

Overweight in school-aged children and its relationship with demographic and lifestyle factors: results from the WHO-Collaborative Health Behaviour in School-aged Children (HBSC) Study

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Abstract

Objectives: To examine overweight prevalence and its association with demographic and lifestyle factors in 11–15 year olds in the HBSC 2005–2006 survey.

Methods: Self-reports of height, weight, eating patterns, physical activity and sedentary behaviours were obtained from nationally representative samples in 41 countries (n=204,534).

Results: Overweight prevalence was highest in USA (28.8%) and lowest in Latvia (7.6%). In most countries, overweight was more prevalent in boys than girls. Overweight was consistently negatively associated with breakfast consumption and moderate to vigorous physical activity; OR range: 0.48–0.79 and 0.50–0.78, respectively.

Conclusion: Overweight prevalence in youth remained high across the countries examined. The primary factors linked to overweight were breakfast consumption and physical activity. These data should contribute to formulating preventive programs and policies.

Keywords: School children – Overweight prevalence – Eating patterns – Physical activity – Sedentary behaviours.

Introduction

Overweight negatively impacts the present and future psycho-social and physical aspects of health of youth. Data on

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overweight in young persons are, however, still lacking in many countries including those undergoing transition. To better understand the global prevalence and circumstances associated with overweight in youth, there is a need to provide comparable updated information on the burden of overweight in young persons across several nations by using nationally representative samples and standardized international definitions for overweight¹.

Considering the complex aetiology of overweight and the lack of agreement on its determinants,² it is important to concomitantly examine the relations of overweight with several demographic and potentially modifiable lifestyle factors such as eating habits, physical activity and sedentary behaviours of youth. There is growing literature on the association between eating patterns and overweight, particularly on breakfast habits. The findings generally support that skipping breakfast is associated with increased probability of being overweight^{3,4}. For the association of fruit and vegetable intake and soft drink consumption with overweight, however, the evidence is less consistent^{5–8}. In contrast, most studies support that childhood physical activity is negatively related to overweight⁹ and that this association endures into adulthood¹⁰. Studies examining sedentary behaviour also show an independent and causal effect on weight status^{2,8}.

If consistent associations between overweight and potentially modifiable lifestyle factors are observed across countries, such information could provide substantive evidence to support preventive policies and programs to reduce overweight and associated health risks in young persons in the national- and international-context.

Thus, the objectives of the current paper were to describe the prevalence of overweight (pre-obesity and obesity) in 11-, 13-, and 15-year-olds from 41 countries participating in the 2005–2006 WHO Collaborative HBSC survey, and to examine the associations between overweight and certain lifestyle factors including dietary habits, physical activity and sedentary behaviours.

Methods

Data for present analyses were collected in 41 countries participating in the 2005–2006 WHO collaborative HBSC study, an international collaboration between research teams across Europe and North America with the aim of gaining insights into adolescents' health and health behaviours. The standardised international research protocol was followed within each country to ensure consistency in survey instruments, data collection and processing procedures¹¹. Participation was voluntary, and anonymity and confidentiality were ensured. Ques-

Table 1. Number of students surveyed (N), availability of BMI data (%), and prevalence (%) of overweight by region, country, age, and gender.

Region	Country	Number of students	Sample with BMI data (%)	Prevalence of pre-obesity (PO) and obesity (O) by age and gender																				
				11 years			13 years			15 years			All age groups											
				Boys	Girls	All	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All									
Non-European countries																								
	Canada	2732	3055	5930	80	17.1	6.7	14.9	6.1	18.7	8.1	13.0	4.1	18.9	5.6	11.5	2.7	18.5	6.7	12.7	3.9	*	15.5	5.2
	Israel ^v	2248	3102	5686	71	11.0	3.3	7.2	2.2	12.7	2.9	8.7	1.4	15.3	3.3*	7.9	1.2	13.1	3.2	7.9	1.5	*	10.2	2.3
	USA	1857	2035	3892	90	22.1	12.0	20.5	6.3	22.2	10.2	18.2	7.3	20.5	11.2	17.0	7.0	21.6	11.0	18.4	6.9	*	19.9	8.9
Central-European countries																								
	Austria	2340	2435	4848	93	10.0	3.5	7.4	1.2	11.6	2.3	6.0	0.8	15.1	3.5*	7.3	1.3	12.1	3.1	6.9	1.1	*	9.4	2.1
	Belgium, FI	1595	2113	4311	92	6.5	1.8	7.4	0.7	8.2	2.0	8.0	1.8	9.9	1.3	6.3	1.3	8.3	1.7	7.2	1.3		7.8	1.5
	Belgium, W ^v	2313	2163	4476	73	8.4	1.3	8.2	1.8	10.1	3.6	7.0	2.9	12.4	2.3*	9.6	2.3	1.3	2.5	8.3	2.3		9.3	2.4
	France	3551	3590	7155	92	8.3	1.8	9.1	1.8	9.6	2.2	7.2	0.8	12.2	1.5*	6.4	1.5	10.0	1.8	7.6	1.4	*	8.8	1.6
	Germany	3632	3592	7274	91	11.1	1.9	8.3	1.3	11.1	3.0	6.8	1.0	13.9	2.2*	8.6	2.1	12.1	2.4	7.9	1.5	*	11.0	1.9
	Luxembourg	2162	2138	4387	89	11.0	2.9	9.5	1.6	13.5	1.8	7.8	1.9	12.8	3.1	6.6	2.4	12.6	2.6	7.9	2.0	*	10.3	2.3
	Netherlands	2114	2114	4278	90	4.2	1.0	5.9	0.8	7.5	1.0	7.5	0.9	9.2	1.0*	8.7	1.5*	7.0	1.0	7.4	1.1	*	7.2	1.0
	Switzerland	2233	2346	4621	92	5.8	0.7	4.5	0.3	10.7	1.2	4.0	1.0	13.2	1.1*	5.9	1.0	9.9	1.0	4.8	0.8	*	7.4	0.9

