ARTICLE

Body Mass Index and Overweight in Adolescents in 13 European Countries, Israel, and the United States

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Objective: To compare the body mass index (BMI) (calculated as weight in kilograms divided by the square of height in meters) and the prevalence of BMI at or above the 85th centile and 95th centile (overweight) in adolescents.

Design: Cross-sectional, nationally representative school-based surveys in 1997-1998 by means of identical data collection methods.

Setting: Austria, Czech Republic, Denmark, Flemish Belgium, Finland, France, Germany, Greece, Lithuania, Ireland, Israel, Portugal, Slovakia, Sweden, and the United States.

Participants: A total of 29 242 boys and girls, aged 13 and 15 years.

Main Outcome Measures: The BMI, BMI at or above the 85th centile, and BMI at or above the 95th centile (overweight) from self-reported height and weight.

Results: The highest prevalence of overweight was found in the United States and the lowest in Lithuania. On the basis of the study reference standard, the prevalence of overweight (percentage) in the United States was 12.6% in 13-year-old boys, 10.8% in 13-year-old girls, 13.9% in 15-year-old boys, and 15.1% in 15-year-old girls, all significantly increased. Prevalence of overweight in Lithuania was significantly below the expected 5%, with 1.8% in 13-year-old boys, 2.6% in 13-year-old girls, 0.8% in 15-year-old boys, and 2.1% in 15-year-old girls. Relative rankings among countries were similar for BMI at or above the 85th centile, although there were less dramatic differences at this level.

Conclusions: The highest prevalences of overweight were found in the United States, Ireland, Greece, and Portugal.

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OVERWEIGHT AND OBESITY have increased globally among children, adolescents, and adults.[1] The World Health Organization (WHO) designates obesity as one of the most important public health threats because of the significant impact of chronic conditions associated with obesity. Obesity in adults increases the risk of cardiovascular diseases, diabetes, and musculoskeletal disorders.[2,3] Obesity is less prominently associated with morbidity in adolescence[4] but is a strong precursor of obesity and related morbidity in adulthood, with 50% to 80% of obese teenagers becoming obese as adults.[5,6] During adolescence, overweight and obesity are often a burden that results in psychosocial problems[7,8] and a reduced capacity for physical activity.[9] Adolescence is a critical period for the onset of obesity[10] and for obesity-associated morbidity in later life.[11-13] Therefore, from a public health perspective, it is important to monitor overweight in adolescence.

In the United States, the increased prevalence of overweight in older children and adolescents has been documented since the mid-1960s, with the current rate of increase being the largest since the period between 1976 and 1980.[14,15] In Denmark, it has recently been shown that the increase of obesity in children began just after World War II and that it started in children before it increased for adults.[16] Secular trends of body mass index (BMI) (weight in kilograms divided by the square of height in meters) in children nationally indicate that the average weight of children who are overweight is now heavier than previously.[17] The most recent examinations of US children in the Third National Health and Nutrition Examination Survey (NHANES III) showed them to be much heavier than in previous surveys, reinforcing the need for appropriate BMI references for both US and international comparisons.[15,18,19]

For adults, BMI values at or above 25 indicate overweight and a BMI at or above

30 defines obesity.[17,18] No such generally accepted definitions exist for children and adolescents. Since BMI increases for youth on average from about age 6 or 7 years, through puberty[19] to age 17 years, it is necessary to have age- and sex-specific definitions of overweight and obesity. A recommendation by the International Obesity Task Force for BMI references averaged BMI-for-age data for measured children, aged 6 to 18 years, across 6 heterogeneous countries (Brazil, Great Britain, Hong Kong, the Netherlands, Singapore, and the United States) and projected the centile curves through the adult cutoff points (25 at the 85th centile and 30 at the 95th centile) at age 18 years in an effort to produce new internationally appropriate references.[18,20,21] In the United States, for children and adolescents, the term *obesity* is generally reserved for clinically diagnosed cases, and the comparable terms and definitions used for measured children in screening or for surveys are *at risk of overweight* (85th-94th centile) and *overweight* (≥95th centile) on the basis of BMI for age.

Even with no generally accepted current international definitions for overweight and obesity in children, both the Centers for Disease Control and Prevention[14,17] and the European Childhood Obesity Group have recommended the use of BMI both for clinical work and for epidemiologic research.[22] Studies on overweight and obesity in children and adolescents are difficult to compare because of differences in methods (measured or self-reported heights and weights) and periods of data collection (secular trends).[23] Other problematic issues include the method used for the assessment and definition of obesity (cutoff points or adequate reference tables relevant to the population studied), nonrandom selection criteria for children and adolescents, representativeness of samples (area or national), sample size, age, and sex.[23]

The aims of this article are to (1) determine and compare country-specific BMI 85th and 95th centiles based on self-reported pooled data from adolescents across 15 countries and (2) estimate the prevalence of BMI at or above the 85th centile and the 95th centile (overweight) in adolescents across countries by means of the study reference standard.

