2001	1 701	Self-reported	16.1	12.8	14.5	6.6	4.2	5.5	4.7	2.6	3.7
	2002–2006	1 878	Self-reported	18.0	11.6	14.9	6.0	4.1	5.0	5.0	2.9	4.0

*Surveys carried out every year, sample size being the sum for 5 years.
BMI, body mass index; SD, standard deviations.

when the WHO standard is used. This may be as a result of a sex bias at 18 years in the IOTF reference, because the BMI plateaus earlier in girls than in boys, so that from 18 to 20 years the BMI rises more in boys than in girls (30). Third, as far as trends over time are concerned, based on the available data from five countries, it appears that there has been no increase in the rates of overweight and obesity among pre-school children in the past 20–30 years, with the possible exception of England. However, as early adiposity rebound predicts later fatness (31,32), it is important to note that the age of adiposity rebound has been reported to occur progressively earlier in the Czech Republic (33). This means that the issue of trends over time has to be further explored, especially in view of the fact that data are available only from five countries and that two of these are countries in economic transition. The lack of an increase in trends in pre-school children is in contradiction with the well-established increase in trends among school children and adolescents (4). However, recent reports from France and Italy indicate that the prevalence may be levelling out in these age groups (34–36).

Finally, many of the papers selected for analysis of prevalence and trends reported associations with socioeconomic status (SES). Parental education is the most used indicator of SES, followed by occupation, income and area of residence. However, the different ways in which these variables are defined and analysed in different studies, together with the frequent lack of control for confounding, preclude a combined analysis and interpretation of results. A standard way of gathering and analysing SES variables associated with overweight and obesity in infants and pre-school children should be used in future research.

In conclusion, this review draws attention to the urgent need for research and policies on the prevention and treatment of overweight and obesity from infancy and early childhood, and for standard methods of surveillance of overweight and obesity in infants and pre-school children, including standard ways of monitoring inequalities, in all EU countries. Should EU countries adopt the new WHO standard for growth monitoring and surveillance, because it covers all age groups from birth to 5 years and removes the gender bias associated with the use of the IOTF reference and cut-offs, research will be needed to identify cut-offs for overweight and obesity associated with poor health outcome.

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Conflict of Interest Statement

All authors declare that they have no conflict of interests.

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