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Original article

## Weight Reduction Behaviors Among European Adolescents—Changes From 2001/2002 to 2017/2018



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### A B S T R A C T

**Purpose:** The purpose of this study was to analyze changes in the prevalence of weight reduction behaviors (WRBs) among European adolescents from 26 countries between 2001/2002 and 2017/2018. The impact of the perception of body weight on WLB was also analyzed, with particular attention being paid to overestimation.

**Methods:** The data of 639,194 European adolescents aged 11, 13, and 15 years who participated in the Health Behaviour in School-aged Children survey were analyzed. Age-standardized prevalence rates of WRB were estimated separately by survey round and gender for each country, using the overall 2017/2018 Health Behaviour in School-aged Children study population as the standard. Multivariate logistic regression analyses were used to assess WRB trends over time, adjusted for survey year, body mass index, body weight misperception, and family affluence and stratified by gender and age.

**Results:** In the 26 countries examined, the overall age-adjusted prevalence rates of WRB were 10.2% among boys and 18.0% among girls. The prevalence of WRB was higher for girls, but in the more recent surveys, gender differences in WRB decreased. There was a significant increase in the percentage of WRB among boys in most countries. Among girls, most countries did not experience

### IMPLICATIONS AND CONTRIBUTION

This study presents changes in the prevalence of weight reduction behavior among European adolescents between 2002 and 2018. When designing public health interventions, it should be taken into account that weight reduction behavior is no longer a female phenomenon among adolescents.

**Conflicts of interest:** There are no potential conflicts, real or perceived, for any author.

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significant changes. Increases in body mass index and overestimation of body weight were significant factors increasing the risk of WRB in both genders.

**Conclusions:** The change in the prevalence of WRB by gender warrants greater attention from researchers and practitioners alike.

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Weight reduction behaviors (WRBs) include various behavioral changes, including dietary modifications and an increase in the frequency of exercise or making other efforts with the purpose of reducing body weight or changing body shape [1]. In developed countries, WRBs are practiced by a large proportion of the adolescent population [2,3]. The 2013/2014 Health Behaviour in School-aged Children (HBSC) study showed that overall, 14%–18% of adolescents aged 11–15 years reported being on a diet or doing something else to lose weight. However, a wide variation between countries was observed, from 44% of 15-year-old Danish girls to 5% of Albanian boys [2]. In general, WRB is more prevalent among girls than boys and increases with age [2,3]. Moreover, risky weight control behaviors, for example, fasting, taking pills, and using food substitutes, and their negative effects are more often found among girls [4]. In addition, adolescent girls who diet are more likely to engage in other health-compromising behaviors, including smoking, binge drinking, and skipping breakfast [5].

The prevalence of WRB in 11- to 18-year-old adolescents is concerning, given that many do not need to lose weight for health reasons [3,4]. Unnecessary or inappropriate WRB can affect physical, mental, and social health in different ways, including an increased risk of mood disorders and mental health problems [6,7] and the development of various types of eating disorders [8], which may track into adulthood [9]. Moreover, restricting food to reduce weight can lead to overeating and tends to be associated with weight gain over time, thus making young people vulnerable to the long-term risk of obesity [10–12]. Unhealthy weight loss practices can also increase the risk of nutrient deficiencies and result in insufficient stores of energy and a higher risk of diabetes, osteoporosis, and cardiovascular disease [13,14].

Dieting intentions, weight loss attempts, and using healthy and unhealthy weight control strategies are more likely to occur among individuals who perceive themselves as overweight compared with those who perceived themselves as being of a healthy weight [15], irrespective of self-reported weight status [16,17].

The reasons for these behaviors being adopted by adolescents are complex and cover a broad spectrum of factors related with closer and more distant developmental contexts, combined with individual influences [18]. For example, socioenvironmental factors might be related to family factors, that is, parental dieting [19] or parental weight concerns [20], family functioning [7], parent–adolescent relationships [21], or the family's level of education and work status [21]. Moreover, peer environmental factors leading to WRB, that is, peer dieting norms [22,23] and “fat talk” or weight teasing are also related to WRBs [24,25]. Individual factors predominantly relate to the onset of puberty, which is characterized by dynamic psychological and physical changes [26]. The experience of intense physical changes in body structure and shape accompanying the transition from childhood to adulthood, together with pubertal timing, may influence an

adolescent's perception of their body [27]. In turn, increased body dissatisfaction can lead to problematic weight management behaviors, which may persist in late adolescence [28].