METHODS

SUBJECTS

The analysis is based on nationally (or regionally for Flemish Belgium and France) representative, cross-sectional 1997-1998 school-year surveys of adolescents in Europe, Israel, and the United States.[24] The surveys were done as part of the Health Behaviour in School-aged Children (HBSC) project, a cross-national survey conducted in collaboration with the WHO Regional Office for Europe. Because the HBSC is carried out under the auspices of the WHO, the research protocol for each HBSC survey complies with the strict ethical standards that the WHO requires of its collaborative research. The survey was also carried out according to the ethical procedures required by each individual participating country or region. For the United States, the survey protocol was approved by the National Institute of Child Health and Human Development (National Institutes of Health, US Department of Health and Human Services) institutional review board, and active parental and student consent was solicited.

The HBSC school-based surveys used a common research protocol to standardize sampling methods, data collection, and measurements.[24] In each country, a cluster sample design of classrooms within schools was used to obtain recommended self-weighting samples to meet the required precision for nationally representative estimates. The precision required was that the 95% confidence intervals (CIs) be no more than ±3% for each age group (11-, 13-, and 15-year-olds) and that the effect of each country's sample design be no more than 1.4 times the expected variance for estimates that would be obtained if the survey were performed as a nonclustered simple random sample. An average design effect of 1.2 due to the clustering of school-based samples was expected.

Each country needed to submit about 1540 students for each age group to meet the minimum criteria for participation, although very small countries or regions may have required fewer students. Further descriptions of the sample designs, statistical requirements, and procedures in each country are available in a recent WHO publication.[24] The anonymous and standardized questionnaire and measures were translated forward and backward from the English-language standard version to the national languages. This analysis uses data from optional questions on height and weight as completed in 15 countries during the 1997-1998 survey.[25] Adolescents younger than 13 years were not used in this analysis because of variability associated with puberty and lack of reliability in self-reported height and weight among young adolescents.[26]

DATA

The data from 15 countries were included in an international data file of all countries' data on self-reported height and weight. Adolescents at ages less than 13, 14, or greater than or equal to 16 years were excluded to yield measures for age in months at 13 and 15 years. Adolescents were excluded from the international file if month or year of birth was unknown.

Two items measured height and weight: "How much do you weigh without clothes?" and "How tall are you?" The BMI was calculated from self-reported height and weight. Some countries allowed reporting in stones, pounds, ounces, feet, or inches, which were then converted to kilograms and centimeters, as appropriate.

In 12 countries, either height or weight was missing in 8% or less of cases; missing data involved 13% of total students surveyed in Israel, 21% in Lithuania, and 39% in Ireland. Use of multiple languages and types of measures within a country was considered the probable reason for missing reports in these latter countries after the completed questionnaires were double-checked. For example, Ireland asked for the weight measures to be reported in stones, pounds and ounces, or kilograms and grams; and height in feet and inches or centimeters. Irish students frequently just left these questions blank.

Data on height and weight were deemed valid for inclusion on the basis of height and weight range specifications available from the NHANES III.[14] The NHANES III ranges were created to exclude values due to measurement errors resulting in extremely improbable heights and weights for a given age. Height ranges allowed for boys aged 13 and 15 years, respectively, were 130 to 199 cm and 140 to 199 cm, and for girls, 130 to 199 cm and 135 to 199 cm. The lowest weight allowed in both sexes aged 13 and 15 years was 25 and 32 kg, respectively, and the highest was 115 kg. Across the 15 countries, 2311 and 1189 records were excluded because of missing values on height and weight, and 91 and 52 because of extreme values for height and weight, respectively. Furthermore, 50 were excluded because of extreme low values of BMI (lowest accepted value was 12), resulting in a final analytic data file of 29 242 adolescents aged 13 and 15 years from 15 countries.

