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Trends in overweight prevalence among 11-, 13- and 15-year-olds in Europe, Canada and USA from 2002 to 2010

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ABSTRACT

Background/purpose: The purpose of this study was to assess recent changes in the prevalence of overweight (including obesity) among 11-, 13-, and 15-year-olds in 33 countries from 2002 to 2010.

Methods: Data from 25 countries from three consecutive survey cycles (2002, 2006, and 2010) that had at least 80% response rate for self-reported height, weight and age were analysed using logistic regression analysis.

Results: Overweight prevalence increased among boys in 13 countries and among girls in 12 countries; in 10 countries, predominantly in Eastern Europe, an increase was observed for both boys and girls. Stabilization in overweight rates was noted in the remaining countries; none of the countries exhibited a decrease over the 8-year period examined. In the majority of countries (20/25) there were no age differences in trends in overweight prevalence.

Conclusion: In over half of the countries examined overweight prevalence did not change during 2002 to 2010. However, increasing overweight prevalence was noted in many Eastern European countries over this time period. Overweight prevalence remained high in several countries in Europe and North America. These patterns call for continued research in youth overweight and highlight the need to understand cross-national differences by examining macro-level indicators. Such research should feed into developing sound translations and practices to prevent and reduce overweight in youth.

Key words: *Overweight, adolescents, time-trends; cross-sectional survey; national samples*

INTRODUCTION

Overweight and obesity in childhood and adolescence are associated with several short and long-term adverse health consequences and high health-care costs¹⁻³. These include increased risk of cardiovascular disease and related metabolic abnormalities such as dyslipidaemia and impaired glucose tolerance, other conditions such as sleep apnoea and orthopaedic problems, as well as several psychological and social repercussions^{1,3,4}. Beyond tracking from adolescence into adulthood, adolescent overweight and obesity itself can have long-term adverse effects on adult health regardless of the weight status in adulthood^{5,6}.

The prevalence of childhood overweight and obesity has been increasing globally during the past two decades. Studies often describe overweight in children including its more advanced form i.e. obesity; in this paper, we use the term overweight to include obesity (unless otherwise indicated). Childhood overweight (including obesity) prevalence ranged between 6 and 36% in European countries in early 2000s⁷. An increase in overweight by up to 1% annually was noted in some European countries in the early 2000s⁸; however in recent years a stabilization in overweight prevalence has been suggested by cross-sectional surveys in several countries^{2,9}. Nevertheless, some studies indicate that this overall plateau in overweight prevalence in the last decade in children and adolescents may mask an increase in certain groups related to income, gender, or race-ethnicity^{2,9-11}.

Few studies have examined cross-national trends in overweight prevalence using the same definitions for overweight/obesity status². A recent report by Olds et al² based on data from 9 countries around the world using the International Obesity Task Force (IOTF)-2000 cut-offs to describe the trends in the prevalence of childhood overweight and obesity, shows a slowing plateau effect or a declining trend in several countries.

The Health Behaviours in School-aged Children (HBSC) study uses a common measure of overweight across countries. It has been collecting cross-sectional self-reported data on height and weight from nationally representative samples of 11-, 13-, and 15-year olds since 2002 in more than 30 countries

in Europe and North America with surveys conducted every four years. The HBSC datasets from surveys in 2002, 2006 and 2010 enable systematic examination of cross-national trends in childhood overweight using comparable data collected over the same period using standardized procedures¹² thereby adding to the limited cross-national literature on this topic in this age-group. The objective of the current analysis is to examine trends in the prevalence of overweight (including obesity) in 11-15 year olds in 33 countries in Europe and North America with data on 3 survey cycles of the HBSC (2002, 2006, and 2010) by gender.

METHODS

Data for present analyses were collected in 33 countries participating in the three consecutive cycles of the WHO collaborative HBSC study (2002, 2006, and 2010), an international collaboration between research teams across Europe and North America with the aim of gaining insights into adolescents' health and health behaviours. The standardized international research protocol was followed in each country to ensure consistency in survey instruments, data collection and processing procedures¹². Participation was voluntary, and anonymity and confidentiality were ensured. Questionnaires were administered in classrooms by trained personnel, teachers, or school nurses. The time frame for filling the questionnaires was one school period. Each country followed ethical and legal requirements in their country for this type of survey.