Table 1. Continued

Region	Number of students	Sample with BMI data (%)	Prevalence of pre-obesity (PO) and obesity (O) by age and gender																									
			11 years						13 years						15 years						All age groups							
			Boys		Girls		All		Boys		Girls		All		Boys		Girls		All		Boys		Girls		All			
Country	Boys	Girls	All	PO	O	PO	O	PO	O	PO	O	PO	O	PO	O	PO	O	PO	O	PO	O	PO	O					
Southern-European countries																												
Croatia	2439	2526	4968	95	15.7	3.9	12.2	1.6	14.1	2.9	8.5	1.7	16.6	2.0	9.0	1.3	15.5	3.0	9.9	1.5	*	12.6	2.2	15.5	3.0	9.9	1.5	*
Greece	1746	1944	3715	96	17.4	4.1	12.9	2.3	23.7	3.4	11.8	1.0	21.6	3.2	9.2	1.5	21.0	3.5	11.1	1.6	*	15.8	2.5	21.0	3.5	11.1	1.6	*
Italy	1974	1946	3951	90	22.6	3.7	13.2	1.3	22.5	2.0	9.6	1.8	20.3	3.0	8.4	1.5	21.8	2.9	10.3	1.6	*	16.1	2.2	21.8	2.9	10.3	1.6	*
Maccedonia	2625	2646	5281	93	17.3	3.6	11.0	2.5	13.8	3.0	8.4	1.2	17.2	2.0	6.3	0.6	16.1	2.8	8.4	1.4	*	12.3	2.1	16.1	2.8	8.4	1.4	*
Malta [†]	686	703	1404	74	18.6	11.4	16.0	9.4	19.6	11.4	21.0	9.9	17.1	15.0	19.4	8.3	18.5	12.5	18.4	9.3	*	18.5	10.7	18.5	12.5	18.4	9.3	*
Portugal	1884	2035	3919	91	20.3	5.0	18.0	3.7	15.0	2.6	11.3	1.9	18.9	3.5	11.4	1.8	18.0	3.7	13.2	2.4	*	11.5	3.0	18.0	3.7	13.2	2.4	*
Slovenia	2549	2570	5130	95	14.7	4.9	10.5	1.0	16.1	3.9	8.6	1.7	16.3	3.6	8.4	1.9	15.7	4.1	9.2	1.5	*	12.5	2.8	15.7	4.1	9.2	1.5	*
Spain	4368	4523	8891	83	18.7	4.6	16.5	2.3	17.9	2.5	11.0	1.7	17.2	2.1	8.8	1.3	17.9	3.0	12.1	1.8	*	14.9	2.4	17.9	3.0	12.1	1.8	*
Turkey	2847	2705	5639	83	11.4	2.3	6.3	0.8	11.6	1.7	6.3	0.7	12.5	1.5	4.3	0.6	11.9	1.8	5.7	0.7	*	9.0	1.3	11.9	1.8	5.7	0.7	*
Eastern-European countries																												
Bulgaria	2405	2449	4854	94	16.2	4.0	8.8	1.4	16.7	1.7	5.9	0.7	15.1	3.0	5.2	0.6	16.0	2.9	6.5	0.9	*	11.3	1.9	16.0	2.9	6.5	0.9	*
Czech Rep	2413	2364	4782	99	16.8	3.9	15.6	2.7	13.7	2.1	10.7	1.5	11.5	3.0	7.4	2.1	13.9	3.0	11.1	2.1	*	12.5	2.6	13.9	3.0	11.1	2.1	*
Hungary	1677	1821	3532	91	16.1	4.5	10.3	2.8	16.6	3.6	8.8	1.8	13.7	2.9	9.0	2.2	15.5	3.6	9.3	2.2	*	12.3	2.9	15.5	3.6	9.3	2.2	*
Poland	2649	2840	5489	97	13.8	3.0	9.1	1.2	11.9	2.3	6.9	1.0	10.1	1.8	5.4	0.3	11.7	2.3	6.9	0.8	*	9.2	1.5	11.7	2.3	6.9	0.8	*
Romania	2139	2545	4684	95	15.8	2.9	11.2	2.7	11.7	3.8	7.0	0.7	8.9	1.5	3.6	0.2	12.5	2.8	6.9	1.1	*	9.5	1.9	12.5	2.8	6.9	1.1	*
Russia	3892	4340	8232	83	12.7	2.1	9.9	0.6	10.2	1.2	6.4	0.3	10.7	1.0	3.9	0.2	11.2	1.4	6.5	0.4	*	8.7	0.9	11.2	1.4	6.5	0.4	*
Slovakia	1794	2083	3882	95	11.9	1.2	6.6	0.9	10.0	1.2	5.3	0.3	9.7	1.4	4.4	0.0	10.5	1.3	5.4	0.4	*	7.8	0.8	10.5	1.3	5.4	0.4	*
Ukraine	2388	2681	5069	91	9.8	1.3	8.0	0.8	8.2	1.0	4.4	0.2	10.0	1.7	4.5	0.3	9.3	1.3	5.4	0.4	*	7.2	0.8	9.3	1.3	5.4	0.4	*
Northern-European countries																												
Denmark	2727	2955	5741	82	7.5	1.4	9.4	1.8	7.8	1.3	6.6	0.8	11.9	1.3	7.7	0.9	8.9	1.4	7.9	1.2	*	8.4	1.3	8.9	1.4	7.9	1.2	*
England [†]	2308	2460	4783	41	11.7	1.5	8.8	0.8	12.1	2.0	11.7	1.9	10.8	1.8	6.5	1.7	11.5	1.8	8.9	1.5	*	10.2	1.7	11.5	1.8	8.9	1.5	*
Estonia	2217	2260	4484	94	10.6	2.3	8.2	0.7	11.2	2.9	6.0	0.7	8.7	1.9	3.9	0.8	10.1	2.4	6.0	0.8	*	8.0	1.5	10.1	2.4	6.0	0.8	*
Finland	2474	2719	5249	94	16.7	2.9	14.0	1.8	14.2	2.7	9.7	1.5	15.3	3.7	10.0	1.6	15.4	3.1	11.3	1.6	*	13.3	2.3	15.4	3.1	11.3	1.6	*
Greenland [†]	665	693	1366	69	9.1	1.9	14.6	3.0	19.7	4.0	14.6	1.3	18.4	2.7	19.2	3.3	15.8	3.0	16.1	2.5	*	16.0	2.7	15.8	3.0	16.1	2.5	*
Iceland	4792	4684	9540	84	12.0	3.4	9.2	1.0	13.5	2.9	10.2	1.7	17.0	4.8	9.1	2.9	13.7	3.5	9.6	1.7	*	11.7	2.6	13.7	3.5	9.6	1.7	*
Ireland [†]	2451	2349	4894	32	14.2	5.5	9.4	3.1	11.5	1.9	10.9	2.6	13.3	1.6	8.1	1.5	12.8	2.3	9.3	2.2	*	11.3	2.2	12.8	2.3	9.3	2.2	*
Latvia	2034	2187	4245	89	9.0	1.5	4.8	0.8	10.4	1.2	4.0	1.0	7.4	0.5	5.5	0.3	8.9	1.1	4.7	0.7	*	6.7	0.9	8.9	1.1	4.7	0.7	*
Lithuania [†]	2904	2728	5632	68	13.0	1.5	5.3	0.9	7.8	0.9	3.2	0.5	7.3	1.1	2.9	0.7	9.0	1.2	3.7	0.7	*	6.3	0.9	9.0	1.2	3.7	0.7	*
Norway [†]	2428	2269	4711	78	8.5	1.5	5.7	1.2	8.3	2.0	8.5	0.5	14.5	1.8	7.1	1.3	10.6	1.8	7.2	1.0	*	9.0	1.4	10.6	1.8	7.2	1.0	*
Scotland [†]	3032	3113	6190	42	18.3	3.6	13.8	1.4	14.7	1.7	11.6	3.1	12.1	2.3	10.5	1.5	14.4	2.4	11.6	2.0	*	13.1	2.2	14.4	2.4	11.6	2.0	*
Sweden	2179	2213	4415	90	7.7	1.3	7.0	1.1	10.9	1.7	7.8	1.1	12.5	2.5	8.0	0.7	10.4	1.9	7.6	1.0	*	9.0	1.4	10.4	1.9	7.6	1.0	*
Wales [†]	2169	2227	4409	66	14.3	4.6	16.3	4.9	14.9	3.4	13.5	3.1	15.5	5.6	15.7	2.6	15.0	4.6	15.1	3.4	*	15.0	4.0	15.0	4.6	15.1	3.4	*

† $\leq 80\%$ children reported data on age, height, or weight to allow for estimation of body mass index and characterizing overweight status

† Overweight includes pre-obesity and obesity; pre-obesity and obesity were based on age- and gender-specific cutoffs corresponding to adult reference levels of 25–30 and $>30 \text{ kg/m}^2$, respectively.

* Significant gender difference using chi-square test with continuity correction

+ Significant positive correlation between age and overweight (Spearman's rho correlation)

– Significant negative correlation between age and overweight (Spearman's rho correlation)

tionnaires were administered in school classrooms by trained personnel, teachers, or school nurses. The time frame for filling out the questionnaires was one school period. Each country respected ethical and legal requirements in their countries for this type of survey.

The population selected for sampling was 11, 13 and 15 year olds attending school with the desired mean age for the three age groups being 11.5, 13.5 and 15.5 years. Participating countries were required to include a minimum of 95% of the eligible target population within their sample frame. In the majority of countries, national representative samples were drawn and samples were stratified to ensure representation by, for example, geography, ethnic group and school type. Participants were selected using cluster sampling, with school or class as the sampling unit. The recommended sample size for each of the three age groups was approximately 1,500 students, assuming a 95% confidence interval of +/- 3 percent around a proportion of 50% and allowing for the clustered nature of the samples. More detailed information about the study is provided elsewhere^{12–15}.

Of 204,534 school-aged children participating in the survey those not reporting their weight or height were excluded, leaving 171,809 pupils (84%) in the analyses.

Body Mass Index (BMI) (kg/m^2) was calculated using self-reported weight and height. Overweight included both pre-obesity and obesity, that were based on age- and gender-specific cutoffs corresponding to adult reference levels of 25–30 and $>30\text{kg}/\text{m}^2$, respectively as recommended by the International Obesity Task Force¹.