From each country, the following numbers of adolescents were included: Austria, n=1946; Belgium, n=2643; Czech Republic, n=1988; Denmark, n=1910; Finland, n=2170; France, n=2243; Germany, n=2516; Greece, n=2301; Ireland, n=826; Israel, n=991; Lithuania, n=1724; Portugal, n=1460; Slovakia, n=2233; Sweden, n=2223; and United States, n=2068. Means ages for all countries combined were 13.5 and 15.5 years for both boys and girls. Across countries, mean ages varied among 13-year-old boys from 13.3 to 13.7 years, among 13-year-old girls from 13.3 to 13.8 years, and in 15-year-old boys and girls from 15.3 to 15.7 years. The SEs for age were very small and varied little across countries, sex, and age (from 0.01 to 0.03).

STATISTICAL ANALYSES

Univariate analyses of the mean, median, and centile distributions of age, height, weight, and BMI were completed for each country. We present the country-specific 85th and 95th centile levels for BMI, since they are frequently recommended for the assessment of risk of overweight status.[17,27] The SEs and CIs based on variance in estimates for each country were calculated by means of SUDAAN,[28] which adjusts variance estimates for complex sample survey designs. The school was the primary sampling unit for each country's survey, so the variance estimates were adjusted for clustering of adolescents within schools for this analysis. All CIs are shown at the 95% level.

The International Obesity Task Force and other country-specific reference curves were tested for use as a reference[29-32] but were not sensitive for comparing at BMI at or above the 85th centile and BMI at or above the 95th centile (overweight) among most countries in our study. A distributional curve based on total self-reported BMIs among HBSC countries appeared skewed in comparison with the International Obesity Task Force and other references. After extensive checking for country-specific consistency between self-reported and measured BMIs when such comparisons were available, less divergence was found within these countries when a BMI curve was used that included only the reports from 15 HBSC countries. For purposes of having an appropriate reference based on self-reported weights to be used just for this analysis, a study reference standard was created.

STUDY REFERENCE STANDARD

A reference curve, based on the 29 242 observations from all 15 countries, was created from self-reported heights and weights to establish cutoffs for BMI at or above the 85th centile and BMI at or above the 95th centile. Data were weighted so that the 15 countries were equally represented in the combined data set to address potential bias to the study reference standard from different numbers of observations from each country.[28] Centile curves at the 85th and 95th centiles were smoothed across month of age within year, resulting in references appropriate for each sex by month of age to use in comparisons.

The study reference standard cutoff points were determined at the BMI levels at or above the 85th and 95th centiles for 13.5- and 15.5-year-olds, as given in **Table 1**.

Table 1. Age- and Sex-Specific BMI Cutoff Points at 13.5 and 15.5 Years According to the Study Reference Standard for BMI at or Above 85th or 95th Centile

		BMI	
Age, y	BMI Centile	Boys	Girls
13.5	≥85th	22.1	21.7
	≥95th	24.8	24.4
15.5	≥85th	23.2	22.8
	≥95th	26.0	25.4

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters).

RESULTS

Table 2 describes mean weights, heights, and BMI for each country. Weights for boys ranged from the lowest in Lithuania to the highest in Greece, and the United States at both 13 and 15 years. Means and medians were very similar, usually with overlapping CIs. Data for medians are not shown because the distributions at the 85th and 95th centiles address issues of data skewness.

Figures 1, **2**, **3**, and **4** show the 85th and 95th centile values of BMI in each country for 13- and 15-year-old adolescents of each sex. The highest 85th and 95th centiles consistently were from the United States. The lowest 85th and 95th centiles of 13-year-old boys were those from Lithuania and Denmark.

Table 3 presents the proportion of children at or above the 85th centile and at or above the 95th centile (overweight) of the BMI distribution compared with the study reference standard (see the "Methods" section). For instance, 13-year-old boys from the following countries had statistically significantly increased prevalence at the 85th centile or greater (lower limit of CI at or above 15%): Greece (28.7%), Ireland (24.7%), the United States (25.5%), and Finland (19.4%). Girls showed the same pattern among 13-year-olds, with the addition of Portugal (22.8%).

For 13-year-olds, the prevalence of overweight at or above the 95th centile was statistically significantly increased (lower limit of CI at or above 5%) only in US boys (12.6%) and girls (10.8%) and in Greek boys (8.9%).

Among 15-year-old boys, US, Greek, and Israeli children had significantly increased prevalence of BMI at or above the 85th centile. Patterns of BMI at or above the 85th centile for 15-year-old girls were slightly different, although the United States was much higher than all other countries, with 31.0%. At age 15, only US (13.9%) and Greek (10.8%) boys and US (15.1%) and Portuguese (6.7%) girls were statistically significantly increased at the 95th centile.