Self-reported data on BMI related variables (sex, age, height, and weight) from 33 countries (including Flemish and Francophone Belgium, Scotland, Wales and England as separate countries) taking part in HBSC surveys in 2002, 2006 and 2010 were examined. However, only countries (n=25) where there was less than 20% missing data on BMI were included for describing statistical findings and drawing conclusions, to be consistent with our previous publication¹³. Overweight (including obesity) status was assessed based on BMI using the IOTF-2000 cut-offs¹⁴. Age-standardized overweight prevalence rates were estimated, separately by survey cycle and gender, for each of the countries; the 2010 estimates were used as the standard. Overweight trends within each country were evaluated over time using logistic regression analyses considering overweight (dichotomized into yes vs. no) as the dependent variable and survey year

(continuous) and age (categorized with 11 year olds as reference) as independent variables. The significance of the trend was tested from the p-value of the slope coefficient β from the logistic fitting process. An interaction term between age and survey year was also included in the model to examine whether the trends were modified by age. All analyses were performed considering the effect of the survey design (including stratification, clustering and weighting) using STATA v12.1 (StataCorp, College Station, TX: StataCorp LP); a statistical significance level of 5% was used.

RESULTS

The description of statistical findings was limited to 25 countries with BMI data available on at least 80% of the surveyed population. Findings on the remaining 8 countries (with >20% data missing on BMI) are also presented at the end of the tables, but are not considered in describing the results or drawing conclusions.

Tables 1 and 2 present the number of pupils surveyed and percentage of sample with BMI data by survey year for boys and girls, respectively. Age-standardized prevalence of overweight by survey year for each gender is also shown in Tables 1 and 2. The prevalence of overweight was highest in USA (29 to 32.7 % for boys; and 20 to 25.6 % for girls) and lowest in Ukraine (6.8 to 13.0% for boys; and 4.6 to 7.3% for girls) during the study period (2002-2010).

For boys, overweight prevalence increased significantly in 13 out of the 25 countries, most (9 of 13) being in Eastern Europe (Table 1), and remained stable in the remaining countries; no country showed a decreasing trend.

For girls, overweight prevalence increased significantly in 12 out of 25 countries, most (9 of 12) being in Eastern Europe (Table 2) and, as for boys, overweight prevalence over the study period was relatively stable elsewhere; none of the countries exhibited a decreasing trend.

Despite the observation of increasing overweight prevalence in several Eastern European countries the prevalence levels in these countries generally did not exceed the levels observed in many Western European countries.

Increase in overweight prevalence was observed consistently in both genders in 10 out of 25 countries: Croatia, Czech Republic, Estonia, Greece, Latvia, Macedonia, Poland, Russia, Slovenia and Ukraine. With the exception of Greece, all other countries belong to the Eastern part of Europe. In the other 15 countries examined, the prevalence of overweight increased only for girls in the USA and Germany, and only for boys in Austria, Sweden and Hungary (data not shown).

The interaction between wave of data collection and age was also examined separately for boys and girls (Tables 1 and 2, respectively). A significant interaction with age for boys was noted only in Russia; increasing prevalence between 2002 and 2010 was greater for 11 year olds (8-20%) than for 15 year olds (7-10%). A similar significant interaction was also seen in girls in Russia even though absolute estimates were low in all ages and all surveys.

A similar interaction between age and wave of data collection was found among girls in Estonia and Poland, where 11 and 13 year olds showed a marked increase in overweight between 2002 and 2010, while the 15yearolds in these countries showed an increase in overweight prevalence only in 2006-2010. In contrast, Portugal exhibited a stable overweight prevalence in the two youngest cohorts and an increasing trend in the 15 year olds. In the Netherlands, a marked decreasing trend in overweight prevalence was noted for the oldest age group (from 10.2 to 4.8% from 2006-2010 after a significant increase in the previous period from 8 to 10.2%) whereas overweight prevalence was stable in the younger age groups.