According to the results from the cross-sectional 2013–2014 HBSC study of European and North American adolescents, at the age of 15 years, 40% of the girls and 22% of the boys are dissatisfied with their body weight [2]. Furthermore, most girls at this age prefer to be thinner and are afraid of gaining weight or becoming fat [29], whereas boys predominantly pursue strategies to increase their weight and muscle tone [30]. A disturbed or distorted body image, which refers to the cognitive aspect of erroneous perceptions of the actual size of the body or its weight [24], could manifest itself in behavioral changes, such as attempting to lose weight [26,31]. In addition, the perception of being overweight, rather than the actual weight, appears to be a potent force leading to WRBs [32].

Unnecessary WRB during adolescent development, especially unsupervised weight reduction attempts, warrants attention [16], as does the need to monitor the trends and associations of WRB among adolescents. The latter provided the impetus to examine trends in the prevalence of WRB in relation to the overestimation of body weight among Europeans. An analysis of the changes in WRB in adolescence covering a period of 16 years, together with a presentation of the sociocultural differences between countries, can support international and national activities in the promotion of child and adolescent health.

The main purpose of our study was to examine the trends of WRB of adolescents aged 11, 13, and 15 years in 26 European countries from 2002 to 2018, taking into account overestimation of body weight, body mass index (BMI), the level of family affluence, and demographic factors.

The following research questions were addressed:

- What are the trends (2002–2018) in the prevalence of adolescents' WRB in the 26 countries?
- Do the overall prevalence and the time trends of the WRB differ in groups stratified by age and gender?
- What is the overall prevalence of the overestimation of body weight by adolescents, and how is it related to age and gender?
- What is the relationship between the overestimation of body weight, BMI, and WRB in the sample that was studied?

## Methods

### Sample and procedure

The HBSC study is a World Health Organization collaborative cross-sectional study conducted since 1983 in a growing number of countries across Europe and North America. Data collection procedures in all countries are conducted in accordance with a standardized international protocol [33]. Data are collected in school settings every 4 years from a nationally representative

random cluster sample of the 11-, 13-, and 15-year-old adolescents in each participating country. The primary sampling unit is schools. More detailed information about the methodology of the HBSC study is reported elsewhere [33]. The consent of the relevant ethics commission was obtained in each participating country. Participation in the study was anonymous and required the consent of the young people and their parents.

Data on trends in WRB were examined for 26 countries that provided data for at least three consecutive waves of data collection from 2002 to 2018 and with WRB, BMI, and congruence between reported and perceived body weight data on at least 75% of the population that was surveyed (Table 1).

### Measures

**Weight reduction behavior.** WRB was evaluated by the responses to the question: “At present, are you on a diet or doing something else to lose weight?” The response options were as follows: “no, my weight is fine”; “no, but I should lose some weight”; “no, I need to put on weight”; and “yes.” The data were dichotomized into yes/no.

**Body mass index.** The BMI (kilogram per square meter) was calculated using self-reported weight and height, and body weight status was assessed according to the International Obesity Task Force cut-off values [34] in three categories: underweight/normal weight (UN), overweight (Ow), and obesity (O). We categorized the students into overweight or obese (OwO) and not overweight or obese (not OwO).

**Body image.** Body image was assessed using responses to a question about how they perceived their body: “much too thin”; “a bit too thin”; “about right”; “a bit too fat”; “much too fat.” According to the HBSC international recoding guidelines [2], we collapsed the responses into “perceived fat” (being a bit or much too fat), compared with “perceived not fat” (the other three options).

**Body weight congruence.** A variable based on the recoded BMI and body image questions was used to create the congruence between reported and perceived body weight variable, identifying four groups:

- Group 0: adolescents who perceived themselves as not fat and were not OwO according to their self-reported height and weight
- Group 1: adolescents who perceived themselves as overweight/obese in accordance with their weight status (perceived fat and OwO)
- Group 2: adolescents who underestimated their weight status (perceived not fat and OwO)
- Group 3: adolescents who overestimated their weight status (perceived fat and not OwO)

We analyzed the relationship between the WRB trend, two types of congruence between reported and perceived body weight (Groups 2 and 3) and Group 1 of accurate weight perception (using Group 0 as a reference). Based on the results, we only present data on adolescents who overestimated their weight status (Group 3).