COMMENT

The first main finding was the strong contrast between countries, with the highest prevalence of BMI at or above the 85th and 95th centiles (overweight) being seen in the United States and the lowest in Lithuania. Among 13-year-olds, countries with significantly increased prevalence of BMI at or above the 85th centile (for both sexes) were Ireland, Finland, and Greece. Countries with significantly low prevalence of BMI at or above the 85th centile were the Czech Republic, Denmark, Flemish Belgium, France, Germany, Lithuania, and Sweden, although comparisons within and among countries by age and sex varied.

Prevalence of overweight (BMI ≥95th centile) using the study reference standard from this survey showed similar trends, with the US adolescents reporting a higher

Table 2. Weight, Height, and BMI by Sex and Age Group*

	Weight, kg				Height, cm				BMI			
	Boys		Girls		Boys		Girls		Boys		Girls	
Country	13 y	15 y	13 y	15 y	13 y	15 y	13 y	15 y	13 y	15 y	13 y	15 y
Austria	50.4	61.5	49.0	54.9	161.5	173.7	160.7	165.9	19.2	20.4	18.9	19.9
Belgium (Flemish)	48.6	61.0	48.8	55.4	161.7	173.7	161.5	165.7	18.5	20.2	18.7	20.2
Czech Republic	50.9	62.4	49.6	55.8	163.4	175.1	162.2	166.6	19.0	20.3	18.8	20.1
Denmark	50.8	63.3	49.5	57.7	164.3	176.3	162.4	167.7	18.7	20.3	18.7	20.5
Finland	53.0	63.4	51.2	56.2	162.3	174.7	161.2	165.5	20.0	20.7	19.6	20.5
France	49.3	61.6	48.9	54.2	161.5	173.4	160.1	164.4	18.8	20.4	19.0	20.0
Germany	51.3	63.8	49.7	56.8	164.0	176.1	162.6	167.7	19.0	20.5	18.8	20.2
Greece	57.1	68.8	52.3	56.5	166.0	176.6	163.2	166.3	20.6	22.0	19.6	20.4
Ireland	53.8	63.1	50.7	55.1	163.0	172.2	159.3	163.6	20.3	21.2	20.0	20.6
Israel	49.1	62.7	47.7	54.3	161.2	173.6	159.0	163.2	18.8	20.8	18.9	20.4
Lithuania	48.0	58.7	47.5	54.8	161.3	173.3	160.7	166.4	18.3	19.5	18.3	19.8
Portugal	50.2	62.3	49.9	55.7	162.6	173.9	160.3	165.0	19.0	20.6	19.4	20.5
Slovakia	53.6	64.6	50.9	54.7	166.5	175.7	163.4	166.1	19.3	20.9	19.0	19.8
Sweden	51.0	63.4	50.1	55.8	162.9	175.5	161.5	165.8	19.1	20.5	19.1	20.3
United States	56.0	67.0	52.5	58.8	164.6	174.7	161.1	164.5	20.6	21.9	20.2	21.7

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters).
*The SEs for weight, height, and BMI are very small and vary little across country, sex, and age (from 0.1 to 0.8).