DISCUSSION

This is the first cross-national report of trends in overweight (including obesity) in adolescents in Europe and North America using a standardized methodology¹². In the current study, over half of the countries examined demonstrated stabilization of overweight prevalence for both boys and girls i.e. the prevalence of overweight in 10-15 year olds did not change during the study period (2002-2010). These findings confirm the generally reported trend of an overall plateau in overweight and obesity prevalence in children and adolescents in several countries^{2,9,15}. However, the current ecologic analysis finds that in several countries from Eastern Europe (with many in-transition economies) there is a clear and marked increase in overweight prevalence for both boys and girls. The change in overweight prevalence between 2002 and 2010 ranged from 4.5% (FYR Macedonia) to 10.5% (Poland) for boys, and from 2.3% (FYR Macedonia) to 7.2% (Estonia) for girls. This is consistent with the reported increase in overweight by up to 1% annually in some European countries⁸. Still, it should be noted that despite the observation of increasing prevalence in several Eastern European countries overweight prevalence in these countries did not generally exceed the levels observed in many Western European countries.

The analysis shows an increasing trend in overweight prevalence over an 8-year period examined in girls in Germany and in the US, in boys in Sweden, Hungary and Austria, and in both girls and boys in Greece. This latter finding is consistent with the previously reported increase in overweight prevalence in 8-9 year old children between 1997 and 2007 in Greece¹⁶. On the other hand, our findings are in contrast with the plateau or decrease in gender-specific overweight prevalence noted in previous studies (based on surveys other than HBSC) in Germany (overweight including obesity decreased in 12-16 year old girls and 8-16 year old boys)¹⁷, Sweden (no change in prevalence of overweight including obesity in 10-year old boys and significant decreased trend in prevalence of overweight including obesity for girls)¹¹, and in the USA (among 2-19 year old girls no change in obesity prevalence; and for adolescent boys increasing trend in obesity)¹⁰.

It is likely that the differences in methodology related to the use of measured vs. self-reported anthropometric measurements, the ages of samples examined, overweight/obesity definitions used, sample representativeness, and participation rates could contribute to differential findings reported across the literature. The findings from the current study involving several countries using the same methodology for data collection and analysis, indicating a general stabilization of overweight prevalence in several Western countries are therefore reassuring. However, our results highlight that in no country a decrease in overweight prevalence was noted in the 8-year study period, while an increasing trend in overweight prevalence was seen in several countries in economic transition in Eastern Europe. These findings suggest the continued need for programs and policies targeting child overweight via multifaceted approaches, including increased physical activity, reduced sedentary behaviours, and improved nutrition habits¹³ in countries demonstrating stabilization or no reduction in overweight prevalence. In the future, efforts to optimize such programs and policies may assist to further stabilize or reduce overweight prevalence. In addition, overweight prevention programs need to be increased particularly in Eastern European countries that showed a marked increase in overweight prevalence.

Age and Sex Effects on Overweight Trends

An overall plateau in the prevalence of overweight and obesity in children has been described in recent reviews^{2,9} that was consistent across genders and ages. However, in the current study we noted some differences in the trends in overweight prevalence across genders and ages. An interaction between time and age was observed only in a few countries, suggesting that the relationship did not differ between the age groups in general. However, studies including larger age-range indicate that time trends in overweight may differ by age. In a large German study a downward trend between 2004 and 2008 was observed in the youngest children, aged 4 – 7.99 years, whereas it stabilized in the older age groups¹⁷. However, a more marked stabilization in overweight (including obesity) among pre-school and primary school children as compared to older children has been shown in a recent review of findings from nine countries². These results are in contrast to our finding of a significant trend towards increasing prevalence of overweight from 2002 to 2010 in 11 to 13 year olds in Russia (for both genders) and in Poland and

Estonia (for girls). In these countries, an increasing prevalence was also observed among 15-year-olds between 2006 and 2010. These results could relate to country-specific factors pertaining to an interaction of lifestyle habits and age in the context of the increased purchasing power in countries with in-transition economies⁹. Additional studies are needed to verify the differential age effects we noted in certain countries prior to identifying and addressing underlying factors that are involved in these trends.