Family affluence was determined with the Family Affluence Scale as a score of four items: Does your family own a car, van or truck? (0–2 points). Do you have your own bedroom for yourself? (0–1 points). During the past twelve months, how many times did you travel away on holiday (vacation) with your family? (0–2 points); and how many computers does your family own? (0–2 points).

Lifestyle variables

Usual eating habits were assessed by asking participants how many times a week they eat fruit, vegetables and soft drinks. The possible responses were: “never”, “less than once a week”, “about once a week”, “two to four days a week”, “five to six days a week”, “once a day, every day”, “every day, more than once”. For each of these variables, responses were dichotomised: less than daily and daily¹⁶.

To assess regular breakfast consumption, students were asked to estimate how many weekdays they had breakfast (i.e. having more than a glass of milk or fruit juice). Possible response categories were “never”, and 1, 2, 3, 4, or 5 days. Responses were recoded: “less than daily” versus “daily”.

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Moderate to vigorous physical activity (MVPA) was assessed by asking: “On how many days in the past week were you physically active for 60 minutes or more”. Physical activity was defined as “any activity that increases your heart rate and makes you get out of breath some of the time” with examples of such activities. Response categories were: “0 days”, “1”, “2”, etc up to “7 days”, recoded as $<$ or ≥ 5 times/week¹⁷. Vigorous physical activity (VPA) was assessed by asking: “Outside school hours, how many hours a week do you usually exercise in your free time so much that you get out of breath or sweat?” Response categories were none, about 30 minutes, and 1, 2–3, 4–6, ≥ 7 hours; recoded into $<$ or ≥ 2 hour/week¹⁸.

Three items assessed sedentary screen-based activities: 1) “About how many hours a day do you usually watch television (including DVDs and videos) in your free time?” 2) “About how many hours a day do you usually play games on a computer or games console (Playstation, Xbox, GameCube etc.) in your free time?” and 3) “About how many hours a day do you usually use a computer for chatting on-line, internet, emailing, homework etc. in your free time? All three items had nine possible responses: “none at all”, about 30 min, 1 hour, 2 hour, up to ≥ 7 hour/day. Responses for weekdays were recoded into \leq versus > 2 hour/day¹⁹.

Statistical Analyses

Statistical analyses were performed using SPSS version 15 and STATA 9.2. Association of overweight with gender and age were examined with chi-square or spearman rho correlation analysis, as indicated. To examine the possibility of a selection bias for countries where response rate on BMI-related variables (height, weight, and age) was $\leq 80\%$, the differences in eating patterns, physical activity and sedentary behaviours of students with versus those without data on BMI were assessed using chi-square test. Multilevel logistic regression analyses were conducted using the svy, vec (linearized) command in STATA, with school as the level-2 sampling unit variable and age group as strata (a two-level random intercept model). All analyses were conducted separately for each country and gender. Initially, interaction with age was tested in the main effect models for each lifestyle variable; significant interactions were generally not observed ($< 2\%$). The multilevel regressions on the association of overweight with each independent lifestyle factor (dummy variable) were controlled for age and family affluence because of their potential association with overweight. P-values < 0.05 were considered significant. Results are presented by geographic region as defined by the United Nations²⁰ to examine regional trends.

Table 2. Eating patterns (%) by region, country and gender.

Country	Eating fruit daily		Eating vegetables daily		Eating breakfast daily		Not consuming soft drinks daily	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Non-European countries								
Canada	34	44*	37	45*	66	54*	82	89*
Israel [†]	40†	45†*	39†	47†*	51†	41*	54†	55
United States	38	41*	34	39*	54	42*	64	69*
Central-European countries								
Austria	30	40*	14	19*	56	48*	76	83*
Belgium Fl	30	41*	51	65*	75	68*	55	65*
Belgium W [†]	42	47*	42†	55*	67	63†*	65	73†*
France	29	33*	39	45*	71	62*	70	77*
Germany	30	41*	19	29*	68	60*	78	84*
Luxemburg	31	43*	25	33*	63	55*	68	76*
Netherlands	27	38*	37	47*	84	78*	60	68*
Switzerland	36	47*	35	45*	59	51*	72	78*
Southern-European countries								
Croatia	36	39*	25	29*	60	54*	65	72*
Greece	29	31	27	36*	47	39*	81	89*
Italy	41	45*	23	30*	74	64*	66	77*
Macedonia	37	47*	31	41*	64	65	63	64
Malta [†]	36	43*	9	16*	49	45	53	65*
Portugal	41	46*	23	28*	84	79*	71	77*
Slovenia	34	47*	21	27*	44	41*	71	79*
Spain	30	36*	16	21*	79	72*	75	79*
Turkey	30	44*	23	30*	64	56*	79	82*
Eastern-European countries								
Bulgaria	35	37	33	38*	70	62*	49	51
Czech Rep.	33	45*	24	32*	52	44*	66	73*
Hungary	31	38*	19	24*	53	47*	66	71*
Poland	28	39*	26	32*	69	61*	70	77*
Romania	38	46*	25	31*	49	43*	60	63*
Russia	27	32*	28	30*	64	58*	72	75*
Slovakia	28	34*	22	25	55	49*	62	66*
Ukraine	28	31*	43	50*	69	62*	68	68
Northern-European countries								
Denmark	35	48*	33	41*	77	70*	88	94*
England [†]	38†	48†*	39†	46†*	71†	59†*	75†	81†*
Estonia	26	34*	19	23*	69	63*	87	93*
Finland	19	27*	21	30*	68	63*	93	97*
Greenland [†]	14	16	37	44*	62	59	64	68
Iceland	29	40*	23	31*	72	68*	87	91*
Ireland [†]	32	42†*	37†	46†*	74	66†*	74	79*
Latvia	19	27*	19	28*	67	62*	87	88
Lithuania [†]	21	26*	22	27†*	67	60*	84	87*
Norway [†]	36	47*	27†	34*	75	66*	85	90†*
Scotland [†]	35	42†*	33†	43*	66†	56*	68†	75*
Sweden	29	36*	32	41*	78	71*	92	95*
Wales [†]	31	39*	29†	33†*	66	53†*	69	74†*

[†] ≤80% children reported data on age, height, or weight to allow for estimation of body mass index and characterizing overweight status

* Significant gender differences using chi-square test with continuity correction (P < 0.05)

† Significant differences in eating patterns between those with missing / non-missing BMI using chi-square test with continuity correction (P < 0.05) for countries where the response on age, height and / or weight variables was ≤80%.

Table 3. Physical activity and screen based sedentary behaviors (%) by region, country and gender.