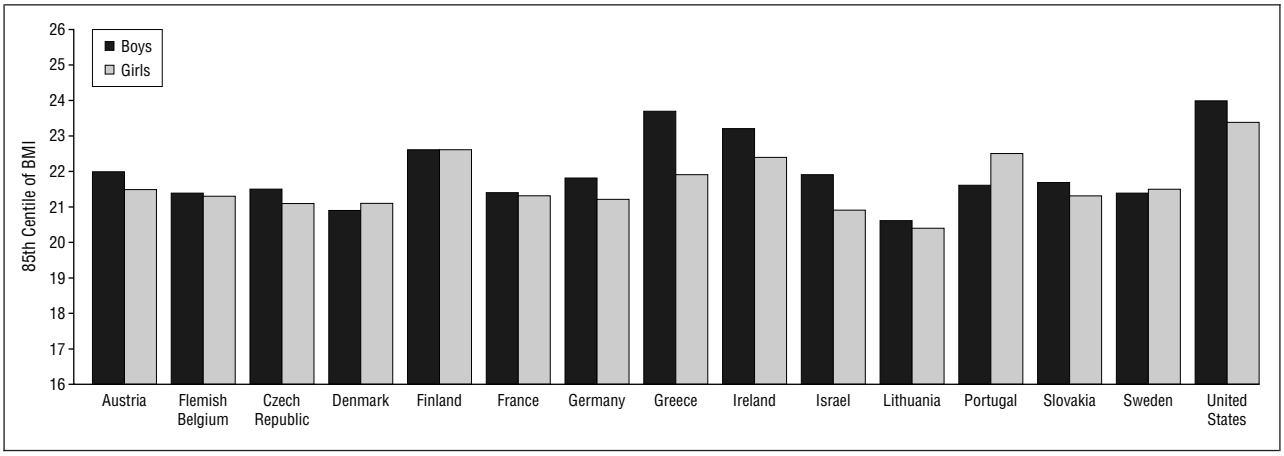

Figure 1. Body mass index (BMI) levels (calculated as weight in kilograms divided by the square of height in meters) at the 85th centile from self-reported heights and weights of 13-year-old boys and girls from 13 European countries or regions, Israel, and the United States. Data are from the 1997-1998 Health Behaviour in School-aged Children survey.

prevalence of overweight than any of the European countries or regions or Israel. Other countries with significantly increased prevalence of overweight were Greece and Portugal.

Our findings are generally consistent with the available country-specific references. The US study population data are generally consistent with current measurements from the NHANES III survey performed in 1988 to 1991.[14] The reference curve developed by Rolland-Cachera et al,[31] based on French children, was also consistent with the French data of this study, but distributions in many countries appeared skewed in comparison as well. Comparisons with references based on British adolescents,[29] who would be expected to be somewhat similar to those in neighboring countries included in this study, show 90th centile values similar to the 85th centiles of the Must curves based on US adolescents,[30] with higher values for girls than for boys. By contrast, the 90th centiles for French adolescents[31] are very similar for both sexes and are somewhat lower than both the Must 85th centile and British 90th centile. Data based on Belgian adolescents, which used measured height and weight, show similar values for the 85th centile in boys and girls aged 12 to 13 years and 14 to 15 years and in 14- to 15-year-old boys, but both the 85th and the 95th centiles for 14- to 15-year-old girls were considerably higher in this study when compared with Belgian figures.[33]

The best comparison may be a study on Finnish adolescents, which also used self-reported data from 1999. Our results on Finnish adolescents are very similar to the results from Kautiainen et al,[34] who measured 85th and 95th centiles as well as prevalence of overweight and obesity by means of International Obesity Task Force cutoff points in 12-, 14-, and 16-year-olds.

Our results should be seen in light of the strengths and weaknesses of the study. The major strength of this study is the comparable BMI data on adolescents from 15 different countries. The study is based on large rep-

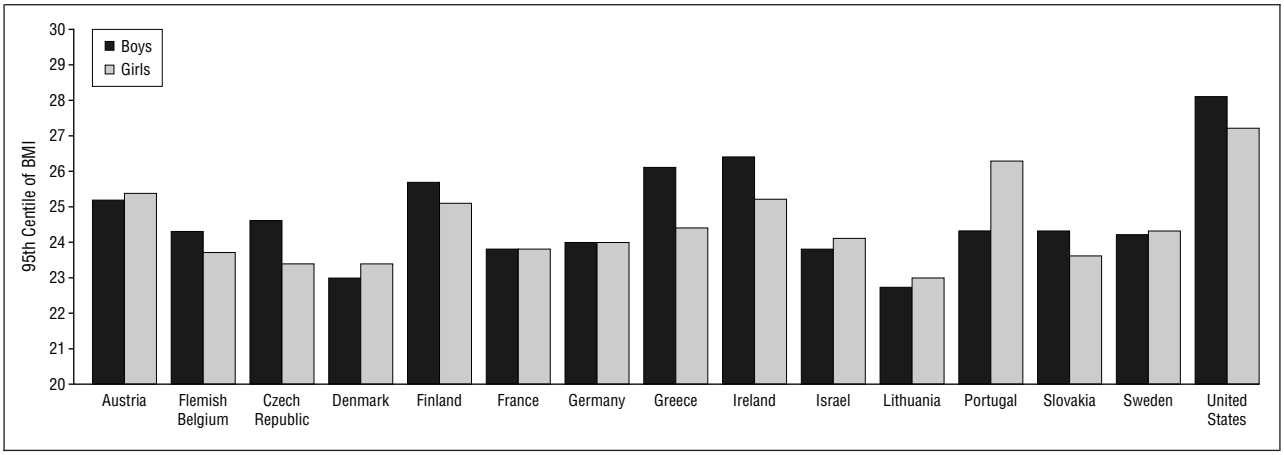

Figure 2. Body mass index (BMI) levels (calculated as weight in kilograms divided by the square of height in meters) at the 95th centile from self-reported heights and weights of 13-year-old boys and girls from 13 European countries or regions, Israel, and the United States. Data are from the 1997-1998 Health Behaviour in School-aged Children survey.