Socioeconomic status was assessed by the Family Affluence Scale, a reliable indicator of family wealth [35]. The scale consists of four questions, including family car ownership (0 = no;

1 = yes, one; 2 = yes, two or more), whether adolescents have their own bedroom (0 = no and 1 = yes); number of vacations taken last year (0 = not at all, 1 = once, and 2 = twice or more than twice) and the number of computers owned by the family. The score obtained (0–7) was recorded on a 3-point ordinal scale: low (0–3), medium (4–5), and high ( $\geq 6$ ) family affluence.

### Statistical analysis

Age-standardized prevalence rates of WRB were estimated separately by survey round and gender for each country using the overall 2017/2018 HBSC study population as the standard. The trends of the prevalence of WRB within each country over time were evaluated using multivariate logistic regression analyses considering WRB (yes/no) as the dependent variable and the survey year, BMI, congruence between reported and perceived body weight (Group 0 as reference), and Family Affluence Scale (low category as reference) as independent variables. An interaction term between gender and the survey year was also included in the model to examine whether the trends were moderated by gender. Because of the interaction, the analyses were stratified by gender and age category. All the analyses were performed considering survey design effects (including stratification, clustering, and weighting) using STATA version 14.1 (StataCorp, College Station, TX). Because there were multiple comparisons, a more conservative approach to type 1 error was set, and the significance level of 1% was used.

### Results

Ten countries covered the entire study period, 13 had data from 2002 to 2014, two from 2006 to 2018, and one from 2006 to 2014. Overall, we examined 639,194 adolescents, of whom 51.1% ( $n = 326,561$ ) were females, and 33% were aged 11 years, 34% were aged 13 years, and 33% were aged 15 years.

In the 26 countries examined, the overall age-adjusted prevalence rate of WRB was 10.2% among boys and 18.0% among girls (Figure 1A): in the 10 countries with data from 2002 to 2018 (Figure 1B), the overall age-adjusted prevalence rate of WRB was 10.2% among boys and 18.5% among girls, ranging from 7.9% and 17.2% in 2002 to 12.2% and 18.8% in 2018, among boys and girls, respectively; in the 13 countries with data from 2002 to 2014 (Figure 1C), the prevalence was 9.5% for boys and 16.8% for girls (Table 1 and Figure 1). The lowest prevalence over the entire study period was reported in Dutch boys (5.2%) and girls (9.2%). The highest prevalence was reported in Denmark, both for boys (14.8%) and girls (30.2%).

From 2002 to 2018, steadily increasing rates among both genders were observed in five countries (Belgium, Greece, Italy, Latvia, and Slovenia), and the same tendency was observed in five (the Czech Republic, Germany, Spain, Croatia, and Ukraine) of the 13 countries with data from 2002 to 2014. France was the only country with a decreasing trend for both boys (from 7.3% in 2002 to 6.3% in 2014) and girls (from 16.2% in 2002 to 12.4% in 2014).

In all 26 countries, girls were more likely to take WRB compared with boys at all ages. In seven countries (the Czech Republic, Denmark, Hungary, Israel, Poland, Russia, and Ukraine), the frequency of adolescents reporting WRB was more than 10% higher in girls, compared with boys.

Prevalence rates from the other three countries that had data from the period 2006–2014 or 2006–2018 are presented in Table 1.