Region	Physical activity (1 hr for ≥ 5 days/week)		Vigorous physical activity (≥ 2 hr/week)		Television-viewing (≤ 2 hr/day)		Using electronic games (≤ 2 hr/day)		Using computer (≤ 2 hr/day)	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Non-European countries										
Canada	62	49*	69	59*	54	61*	71	87*	74	69*
Israel [†]	41†	24*	57†	36†*	48†	41*	56	73†*	67	63*
United States	62	46*	56	41*	62	60	82	93*	86	83*
Central-European countries										
Austria	50	40*	57	42*	62	67*	72	88*	80	85*
Belgium, F1	42	31*	70	52*	60	60	78	92*	77	77
Belgium, W [†]	49†	42†*	69†	51†*	67	74*	77	85*	83	85
France	42	25*	65	42*	63	68*	80	94*	84	84
Germany	46	34*	69	56*	64	67*	75	90*	81	83*
Luxemburg	45	30*	73	56*	68	72*	79	91*	82	83
Netherlands	55	47*	82	72*	50	56*	63	90*	64	65
Switzerland	40	31*	80	60*	81	83	89	97*	88	92*
Southern-European countries										
Croatia	58	40*	52	31*	46	50*	75	95*	88	90
Greece	44	28*	66	47*	52	47*	74	94*	90	96*
Italy	44	27*	62	43*	61	63	83	96*	91	92
Macedonia	49	39*	44	27*	56	55	74	88*	84	87*
Malta [†]	40	30*	39†	24*	n.a.	n.a.	n.a.	n.a.	69	69
Portugal	42	18*	n.a.	n.a.	46	44	64	86*	77	78
Slovenia	46	33*	55	41*	61	67*	74	94*	83	84
Spain	46	34*	55	31*	64	67*	84	93*	89	90
Turkey	40	35*	45	25*	57	59*	78	92*	82	84*
Eastern-European countries										
Bulgaria	51	39*	52	33*	40	34*	56	82*	70	76*
Czech Rep.	52	37*	44	24*	58	62*	69	93*	86	86
Hungary	48	33*	57	41*	60	64*	76	92*	82	88*
Poland	48	35*	49	30*	45	59*	64	92*	70	79*
Romania	41	23*	45	25*	60	48*	55	76*	76	84*
Russia	35	23*	49	35*	51	50	70	87*	88	91*
Slovakia	67	51*	74	54*	43	44	65	89*	83	87*
Ukraine	53	36*	49	32*	46	43	75	92*	88	95*
Northern-European countries										
Denmark	55	50*	80	73*	60	64*	68	92*	80	83*
England [†]	54†	38*	63†	48†*	63	69†*	75†	92†*	75	75
Estonia	45	34*	52	43*	49	50	59	86*	68	70
Finland	58	50*	71	69*	72	73	76	94*	83	83
Greenland [†]	50	38*	55	41†*	66	64	81	93†*	89	88
Iceland	52	47*	60	56*	64	71*	73	97*	74	77*
Ireland [†]	67	52†*	62†	49†*	62	65*	85†	95†*	93	95
Latvia	54	40*	51	32*	45	50*	65	91*	77	75
Lithuania [†]	47†	35*	51†	31†*	45	43	68	92*	88†	90†
Norway [†]	47†	39*	72†	67†*	66	64	74†	93*	79	74†*
Scotland [†]	57†	39*	60†	48†*	53 -	58*	67†	88†*	73	72
Sweden	45	41*	61	55*	69	72	70	93*	77	78
Wales [†]	57†	39*	60†	45†*	55	56	72†	88†*	73	73

[†] ≤ 80% children reported data on age, height, or weight to allow for estimation of body mass index and characterizing overweight status

† Significant differences in physical activity and screen based sedentary behaviors between those with missing / non-missing BMI using chi-square test with continuity correction ($P < 0.05$) for countries where the response on age, height and / or weight variables was ≤ 80%.

n.a. = not available

Results

The response rate of study participants on height, weight or age, necessary to estimate BMI, varied between 32 % in Ireland and 99 % in Czech Republic (Tab. 1). It increased with age consistently across most countries (data not shown). Ten countries, most in Northern-Europe, had response rates on BMI-related variables of ≤ 80 %. For these countries we compared youth providing data concerning BMI to those without BMI values, and found that those without BMI data generally had less healthy lifestyle (eating patterns, and physical and sedentary activities) (Tab. 2 and 3). Thus, in all tables, countries with ≤ 80 % response rate on BMI-related variables are presented, but not included in cumulative cross-national comparative findings. The results described below are, therefore, generally based on 31 countries.

The highest mean prevalence of overweight was seen for the non-European countries (24.2 %) followed by countries in Southern-European region (15.8 %). Little difference was seen between Central (10.5 %), Eastern (11.3 %) and Northern-European (11.7 %) regions. Across countries, the highest prevalence of overweight (pre-obesity and obesity) was observed in USA (28.8 %) followed by Italy (18.3 %), and that of obesity was seen in USA (8.9 %) followed by Canada (5.2 %). The lowest prevalence of overweight was observed in Latvia (7.6 %) followed by Ukraine (8.0 %), and that of obesity in Slovakia and Ukraine (0.8 %) (Tab. 1).

In virtually all (29 of 31) countries, the prevalence of overweight was significantly higher among boys than among girls. Among boys, prevalence of overweight increased with age in eight countries and decreased with age in five countries. The positive correlation between overweight and age for boys was predominately observed in the Central- and Northern-European regions while a negative association was noted in Eastern-European countries. Among girls, negative correlations between overweight and age were seen in 18 countries, predominantly countries from the Southern (6 countries) and Eastern-European (7 countries) regions.

Table 2 provides descriptive data on patterns of healthy eating among participants. Less than 50 % of young people report eating fruit or vegetables daily. Specifically, the proportion of young people who eat fruit daily during the week ranged from 19 to 47 %, with girls reporting significantly greater fruit consumption than boys in nearly all (29 of 31) countries and regions, with considerable geographic variation. For vegetable consumption, similar gender effect was noted in virtually all countries and regions (30 of 31); girls consuming more vegetables daily than boys, with considerable geographic variation (range for both genders: 14–65 %). However for breakfast consumption (range: 39–84 %), this gender effect

was inverted with more boys consuming breakfast daily than girls in nearly all (30 of 31) countries.

Not having soft drinks daily was reported by a majority of young people across all countries and regions. In most countries girls were less likely to consume soft drinks than boys. Soft drink consumption was highest in Bulgaria (~50 %) and lowest in Sweden, Iceland, Finland, and Estonia – countries in Northern-Europe – where only 10 % or less had soft drinks daily.

Table 3 shows the physical activity and sedentary behaviours of young people. In most countries across all regions, about a third of young people met the guideline of 60 minutes of MVPA on five or more days a week, with the exception of Russia and Portugal. Boys met this recommendation more often than girls in all countries examined; the range being 35 to 67 % for boys and 18 to 51 % for girls, with considerable regional variation. One-third of young people also reported engaging in VPA at least 2 hours/week; with boys reporting this behaviour more often than girls.

With respect to television-viewing, electronic games and computer use (each ≤ 2 hour/day) (Tab. 3), girls were more likely to report engaging in these sedentary behaviours than boys in almost all countries, with the exception of Bulgaria, Greece and Romania for television; and Canada and USA for computer use. The reported rate of television-viewing varied across countries a lot more than computer use (ranges were 34–83, 76–97, and 65–96 % for television-viewing, electronic games and computer use, respectively).

Tables 4 and 5 present the age- and SES-adjusted odds ratios for being overweight in relation to lifestyle factors. With regards to eating patterns (Tab. 4), only daily breakfast consumption was consistently negatively associated with overweight (significant OR ranged between 0.48 and 0.79); this association was stronger for boys than girls (noted in 26 and 18 of 31 countries, respectively) across all regions. Daily fruit, vegetable or soft drink consumption were generally not associated with overweight.

Among the physical activity and sedentary behaviours examined, the most important and consistent associations were observed for physical activity. Engaging in MVPA for 1 hour on at least 5 days a week showed a consistent negative correlation with being overweight (OR range: 0.50–0.78) in 26 of 31 countries for boys and 14 of 31 countries for girls. No regional trends in MVPA were seen for boys, but for girls this association was noted in Central and non-European regions. VPA was also negatively associated with being overweight (OR range: 0.50–0.79). However this association was not as consistent as that for MVPA across countries. Only 14 and 7 of 30 countries showed this negative association between VPA and overweight for boys and girls, respectively.

Table 4. Age- and SES-adjusted odds ratios and 95% confidence intervals for being overweight by eating patterns, stratified by region, country, and gender.