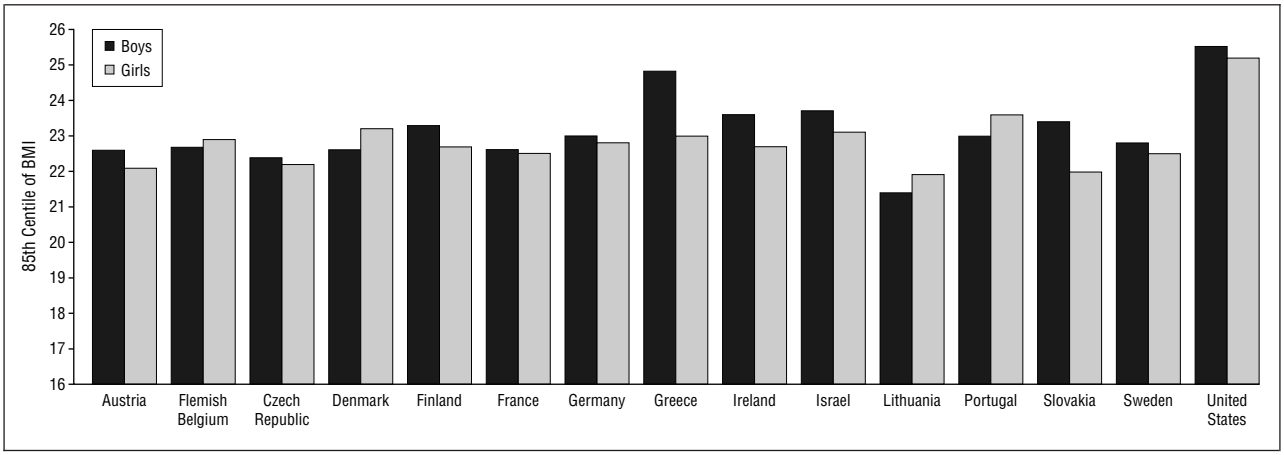

Figure 3. Body mass index (BMI) levels (calculated as weight in kilograms divided by the square of height in meters) at the 85th centile from self-reported heights and weights of 15-year-old boys and girls from 13 European countries or regions, Israel, and the United States. Data are from the 1997-1998 Health Behaviour in School-aged Children survey.

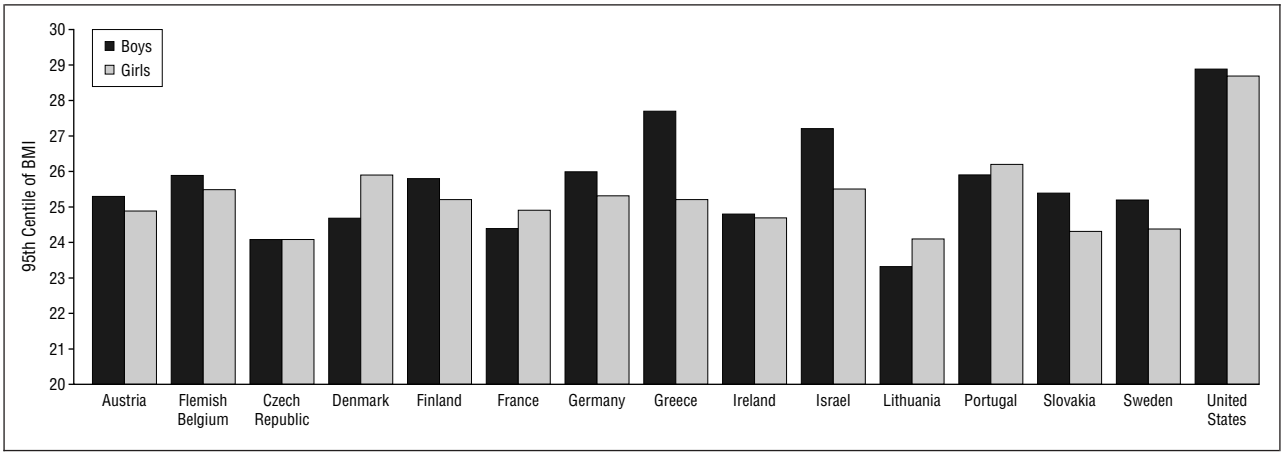

Figure 4. Body mass index (BMI) levels (calculated as weight in kilograms divided by the square of height in meters) at the 95th centile from self-reported heights and weights of 15-year-old boys and girls from 13 European countries or regions, Israel, and the United States. Data are from the 1997-1998 Health Behaviour in School-aged Children survey.

resentative national samples of adolescents with very high participation rates as recommended by an international work group.[21] All countries performed the data collection within the same time span, providing a strong basis for international comparisons. Most adolescents answered the questions of height and weight properly.