Sex-specific trends in overweight and obesity have also been observed in other studies. For instance, trends for an increase in obesity prevalence among adolescent boys in the US¹⁰ and a decreasing prevalence of overweight (including obesity) among girls in Sweden¹¹ have been described. Although changes in overweight/obesity by gender differ from those observed in the current study for these particular countries, taken together, these data highlight the need to recognise gender as a determinant of adolescent weight and health status and that interventions and prevention programs need to be gender-sensitive. While biological factors play a role in weight status, particularly among adolescents, social factors and gender norms related to food, body image, and physical and sedentary behaviours may also be involved.

Strengths and Limitations

The findings from the current trend analyses need to be considered in light of the methodology used. A standardized sampling frame, wording of items, data collection and data management are prerequisites for conducting comparable trend studies across countries. In the present study of trends in overweight prevalence between 2002 and 2010 these requirements were met with the use of the standardized HBSC study protocol¹².

In the HBSC, BMI is used to define weight status. Although BMI, as an indirect indicator of body fat, may be biased by skeletal muscle mass, it is highly correlated with body fat mass and at the population level BMI is generally considered applicable for estimation of overweight prevalence¹⁸. In the present study, BMI values were based on students' self-reports of height and weight. A solid body of literature documents that self-reported data generally lead to an underestimation of BMI especially among girls and

among overweight and obese adolescents¹⁹, and we expect that the prevalence levels in the present study are underestimated. The extent of underestimation may vary by country. However, this may not be a major methodological constraint in the present study as the focus of this analysis was on trends in prevalence of overweight. There is no documented reason to believe that the reporting bias would change over time. However, because of the marked increase in overweight prevalence that many countries have experienced, changes in social norms related to overweight might have occurred resulting in changing patterns of social desirability towards reporting of weight (and height) status. The magnitude and directions of such changing patterns in misclassification over time among adolescents are unknown but this potential bias cannot be ruled out in the current study. In the HBSC study students are assured of confidentiality and anonymity, which may have helped minimise information bias.

In this study we used the IOTF 2000 reference for defining overweight¹⁴ in order to be consistent with our previous publication¹³. Several standards are available (e.g. the WHO growth references) which may not generate the exact prevalence estimate²⁰; however, we believe that the use of other standards should not dramatically affect the findings on trends in overweight.

Eight countries had more than 20% missing data on BMI and were excluded from analyses. There was a considerable variation in proportion of missing BMI data, which could have compromised representativeness in some countries. The large proportion of missing BMI data observed in some countries points to the need for identifying reasons for students not to report height and/or weight and to identify ways of reducing missing data on BMI. Finally, time trends in overweight may depend on factors other than gender and age including socioeconomic status⁹. However, examining interactions between time and additional potential modifiers was beyond the scope of this report.

In conclusion, the current cross-national analysis of trends in overweight (including obesity) from 2002 to 2010 in 11-15 year olds demonstrates stabilization in overweight prevalence for both boys and girls in countries in the European region and in North America. However, our data indicate a marked increase in overweight prevalence in the majority of the countries in Eastern Europe examined in the current analyses.

Overall rates of overweight in many countries remain high. Taken together, the observed patterns in overweight prevalence call for continued research on the epidemiology of youth overweight and point to the relevance of studying cross-national differences through macro-level indicators. Targeting childhood overweight by maintaining existing prevention programs and policies in Western European and North American countries and increasingly building such programs in Eastern European countries are indicated to continue the combat against child and adolescent overweight.

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CONFLICTS OF INTEREST

The authors have no conflicts of interests to declare.

KEY POINTS

1. The prevalence of overweight (including obesity) among 11-15- year- olds remains high in several countries in Europe and North Americas.
2. Overweight prevalence increased in about half the countries examined, and particularly in countries in Eastern Europe in both sexes. Rates of overweight remained unchanged in the remaining countries.
3. None of the countries showed a decline in overweight prevalence over the 8-year study period.
4. Continued efforts to monitor and reduce overweight prevalence in young children and adolescents are needed.