Region	Eating fruit daily				Eating vegetables daily				Eating breakfast daily				Not consuming soft drinks daily			
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Country	ORT	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Non-European countries																
Canada	0.80	(0.66–0.98)	1.06	(0.83–1.36)	0.85	(0.69–1.04)	0.94	(0.75–1.18)	0.66	(0.54–0.81)	0.85	(0.68–1.07)	0.81	(0.64–1.03)	0.72	(0.52–0.98)
Israel ^v	1.05	(0.84–1.31)	0.98	(0.75–1.28)	1.22	(0.97–1.54)	1.15	(0.87–1.51)	0.74	(0.57–0.96)	0.95	(0.71–1.27)	1.04	(0.79–1.37)	1.23	(0.91–1.65)
US	0.96	(0.80–1.14)	1.04	(0.81–1.33)	0.99	(0.86–1.13)	1.10	(0.85–1.42)	0.70	(0.58–0.85)	0.59	(0.52–0.66)	1.01	(0.81–1.26)	0.98	(0.59–1.63)
Central-European countries																
Austria	0.83	(0.62–1.09)	1.22	(0.89–1.69)	0.93	(0.64–1.34)	0.98	(0.66–1.46)	0.63	(0.49–0.80)	0.75	(0.54–1.04)	0.92	(0.70–1.21)	0.91	(0.60–1.39)
Belgium, FI	1.01	(0.75–1.35)	1.30	(0.89–1.89)	0.79	(0.59–1.06)	0.72	(0.52–1.00)	0.70	(0.51–0.96)	0.63	(0.44–0.90)	1.30	(0.94–1.79)	1.72	(1.22–2.43)
Belgium, W*	0.97	(0.71–1.33)	1.14	(0.80–1.63)	1.12	(0.85–1.48)	1.01	(0.72–1.41)	0.61	(0.46–0.80)	0.64	(0.45–0.90)	1.36	(0.97–1.92)	0.97	(0.67–1.43)
France	0.97	(0.76–1.24)	1.04	(0.81–1.34)	0.96	(0.78–1.20)	1.02	(0.80–1.30)	0.74	(0.59–0.94)	0.88	(0.67–1.16)	1.62	(1.25–2.10)	1.19	(0.87–1.62)
Germany	0.86	(0.70–1.06)	0.97	(0.76–1.25)	0.92	(0.70–1.20)	0.98	(0.75–1.27)	0.74	(0.60–0.93)	0.90	(0.70–1.15)	1.16	(0.91–1.47)	1.22	(0.87–1.71)
Luxembourg	1.09	(0.84–1.41)	0.87	(0.65–1.16)	0.90	(0.67–1.22)	0.67	(0.49–0.94)	0.65	(0.49–0.87)	0.55	(0.43–0.72)	1.13	(0.83–1.53)	1.90	(1.23–2.93)
Netherlands	1.26	(0.90–1.76)	1.30	(0.92–1.85)	0.73	(0.52–1.02)	0.78	(0.55–1.11)	0.48	(0.32–0.72)	0.43	(0.31–0.59)	1.04	(0.72–1.51)	0.89	(0.64–1.24)
Switzerland	0.98	(0.74–1.30)	0.99	(0.68–1.44)	0.94	(0.70–1.26)	0.85	(0.56–1.27)	0.66	(0.49–0.88)	0.78	(0.54–1.12)	0.91	(0.67–1.24)	1.77	(1.08–2.91)
Southern-European countries																
Croatia	1.11	(0.89–1.39)	0.82	(0.63–1.07)	1.15	(0.89–1.47)	1.34	(1.04–1.72)	0.72	(0.58–0.89)	0.77	(0.60–0.99)	1.25	(1.00–1.56)	1.19	(0.89–1.59)
Greece	1.01	(0.78–1.30)	0.96	(0.70–1.33)	1.10	(0.87–1.40)	1.15	(0.85–1.56)	0.81	(0.64–1.02)	0.79	(0.59–1.08)	1.08	(0.81–1.45)	1.19	(0.77–1.86)
Italy	1.00	(0.80–1.26)	1.01	(0.74–1.36)	1.05	(0.81–1.37)	0.67	(0.47–0.96)	0.59	(0.47–0.75)	0.64	(0.48–0.85)	1.32	(1.02–1.70)	1.07	(0.74–1.56)
Macedonia	0.90	(0.74–1.10)	0.89	(0.68–1.16)	0.96	(0.77–1.20)	1.14	(0.85–1.53)	0.92	(0.74–1.14)	0.73	(0.58–0.93)	1.20	(0.97–1.47)	1.18	(0.86–1.62)
Malta ^w	0.89	(0.57–1.38)	1.14	(0.78–1.67)	1.45	(0.72–2.94)	0.76	(0.45–1.29)	0.57	(0.37–0.88)	0.71	(0.49–1.04)	1.32	(0.87–2.02)	1.13	(0.76–1.67)
Portugal	1.15	(0.88–1.49)	0.87	(0.67–1.13)	1.36	(1.04–1.78)	0.79	(0.59–1.06)	0.63	(0.46–0.88)	0.74	(0.53–1.02)	1.05	(0.81–1.35)	1.31	(0.95–1.80)
Slovenia	0.87	(0.70–1.08)	0.93	(0.70–1.23)	1.06	(0.83–1.37)	1.00	(0.75–1.34)	0.63	(0.50–0.79)	0.67	(0.51–0.88)	0.97	(0.77–1.21)	1.17	(0.83–1.65)
Spain	1.02	(0.85–1.22)	1.12	(0.92–1.38)	1.21	(0.98–1.51)	1.28	(1.04–1.57)	0.56	(0.47–0.68)	0.77	(0.62–0.96)	1.14	(1.03–1.40)	1.25	(0.97–1.60)
Turkey	1.30	(1.02–1.67)	1.11	(0.75–1.64)	0.74	(0.55–1.00)	0.84	(0.56–1.26)	0.71	(0.55–0.92)	0.57	(0.40–0.82)	1.10	(0.86–1.40)	2.96	(1.45–6.03)
Eastern-European countries																
Bulgaria	0.93	(0.73–1.19)	0.79	(0.56–1.11)	0.94	(0.75–1.18)	1.03	(0.74–1.44)	0.60	(0.48–0.76)	0.65	(0.45–0.94)	1.10	(0.89–1.36)	1.35	(0.97–1.87)
Czech Rep.	0.99	(0.77–1.26)	1.34	(1.06–1.70)	1.10	(0.84–1.44)	1.28	(0.99–1.66)	0.59	(0.48–0.73)	0.76	(0.59–0.99)	1.54	(1.20–1.96)	1.82	(1.33–2.51)
Hungary	1.11	(0.89–1.39)	0.82	(0.63–1.07)	1.15	(0.89–1.47)	1.34	(1.04–1.72)	0.72	(0.58–0.89)	0.77	(0.59–0.99)	1.25	(1.00–1.56)	1.19	(0.89–1.59)
Poland	1.06	(0.83–1.37)	1.21	(0.90–1.62)	0.97	(0.74–1.26)	1.33	(0.97–1.83)	0.59	(0.47–0.75)	0.84	(0.62–1.13)	1.00	(0.78–1.28)	0.79	(0.58–1.09)
Romania	1.00	(0.75–1.32)	1.08	(0.75–1.54)	1.27	(0.96–1.67)	1.29	(0.94–1.78)	0.79	(0.60–1.03)	0.71	(0.52–0.98)	0.99	(0.75–1.30)	0.94	(0.63–1.39)
Russia	0.92	(0.71–1.19)	0.97	(0.71–1.31)	0.80	(0.63–1.03)	0.82	(0.61–1.12)	0.69	(0.55–0.85)	0.66	(0.50–0.87)	1.22	(0.96–1.55)	1.43	(1.00–2.06)
Slovakia ^a	0.90	(0.64–1.28)	0.73	(0.47–1.13)	1.03	(0.71–1.49)	1.45	(0.95–2.20)	0.88	(0.65–1.19)	0.87	(0.59–1.29)	0.96	(0.70–1.32)	1.43	(0.93–2.21)
Ukraine	1.22	(0.90–1.66)	0.97	(0.66–1.43)	0.73	(0.55–0.98)	1.10	(0.78–1.54)	0.70	(0.51–0.96)	0.63	(0.46–0.87)	0.88	(0.65–1.18)	0.84	(0.59–1.20)