Table 3. Prevalence of BMI at or Above 85th and 95th Percentiles (Overweight) by Sex Using the Study Reference Standard

	13-Year-Old Boys, %				13-Year-Old Girls, %				15-Year-Old Boys, %				15-Year-Old Girls, %			
Country	≥85th*	CI	≥95th*	CI	≥85th*	CI	≥95th*	CI	≥85th*	CI	≥95th*	CI	≥85th*	CI	≥95th*	CI
Austria	15.2	11.5-18.9	5.5	3.2-7.8	14.4	10.5-18.3	6.1	3.6-8.6	11.6	8.0-15.3	5.1	2.8-7.4	10.9	7.9-14.0	4.4	2.7-6.0
Belgium (Flemish)	11.1	8.6-13.6	4.2	2.9-5.5	13.0	10.6-15.4	3.4	2.1-4.6	13.1	10.3-15.9	5.2	3.7-6.7	15.4	12.4-18.5	5.8	3.9-7.7
Czech Republic	12.1	8.9-15.3	4.5	2.7-6.3	10.3	7.1-13.6	2.7	1.2-4.2	8.1	5.7-10.4	1.9	0.8-3.0	9.3	6.9-11.8	3.5	1.7-5.3
Denmark	9.8	6.6-13.0	1.8	0.7-2.9	12.2	8.8-15.6	2.6	1.2-4.1	10.4	7.8-13.0	3.2	1.5-5.0	18.2	15.1-21.4	6.5	4.2-8.7
Finland	19.4	15.5-23.3	6.9	4.6-9.2	22.6	18.8-26.3	5.8	3.9-7.7	15.6	12.3-18.8	4.9	3.3-6.6	14.5	11.3-17.6	5.1	3.1-7.0
France	11.4	8.3-14.4	3.4	1.7-5.1	13.6	10.5-16.6	4.2	1.7-6.6	9.8	8.3-11.2	2.7	1.3-4.1	12.8	10.9-14.7	4.0	2.9-5.0
Germany	13.7	10.7-16.6	3.5	2.1-4.9	12.3	9.7-14.8	4.3	2.6-6.0	14.2	11.5-16.9	5.4	3.2-7.5	14.8	10.8-18.8	5.1	3.1-7.1
Greece	28.7	24.8-32.6	8.9	6.2-11.6	18.9	15.1-22.6	5.0	3.0-7.1	28.9	24.5-33.3	10.8	8.0-13.6	16.4	13.3-19.5	5.5	3.7-7.4
Ireland	24.7	18.5-30.8	7.0	3.2-10.7	21.4	15.2-27.6	6.6	2.4-10.7	19.3	13.1-25.6	2.8	0.4-5.2	14.2	10.9-17.4	4.7	2.4-7.0
Israel	13.9	8.7-19.1	3.5	0.7-6.2	12.3	7.5-17.1	4.8	2.0-7.5	20.1	15.9-24.2	6.8	3.9-9.8	16.4	11.9-20.9	6.2	3.4-9.0
Lithuania	7.5	4.6-10.4	1.8	0.3-3.2	9.0	6.5-11.5	2.6	1.2-4.1	5.2	3.0-7.4	0.8	0.0-1.6	8.1	5.9-10.3	2.1	1.0-3.3
Portugal	12.5	7.0-17.9	3.5	1.0-6.0	22.8	16.1-29.6	8.3	3.9-12.7	14.3	11.7-17.0	5.2	3.0-7.4	20.8	18.0-23.6	6.7	5.0-8.4
Slovakia	14.1	11.1-17.1	4.1	2.6-5.6	13.2	10.5-15.9	3.6	2.0-5.2	16.5	12.0-21.0	4.4	1.9-6.9	11.3	7.0-15.5	1.1	0.0-2.3
Sweden	11.5	8.6-14.5	3.8	2.3-5.3	14.4	11.7-17.2	4.8	3.2-6.3	12.3	10.0-14.7	4.0	2.4-5.6	12.3	9.1-15.4	3.4	2.0-4.9
United States	25.5	21.3-29.6	12.6	9.4-15.9	26.6	22.5-30.7	10.8	7.7-13.8	28.2	24.8-31.7	13.9	11.0-16.8	31.0	26.6-35.4	15.1	11.7-18.4
Total	15.1	14.1-16.1	5.0	4.4-5.6	15.4	14.3-16.3	4.8	4.2-5.4	15.0	14.0-16.0	5.3	4.7-5.9	15.3	14.4-16.2	5.5	4.9-6.0

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters); CI, confidence interval.
*Indicates centile.