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Table 1. Age-adjusted prevalence of overweight in boys from 2002 to 2010 by country

Country	N surveyed (% with BMI data)			Age-adjusted overweight%			Age-adjusted p value for trend
	2002	2006	2010	2002	2006	2010	
Austria	2164 (91.1)	2340 (94.4)	2456 (91.2)	13.67	15.37	17.35	0.005
Belgium (Flemish)	2996 (92.8)	2198 (92.0)	2086 (93.4)	10.98	10.01	11.30	0.818
Croatia	2158 (94.7)	2439 (94.8)	3012 (95.4)	15.52	18.41	21.88	<0.001
Czech Republic	2412 (99.5)	2411 (98.8)	2135 (97.1)	12.07	16.97	19.76	<0.001
Denmark	2211 (87.5)	2727 (83.8)	1914 (85.8)	11.67	10.49	10.25	0.217
Estonia	1982 (93.3)	2217 (93.4)	2022 (79.9)	8.95	12.52	17.31	<0.001
Finland	2692 (97.0)	2474 (95.8)	3179 (95.1)	16.19	18.50	18.22	0.051
France	4054 (93.1)	3551 (92.6)	3030 (87.6)	12.52	11.87	12.14	0.608
Germany	2777 (87.6)	3632 (92.3)	2406 (83.7)	15.14	14.41	15.76	0.347
Greece	1870 (93.9)	1746 (96.6)	2380 (96.0)	20.26	24.48	26.44	<0.001

Hungary	1779 (94.0)	1677 (91.7)	2257 (90.5)	15.10	19.12	19.21	0.003
Italy	2106 (93.9)	1974 (91.7)	2408 (89.9)	22.00	24.65	21.38	0.511
Latvia	1619 (88.3)	2034 (88.1)	2054 (91.6)	6.78	9.95	13.29	<0.001
Macedonia	1970 (91.4)	2625 (93.3)	1952 (87.5)	15.56	18.88	20.15	<0.001
Netherlands	2120 (90.2)	2114 (91.3)	2219 (83.7)	8.05	8.02	9.44	0.152
Norway	2550 (89.0)	2428 (80.1)	2171 (81.5)	14.33	12.3	14.36	0.900
Poland	3165 (93.8)	2649 (96.9)	2065 (95.9)	10.27	14.24	20.71	<0.001
Portugal	1413 (89.0)	1884 (90.9)	1878 (93.6)	19.63	21.63	21.34	0.334
Russia	3749 (92.7)	3892 (81.6)	2576 (89.0)	7.28	12.64	14.76	<0.001**
Slovenia	1966 (96.2)	2549 (94.7)	2761 (94.6)	17.09	19.83	21.57	0.002
Spain	2871 (75.7)	4368 (82.6)	2466 (91.8)	22.63	19.82	19.92	0.052

Sweden	1958 (89.7)	2179 (91.0)	3312 (82.4)	12.85	12.31	14.75	0.023
Switzerland	2223 (92.4)	2233 (94.5)	3320 (92.5)	9.83	11.02	11.15	0.156
USA	2322 (89.1)	1857 (91.1)	3260 (85.8)	29.05	32.71	31.7	0.068
Ukraine	1893 (89.0)	2388 (91.2)	2809 (90.6)	6.82	10.87	12.95	<0.001
Countries with >20% missing data on BMI							
Belgium (French)	2069 (71.3)	2313 (73.5)	1985 (71.4)	11.76	12.83	13.59	0.183
Canada	1996 (83.4)	2732 (84.5)	7711 (78.6)	22.96	25.04	23.54	0.868
England	2913 (60.8)	2308 (44.0)	1522 (46.7)	20.38	13.21	10.65	<0.001
Greenland	378 (68.5)	665 (71.3)	586(57.5)	20.06	18.78	15.74	0.183
Ireland	1302 (41.6)	2451 (36.4)	2522 (35.0)	14.41	16.00	17.75	0.189
Lithuania	2886 (71.8)	2904 (65.6)	2740 (69.9)	5.6	10.41	14.06	<0.001

Scotland	2240	3032	3319	16.49	17.39	15.61	0.666
	(50.4)	(44.9)	(40.3)				
Wales	2003	2169	2746	22.72	19.46	20.49	0.136
	(82.2)	(70.0)	(53.8)				

**Significant interaction with age

Table 2. Age-adjusted prevalence of overweight in girls from 2002 to 2010 by country