Table 4. Continued

Region	Eating fruit daily		Eating vegetables daily		Eating breakfast daily		Not consuming soft drinks daily	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Country	OR† (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Northern-European countries								
Denmark	0.95 (0.70–1.29)	1.06 (0.77–1.45)	1.00 (0.74–1.36)	0.80 (0.59–1.08)	0.64 (0.49–0.83)	0.58 (0.41–0.81)	1.38 (0.88–2.18)	1.16 (0.63–2.12)
England [‡]	1.24 (0.83–1.86)	1.03 (0.68–1.56)	1.54 (1.02–2.32)	1.41 (0.94–2.13)	0.67 (0.43–1.02)	0.86 (0.54–1.37)	0.80 (0.50–1.28)	0.83 (0.45–1.50)
Estonia	1.08 (0.83–1.40)	0.84 (0.55–1.27)	1.24 (0.90–1.71)	0.88 (0.58–1.32)	0.81 (0.61–0.07)	0.66 (0.46–0.96)	1.11 (0.71–1.73)	1.65 (0.62–4.37)
Finland	0.96 (0.73–1.26)	0.96 (0.74–1.25)	0.85 (0.66–1.11)	1.00 (0.76–1.31)	0.79 (0.63–0.99)	0.71 (0.56–0.91)	1.17 (0.77–1.78)	1.12 (0.58–2.16)
Greenland [‡]	1.01 (0.78–1.30)	0.96 (0.70–1.33)	1.10 (0.87–1.40)	1.15 (0.85–1.56)	0.81 (0.64–1.02)	0.79 (0.59–1.08)	1.08 (0.81–1.45)	1.19 (0.78–1.86)
Iceland	1.04 (0.85–1.27)	1.04 (0.85–1.28)	0.92 (0.75–1.14)	0.78 (0.62–0.97)	0.77 (0.64–0.92)	0.98 (0.77–1.24)	0.97 (0.76–1.22)	0.71 (0.51–0.98)
Ireland [‡]	0.68 (0.44–1.04)	1.09 (0.66–1.80)	0.85 (0.57–1.26)	1.30 (0.81–2.09)	0.66 (0.43–1.02)	0.78 (0.46–1.32)	1.13 (0.73–1.75)	0.76 (0.42–1.39)
Latvia	0.97 (0.62–1.52)	1.83 (1.20–2.78)	0.77 (0.51–1.18)	1.48 (0.95–2.30)	0.60 (0.43–0.83)	0.71 (0.47–1.08)	0.76 (0.49–1.19)	1.16 (0.60–2.25)
Lithuania [‡]	1.15 (0.80–1.66)	1.90 (1.21–2.99)	0.84 (0.58–1.23)	0.83 (0.51–1.34)	0.62 (0.45–0.86)	0.66 (0.44–0.98)	0.92 (0.62–1.36)	1.29 (0.64–2.61)
Norway [‡]	1.09 (0.83–1.45)	1.16 (0.82–1.64)	0.86 (0.63–1.19)	1.00 (0.71–1.42)	0.82 (0.59–1.12)	0.75 (0.51–1.09)	0.78 (0.52–1.17)	1.17 (0.66–2.06)
Scotland [‡]	0.91 (0.67–1.25)	1.03 (0.74–1.43)	0.89 (0.66–1.21)	0.92 (0.66–1.30)	0.49 (0.35–0.68)	0.94 (0.66–1.34)	0.96 (0.67–1.39)	1.13 (0.77–1.66)
Sweden	0.85 (0.59–1.21)	1.10 (0.80–1.52)	0.98 (0.76–1.26)	0.80 (0.55–1.16)	0.58 (0.43–0.78)	1.04 (0.73–1.50)	1.33 (0.83–2.14)	0.91 (0.43–1.94)
Wales [‡]	1.09 (0.84–1.43)	0.88 (0.68–1.16)	1.10 (0.81–1.48)	0.95 (0.71–1.29)	0.73 (0.54–0.99)	0.75 (0.56–1.00)	1.01 (0.76–1.33)	1.12 (0.82–1.53)

[‡] ≤80% children reported data on age, height, or weight to allow for estimation of body mass index and characterizing overweight status

† Odds ratio (OR) and 95% confidence interval (CI); OR in bold are significant (P<0.05)

School variable was not available as a consequence the clustering in schools was not taken into account for these countries

Among sedentary activities examined, television-viewing ≤2 hour/day was associated with reduced likelihood of being overweight (OR range: 0.51–0.78) in 10 of 30 countries for boys and 13 of 30 countries for girls. Playing games on any electronic media ≤2 hour/day was also associated with reduced likelihood of being overweight; but this was found in only 8 of 30 countries (OR range: 0.39–0.71). Computer use for other activities was generally not associated with overweight. For most physical activity and sedentary behaviours, regional patterns were observed with stronger associations in Central-European countries. In addition, for most countries stronger associations were noted for boys than for girls concerning overweight and physical activity and sedentary behaviours with the exception of television-viewing.

Discussion

The results from this large scale international survey among school-aged youth, utilising standardized methods for data collection, and international cut-offs to define overweight¹ showed that overweight prevalence was >10% in most nations (range: 7.6% in Latvia to 28.8% in USA). Within Europe, the highest prevalence was seen in Southern-European countries. Similar geographical patterns have been observed elsewhere^{5,21}. Thus the prevalence of overweight continues to be an important public health challenge in most countries participating in the HBSC study. In particular, two thirds of the countries that participated in both the 2001–2002 and 2005–2006 study showed a tendency of increasing overweight. A clear pattern of boys (16.2%) being more likely to be overweight than girls (10%) was consistently noted across countries. Such obvious cross-national gender differences have not been observed elsewhere²². The emerging gender patterns could indicate that the obesogenic environmental influences may have become more detrimental and/or that preventive initiatives may be inadequate and/or less effective for boys. The pattern of overweight prevalence according to age was less consistent and varied regionally. For example, in most Eastern-European countries the prevalence of overweight decreased with age in both genders, whereas in Southern-European countries this pattern was observed only in girls. In most Central-European countries a positive correlation between overweight and age was found among boys. Most of the previous literature suggests a positive correlation between age and prevalence of overweight, although varying patterns are often observed²³. It is important to consider that the results are based on self-reported data that could be subject to socially desirable reporting bias. However, students responses were anonymous;

Table 5. Age- and SEs-adjusted odds ratios and 95% confidence intervals for being overweight by physical activity and screen based sedentary behaviours, stratified by region, country, and gender.