One weakness is lack of physical examinations for measures of height and weight, although other studies have shown self-report to be relatively consistent.[26,35,36] Teens may not know their current height and weight or may know it as of several months ago. For the present purpose, namely, to assess differences between the countries, it is probable that differences in reporting during rapid growth periods may average out in cross-country comparisons. To our knowledge, no other studies are available with height and weight from so many countries. The problem with self-report is that the obese tend to underreport their weight, resulting in a lower prevalence of obesity. Prevalence therefore is probably higher than reported herein. Also, minor sex differences in reporting by adolescents may occur, with some boys overestimating their weight and some overweight girls providing underestimates. These reporting biases probably are consistent among countries. A validation study performed before the data collection in Denmark showed the same reporting bias. The correlation between self-reported and measured BMI was 0.8 (I.L., unpublished data, 1997). Also, a later pilot study performed in Flemish Belgium showed that adolescents aged 10 to 17 years could be accurately ranked according to BMI (correlation coefficient, 0.9) on the basis of self-reports of height and weight (Carine Vereecken, MSc, and Lea Maes, PhD, unpublished data, 1998). This preliminary validations study showed that boys' reports are almost identical, while those of girls show more variance, especially in weight. Self-reported weights were slightly lower than those shown in measured Flemish Belgian references.

An additional limitation of this study is the lack of pubertal indicators to adjust the prevalence of overweight for intercountry differences in the timing of maturation, an approach that has been recommended by the WHO.[30] Adjustment for the timing of maturation may be important because overweight status in girls is strongly associated with earlier maturation, while for boys early maturation is associated with a low BMI.[37] Cross-country comparisons in prevalence of overweight and obesity that do not account for population differences in the timing of maturation in relation to the reference may be biased. This point was recently made by Wang and Adair,[38] who found that, with the use of the WHO-recommended reference,[30] maturity adjustment based on population differences in the timing of menarche for girls increased the estimated prevalence of overweight in China and Russia, where girls mature later, and decreased the estimated prevalence in the United States, where girls mature earlier. We would likewise expect that maturity adjustment would have somewhat attenuated the differences in prevalence rates of overweight and obesity among countries, but would not have significantly affected their relative rankings.

The cross-sectional design of this study does not allow for causal analysis of the mechanisms behind the differences. Since most obese adolescents remain obese as

What This Study Adds

Currently there are no agreed-on age-specific definitions of overweight in children and adolescents, which makes comparisons of prevalence across countries difficult. This study compares prevalence of BMI at or above the 85th centile and the 95th centile (overweight) across 15 countries with the use of data collected with identical measures in the same time span. Overall, among 15 countries, the highest prevalence of BMI at or above the 85th centile and the 95th centile (overweight) was found in the Unites States. Among European countries and Israel, the highest prevalence of overweight was found in Greece and Portugal and the lowest in Lithuania.

Health Behaviour in School-aged Children

Health Behaviour in School-aged Children is a WHO/European Regional Office collaborative study. International coordinator of the 1997-1998 study was Candace Currie, University of Edinburgh, Edinburgh, Scotland; data bank manager, Oddrun Samdal, University of Bergen, Bergen, Norway. This publication on the 1997-1998 study reports on data from the following countries (principal investigators): Austria (Wolfgang Dür, MD), Flemish Belgium (Lea Maes, PhD), Czech Republic (Ladislav Csémy, PhD), Denmark (Bjørn E. Holstein, MSS, and Pernille Due, MD), Finland (Lasse Kannas, PhD, and Jorma Tynjälä, PhD), France (Christiane Dressen, PhD), Germany (Klaus Hurrelmann, PhD), Greece (Anna Kokkevi, MD, PhD), Israel (Yossi Harel, PhD), Lithuania (Apolinaras Zaborskis, MD), Ireland (Saiorse Nic Gabhainn, PhD), Portugal (Margarida Gaspar de Matos, PhD), Slovakia (Miro Bronis, MD, PhD), Sweden (Ulla Marklund, PhD), and United States (Mary D. Overpeck, DrPH, and Peter Scheidt, MD).

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adults,[5] this age group is a very important group to reach through preventive programs addressing issues of diet and sedentary lifestyles. Future research should either include more countries or address secular trends of overweight and obesity for youth on the international level.[39]

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