Country	N surveyed (% with BMI data)			Age-adjusted overweight%			Age-adjusted p value for trend
	2002	2006	2010	2002	2006	2010	
Austria	2202(91.8)	2435(94.1)	2547(91.5)	10.35	8.01	11.09	0.422
Belgium (Flemish)	3293 (94.0)	2113 (91.9)	2094 (92.4)	8.58	8.50	10.29	0.123
Croatia	2208 (95.2)	2526 (95.2)	3240 (94.5)	7.32	11.44	12.1	<0.001
Czech Republic	2600 (99.7)	2364 (98.9)	2269 (96.0)	6.47	13.28	9.46	<0.001
Denmark	2373 (87.3)	2955 (82.8)	2132 (86.3)	9.53	9.10	8.23	0.182
Estonia	1994 (95.4)	2260 (94.4)	2002 (81.8)	4.41	6.76	11.58	<0.001**
Finland	2656 (97.7)	2719 (94.7)	3428 (94.2)	10.86	12.79	12.61	0.084
France	4131 (93.2)	3590 (92.5)	2990 (86.5)	9.34	8.95	7.99	0.077
Germany	2858 (85.6)	3592 (90.3)	2549 (82.0)	7.95	9.36	11.07	0.016
Greece	1937 (94.4)	1944 (96.2)	2519 (94.9)	10.84	13.10	15.18	<0.001
Hungary	2278 (95.4)	1821 (92.1)	2530 (90.8)	10.10	11.55	11.06	0.362
Italy	2251 (94.1)	1946 (89.3)	2403 (85.6)	11.16	11.87	13.07	0.067
Latvia	1836 (90.5)	2187 (91.7)	2210 (93.4)	4.33	5.44	8.29	<0.001
Macedonia	2060 (87.2)	2646 (93.5)	1945 (82.9)	8.68	9.95	10.97	0.029
Netherlands	2148 (90.7)	2114 (91.0)	2301 (84.3)	6.64	8.48	7.10	0.637**
Norway	2465 (87.0)	2269 (75.5)	2167 (78.1)	9.14	8.30	9.39	0.788
Poland	3145 (93.5)	2840 (96.9)	2176 (94.4)	5.38	7.93	13.48	<0.001**
Portugal	1515 (87.6)	2035 (91.7)	2158 (93.6)	13.54	15.94	15.87	0.098**
Russia	4283 (92.8)	4339 (83.5)	2598 (88.9)	3.86	7.03	8.17	<0.001**

Slovenia	1949 (96.4)	2570 (94.8)	2668 (93.9)	10.40	10.70	14.03	0.001
Spain	2952 (77.0)	4523 (82.7)	2574 (92.2)	13.00	13.38	13.72	0.407
Sweden	1938 (90.3)	2213 (89.8)	3333 (80.7)	7.94	8.61	8.62	0.407
Switzerland	2305 (92.6)	2346 (90.6)	3291 (91.5)	7.10	5.56	6.36	0.427
USA	2703 (88.0)	2035 (89.7)	3014 (82.2)	20.03	25.57	25.55	<0.001
Ukraine	2197 (88.8)	2681 (90.8)	3081 (91.5)	4.56	6.08	7.34	<0.001

Countries with

>20% missing data

on BMI

Belgium (French)	2254 (70.6)	2163 (71.8)	2027 (67.9)	10.54	10.57	9.14	0.256
Canada	2365 (79.4)	3055 (80.5)	7999 (75.7)	14.83	17.41	16.41	0.245
England	3120 (58.7)	2460 (37.8)	1981 (43.4)	16.66	10.43	12.77	0.002
Greenland	495 (58.6)	693 (68.1)	619 (52.7)	19.25	18.71	15.80	0.121
Ireland	1573 (38.1)	2389 (29.0)	2202 (24.3)	10.41	11.84	13.45	0.649
Lithuania	2758 (76.9)	2728 (70.8)	2583 (74.0)	3.44	4.44	7.40	<0.001
Scotland	2155 (46.6)	3113 (39.2)	3419 (37.0)	13.32	13.96	10.98	0.064
Wales	1883 (80.9)	2227 (63.2)	2665 (42.3)	17.07	18.81	15.03	0.216

**Significant interaction with age