Region Country	Moderate to vigorous physical activity (1 hr for ≥ 5 days / week)				Vigorous physical activity (≥ 2 hr / week)				Television-viewing (≤ 2 hr / weekday)				Electronic game use (≤ 2 hr / weekday)				Computer use (≤ 2 hr / weekday)			
	Boys ORT (95%CI)	Girls ORT (95%CI)	Boys ORT (95%CI)	Girls ORT (95%CI)	Boys ORT (95%CI)	Girls ORT (95%CI)	Boys ORT (95%CI)	Girls ORT (95%CI)	Boys ORT (95%CI)	Girls ORT (95%CI)	Boys ORT (95%CI)	Girls ORT (95%CI)	Boys ORT (95%CI)	Girls ORT (95%CI)	Boys ORT (95%CI)	Girls ORT (95%CI)	Boys ORT (95%CI)	Girls ORT (95%CI)		
Non-European countries																				
Canada	0.70(0.57–0.86)	0.75(0.61–0.93)	0.81(0.65–1.00)	0.95(0.76–1.19)	0.73(0.61–0.88)	0.81(0.63–1.03)	0.82(0.66–1.01)	0.78(0.57–1.07)	0.87(0.70–1.07)	0.98(0.78–1.23)										
Israel ^y	0.89(0.67–1.19)	1.01(0.71–1.45)	0.84(0.64–1.12)	1.11(0.82–1.49)	0.94(0.73–1.22)	0.74(0.54–1.02)	0.77(0.59–1.01)	0.84(0.59–1.20)	0.95(0.71–1.28)	1.09(0.83–1.44)										
US	0.53(0.42–0.67)	0.73(0.57–0.94)	0.72(0.65–0.79)	0.83(0.69–0.99)	0.78(0.62–0.98)	0.70(0.61–0.81)	0.66(0.46–0.93)	0.53(0.33–0.83)	0.77(0.44–1.34)	0.88(0.55–1.41)										
Central-European countries																				
Austria	0.70(0.54–0.90)	0.59(0.41–0.86)	0.83(0.63–1.08)	1.05(0.78–1.42)	0.65(0.51–0.84)	0.67(0.49–0.93)	0.65(0.50–0.85)	0.59(0.39–0.90)	0.76(0.55–1.04)	0.66(0.44–1.01)										
Belgium, FI	0.72(0.53–0.96)	0.97(0.66–1.41)	0.66(0.47–0.91)	0.72(0.52–1.01)	0.62(0.45–0.84)	0.51(0.36–0.72)	0.69(0.48–0.98)	0.58(0.34–0.99)	0.91(0.63–1.29)	0.75(0.52–1.09)										
Belgium, W ^x	0.55(0.41–0.74)	0.79(0.58–1.08)	0.79(0.58–1.09)	0.79(0.55–1.13)	0.62(0.46–0.85)	0.67(0.47–0.95)	0.60(0.42–0.85)	0.87(0.54–1.39)	0.69(0.47–1.00)	0.64(0.41–1.01)										
France	0.66(0.53–0.83)	0.61(0.44–0.85)	0.61(0.49–0.77)	0.66(0.50–0.85)	0.86(0.68–1.07)	0.70(0.54–0.90)	0.92(0.69–1.23)	0.94(0.59–1.50)	1.08(0.81–1.44)	1.08(0.76–1.53)										
Germany	0.78(0.64–0.95)	0.73(0.55–0.97)	0.79(0.63–0.98)	0.95(0.75–1.21)	0.61(0.49–0.75)	0.56(0.43–0.72)	0.71(0.58–0.88)	0.82(0.56–1.21)	0.81(0.63–1.03)	1.04(0.76–1.44)										
Luxembourg	0.65(0.48–0.89)	0.56(0.36–0.89)	0.73(0.54–0.98)	0.64(0.42–0.97)	0.73(0.56–0.94)	0.72(0.49–1.04)	1.01(0.71–1.42)	0.51(0.34–0.76)	0.68(0.47–0.97)	0.62(0.45–0.87)										
Netherlands	0.51(0.36–0.73)	0.54(0.38–0.75)	0.5(0.34–0.73)	0.65(0.47–0.91)	0.85(0.60–1.21)	0.71(0.51–0.98)	0.65(0.47–0.90)	0.56(0.33–0.94)	0.87(0.62–1.20)	0.78(0.54–1.12)										
Switzerland	0.57(0.42–0.77)	0.69(0.45–1.05)	0.64(0.46–0.89)	0.85(0.58–1.24)	0.6(0.44–0.81)	0.72(0.45–1.13)	0.69(0.46–1.05)	0.39(0.20–0.77)	0.56(0.39–0.81)	1.37(0.68–2.78)										
Southern-European countries																				
Croatia	0.68(0.55–0.84)	0.59(0.43–0.80)	0.83(0.68–1.01)	1.00(0.73–1.36)	0.87(0.70–1.08)	0.90(0.70–1.14)	0.99(0.77–1.28)	0.88(0.49–1.58)	0.92(0.68–1.26)	1.2(0.73–1.98)										
Greece	0.78(0.61–0.99)	0.51(0.35–0.73)	0.77(0.6–0.99)	0.80(0.60–1.08)	0.89(0.69–1.14)	0.76(0.56–1.02)	1.16(0.90–1.49)	1(0.55–1.84)	1.28(0.84–1.97)	0.63(0.32–1.24)										
Italy	0.83(0.67–1.04)	0.77(0.55–1.07)	0.87(0.68–1.10)	0.86(0.63–1.17)	0.96(0.77–1.20)	0.78(0.57–1.07)	1.09(0.81–1.46)	0.86(0.41–1.83)	1.17(0.81–1.70)	1.17(0.67–2.05)										
Macedonia	0.67(0.54–0.83)	0.88(0.67–1.16)	1.14(0.92–1.42)	1.05(0.77–1.44)	0.82(0.66–1.02)	0.73(0.56–0.95)	0.82(0.66–1.02)	0.94(0.63–1.40)	0.66(0.51–0.86)	1.04(0.65–1.67)										
Malta ^w	0.58(0.36–0.92)	0.66(0.43–1.02)	0.82(0.53–1.26)	1.14(0.73–1.76)	n.a.	n.a.	n.a.	n.a.	0.90(0.57–1.43)	0.54(0.37–0.81)										
Portugal	0.6(0.46–0.78)	0.92(0.65–1.31)	n.a.	n.a.	1.17(0.92–1.49)	0.94(0.73–1.22)	0.91(0.70–1.18)	0.78(0.55–1.10)	0.93(0.68–1.28)	0.96(0.69–1.34)										
Slovenia	0.54(0.43–0.68)	0.81(0.61–1.09)	0.59(0.48–0.72)	0.62(0.48–0.81)	0.93(0.76–1.14)	0.74(0.56–0.99)	0.88(0.68–1.14)	1.24(0.68–2.27)	1.12(0.84–1.50)	0.97(0.70–1.33)										
Spain	0.68(0.58–0.80)	0.82(0.67–1.00)	0.79(0.67–0.94)	0.84(0.67–1.05)	1.03(0.85–1.23)	0.87(0.70–1.08)	1.02(0.83–1.27)	0.82(0.55–1.22)	0.94(0.71–1.23)	0.74(0.54–1.00)										
Turkey	1.04(0.83–1.31)	1.01(0.72–1.43)	0.84(0.65–1.07)	1.14(0.77–1.68)	0.98(0.78–1.23)	1.17(0.77–1.78)	0.9(0.68–1.19)	0.76(0.45–1.28)	1.04(0.75–1.45)	1.25(0.72–2.15)										
Eastern-European countries																				
Bulgaria	0.81(0.66–1.00)	0.97(0.69–1.35)	0.88(0.71–1.08)	0.99(0.68–1.43)	0.83(0.66–1.03)	1.1(0.79–1.53)	0.99(0.78–1.25)	0.81(0.54–1.22)	1.04(0.82–1.32)	1.02(0.71–1.46)										
Czech Rep.	0.63(0.51–0.79)	0.96(0.75–1.22)	0.84(0.66–1.07)	1(0.76–1.32)	0.87(0.69–1.09)	1.12(0.86–1.46)	0.79(0.62–1.00)	1.52(0.88–2.65)	0.88(0.66–1.18)	1.05(0.70–1.57)										
Hungary	0.68(0.55–0.84)	0.59(0.43–0.80)	0.83(0.68–1.01)	1(0.73–1.36)	0.87(0.70–1.08)	0.9(0.70–1.14)	0.99(0.77–1.28)	0.88(0.49–1.58)	0.92(0.68–1.26)	1.20(0.73–1.98)										
Poland	0.60(0.47–0.76)	0.77(0.55–1.07)	0.87(0.69–1.11)	0.91(0.67–1.25)	0.93(0.73–1.18)	0.76(0.57–1.02)	0.96(0.75–1.22)	1.02(0.61–1.68)	0.86(0.66–1.12)	0.88(0.60–1.30)										
Romania	1.04(0.81–1.34)	0.69(0.46–1.05)	1.03(0.79–1.34)	0.76(0.52–1.10)	0.85(0.65–1.10)	0.93(0.70–1.22)	0.87(0.67–1.15)	0.94(0.64–1.37)	0.82(0.60–1.11)	0.74(0.49–1.14)										
Russia	0.84(0.67–1.06)	0.89(0.66–1.21)	0.98(0.79–1.21)	0.96(0.70–1.31)	0.88(0.71–1.09)	0.89(0.68–1.16)	0.97(0.77–1.22)	0.73(0.50–1.07)	0.67(0.50–0.90)	0.88(0.55–1.40)										
Slovakia ^a	0.59(0.43–0.80)	0.57(0.38–0.85)	0.71(0.51–0.99)	0.74(0.50–1.09)	0.89(0.65–1.21)	0.91(0.62–1.36)	1.02(0.74–1.41)	0.88(0.47–1.64)	0.87(0.57–1.31)	1.09(0.57–2.09)										
Ukraine	0.67(0.49–0.91)	0.64(0.42–0.97)	0.94(0.71–1.26)	0.63(0.41–0.97)	0.76(0.58–1.00)	0.60(0.40–0.89)	0.91(0.65–1.27)	1.03(0.52–2.03)	0.86(0.57–1.28)	0.9(0.36–2.20)										
Northern-European countries																				
Denmark	0.60(0.45–0.81)	0.74(0.54–1.02)	0.59(0.42–0.82)	0.73(0.54–0.98)	0.96(0.73–1.26)	0.78(0.57–1.06)	0.69(0.52–0.91)	0.91(0.57–1.46)	0.75(0.55–1.03)	0.75(0.51–1.09)										
England ^y	0.49(0.34–0.71)	1.14(0.69–1.90)	0.94(0.63–1.40)	1.07(0.70–1.64)	0.77(0.51–1.16)	0.91(0.53–1.58)	0.66(0.43–1.02)	0.54(0.23–1.24)	0.62(0.41–0.94)	0.82(0.50–1.33)										

Table 5. Continued

Region Country	Moderate to vigorous physical activity (1 hr for ≥ 5 days / week)		Vigorous physical activity (≥ 2 hr / week)		Television-viewing (≤2 hr / weekday)		Electronic game use (≤2 hr / weekday)		Computer use (≤2 hr / weekday)	
	Boys OR† (95%CI)	Girls OR† (95%CI)	Boys OR† (95%CI)	Girls OR† (95%CI)	Boys OR† (95%CI)	Girls OR† (95%CI)	Boys OR† (95%CI)	Girls OR† (95%CI)	Boys OR† (95%CI)	Girls OR† (95%CI)
Estonia	0.61(0.46–0.82)	0.58(0.38–0.87)	0.81(0.60–1.08)	0.78(0.56–1.09)	0.81(0.60–1.10)	0.81(0.57–1.14)	0.71(0.54–0.93)	0.79(0.51–1.22)	1.08(0.80–1.45)	0.90(0.61–1.34)
Finland	0.69(0.54–0.89)	0.86(0.66–1.13)	0.73(0.58–0.93)	0.68(0.54–0.87)	0.55(0.44–0.69)	0.69(0.54–0.89)	0.80(0.62–1.02)	0.53(0.35–0.81)	0.69(0.52–0.92)	0.81(0.60–1.09)
Greenland ^y	0.78(0.61–0.99)	0.51(0.35–0.73)	0.77(0.60–0.99)	0.8(0.60–1.08)	0.89(0.69–1.14)	0.76(0.56–1.02)	1.16(0.90–1.49)	1.00(0.55–1.84)	1.28(0.84–1.97)	0.63(0.32–1.24)
Iceland	0.50(0.42–0.61)	0.81(0.65–1.02)	0.59(0.51–0.70)	0.77(0.63–0.95)	0.61(0.52–0.73)	0.59(0.48–0.72)	0.70(0.59–0.83)	0.90(0.52–1.57)	0.85(0.71–1.01)	0.83(0.65–1.05)
Ireland ^y	0.68(0.45–1.03)	0.71(0.40–1.25)	0.65(0.44–0.98)	0.98(0.61–1.56)	0.97(0.66–1.42)	1.01(0.63–1.62)	0.79(0.44–1.42)	0.19(0.06–0.59)	1.72(0.60–4.96)	1.09(0.37–3.24)
Latvia	0.58(0.41–0.82)	1.14(0.77–1.68)	0.90(0.65–1.25)	1.15(0.76–1.75)	1.06(0.76–1.47)	0.64(0.42–0.97)	0.91(0.64–1.31)	1.39(0.64–2.98)	1.11(0.77–1.62)	0.87(0.57–1.33)
Lithuania ^y	0.75(0.56–1.02)	0.87(0.53–1.41)	1.30(0.98–1.73)	0.9(0.57–1.43)	0.85(0.63–1.14)	0.68(0.44–1.07)	1.11(0.81–1.51)	1.27(0.51–3.18)	1.05(0.66–1.67)	1.28(0.54–3.05)
Norway ^y	0.68(0.50–0.92)	0.69(0.47–1.00)	0.53(0.39–0.71)	0.62(0.44–0.87)	0.55(0.41–0.74)	0.64(0.43–0.93)	0.8(0.58–1.12)	0.38(0.22–0.65)	0.80(0.55–1.17)	0.93(0.61–1.40)
Scotland ^y	0.67(0.48–0.93)	0.72(0.49–1.06)	0.74(0.54–1.01)	1.16(0.79–1.70)	0.77(0.56–1.06)	0.91(0.62–1.33)	0.86(0.60–1.23)	1.19(0.65–2.17)	0.79(0.54–1.13)	1.31(0.86–1.98)
Sweden	0.60(0.44–0.83)	0.62(0.43–0.91)	0.79(0.60–1.03)	0.77(0.56–1.05)	0.69(0.52–0.91)	0.66(0.47–0.92)	0.80(0.58–1.10)	0.54(0.32–0.94)	1.07(0.79–1.46)	1.51(1.00–2.28)
Wales ^y	0.55(0.42–0.73)	0.62(0.44–0.86)	0.79(0.60–1.04)	0.75(0.55–1.02)	0.89(0.69–1.15)	0.84(0.63–1.13)	1.03(0.73–1.45)	0.92(0.59–1.46)	0.81(0.60–1.11)	0.75(0.55–1.02)

^y ≤80% children reported data on age, height, or weight to allow for estimation of body mass index and characterizing overweight status

† Odds ratio (OR) and 95% confidence interval (CI); OR in bold are significant (P<0.05)

n.a. data not available

School variable was not available as a consequence the clustering in schools was not taken into account for these countries

therefore, participants had no reason to dissemble or misreport their height or weight. BMI based on self-reported data can produce lower prevalence estimates of overweight (pre-obesity and obesity) than those based on actual height and weight measurements²⁴ while others have reported high accuracy for classification of youth as obese or non-obese based on self-reported data²⁵. Furthermore, BMI based on self-reports has been found to be fairly reliable²⁵ and suitable for identifying valid relationships in epidemiological studies^{25, 26}. Associations between weight status and lifestyle factors (e.g. physical activity, television viewing, breakfast habits) did not differ when based on self-reported versus measured height and weight data²⁵. In the current study 17% of the sample had missing values on BMI; a high proportion of missing data on height and weight has been reported in this age group⁵. In order to maintain validity the ten countries with the highest risk of low generalizability due to a large proportion of missing values, were omitted from current analyses. The current findings are based therefore on analyses restricted to 31 countries where data on variables of interest were available on >80% of the original representative sample in the country. With respect to eating patterns, the presented results show that compared to boys, girls' daily consumption of fruits and vegetables was higher, and of soft drinks and breakfast was lower. A more healthy eating pattern in girls has been previously reported¹⁶. It is interesting to note, however, that breakfast consumption, which is usually considered a positive practice for several health outcomes³, was lower in girls than boys, as reported previously⁴. In this study, no consistent relations between eating patterns and overweight were noted except for an inverse association with breakfast consumption. Importantly our finding of a negative association between regular breakfast consumption with overweight fits well with the literature^{3, 4}. The presented results showing lack of an association between fruit and vegetables intake and overweight are consistent with findings from the HBSC 2001–2002 survey⁵ and in contrast to other reports^{6, 7}. Similarly the finding of no clear association between soft drink consumption and overweight, although reported previously^{5, 7}, is generally inconsistent with the negative, albeit weak association reported elsewhere²⁷. The current results were based solely on the frequency of consumption of food items without any details on quantity consumed; it is likely that the absence of information concerning portion size, particularly for items where the portions could vary considerably (fruit, vegetables, and beverages), could have masked some associations. However, the finding of a strong and significant association between breakfast consumption and lower probability of overweight despite the limitations associated with food frequency questions suggests the strength of this association across nations.

Consistent with the existing literature on inverse association between childhood physical activity and obesity^{9,28}, the present study shows a clear pattern across gender, countries, and regions that MVPA, and to a lesser extent VPA, being negatively related to adolescent overweight. Data were obtained by self-reports which, compared to objective measures, tends to under-report MVPA and over-report VPA¹⁰; however, this is less likely to affect measures of associations. For boys, MVPA for 1 hour on at least 5 days a week was strongly and negatively associated with overweight. The relation of MVPA on weight status may be different across genders and cultures, and influenced by several factors. In all countries, girls reported less physical activity than boys and fewer girls may have reached the threshold necessary to demonstrate the relationships between MVPA and weight status. The weaker association of VPA with overweight suggests that the guidelines for VPA may need to be increased¹⁶. Because MVPA is more accessible to all and showed a consistent negative association with overweight, the findings suggest that it should be integrated into public health messages and programs for young persons. Studies examining both sedentary behaviour and physical activity report weak or no relations between them and yet there is evidence that each has an independent effect on weight status². In the current study, overweight status had a negative relationship with television-viewing and electronic game playing in many countries; this supports former findings⁸ and

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current guidelines but demonstrates variations across countries.

In conclusion, the results of this large multinational survey indicate that overweight in youth continues to be a public health concern. Furthermore, the strong and consistent negative association of overweight with certain lifestyle factors including breakfast consumption and MVPA suggest the importance of formulating and strengthening preventive public health policies concerning these practices.

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