**Table 1**

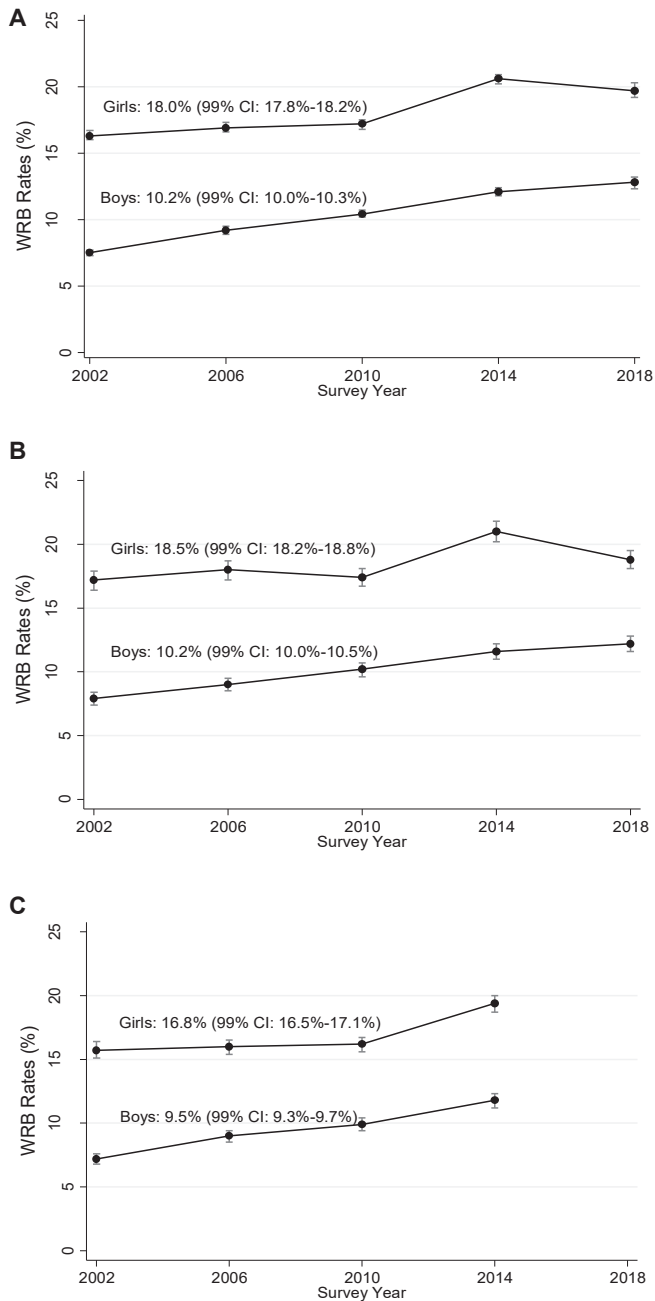
Prevalence of weight reduction behavior (WRB) in 26 countries and regions from 2002 to 2018 (percentage and absolute numbers), missing data (percentage) on BMI, body weight congruence (BWC) and WRB

Country	Prevalence of WRB												Missing data (%)		
	Boys						Girls						BMI	BWC	WRB
	2002	2006	2010	2014	2018	Total	2002	2006	2010	2014	2018	Total			
Belgium (Flemish)	% 6.4	7.7	7.4	9.4	10.9	8.2	12.7	15.5	15.1	16.1	19.3	15.4	9.6	10.4	.8
	n 188	164	154	218	231	955	412	335	310	309	410	1,776			
Denmark	% 13.5	12.9	17.5	16.6	14.7	14.8	30.2	26.0	33.5	35.8	25.4	30.2	13.1	13.4	1.6
	n 297	350	332	290	226	1,495	698	737	691	738	398	3,262			
Greece	% 9.8	10.7	13.4	15.9	16.0	13.2	19.9	23.0	22.2	24.2	24.5	22.8	4.4	4.9	.5
	n 182	187	315	325	301	1,310	390	449	558	502	474	2,373			
Italy	% 9.4	10.3	11.1	14.6	16.7	12.4	18.7	22.6	17.3	28.4	23.6	21.9	10.1	10.8	.5
	n 200	203	265	292	329	1,289	419	447	416	562	506	2,350			
Latvia	% 3.8	7.1	10.2	12.9	13.5	9.9	10.1	14.3	16.1	21.7	19.3	16.9	6.7	7.2	.6
	n 61	144	208	337	293	1,043	188	312	355	626	423	1,904			
Netherlands	% 4.5	5.3	4.4	7.1	5.0	5.2	8.8	10.0	8.5	11.3	7.8	9.2	16.2	22.2	.7
	n 95	111	97	147	108	558	185	210	192	237	192	1,016			
Poland	% 8.9	9.2	14.3	16.7	16.3	12.7	19.7	21.2	20.0	29.9	25.0	23.0	6.3	9.2	.5
	n 280	232	292	369	413	1,586	629	626	434	682	668	3,039			
Slovenia	% 7.7	8.6	9.5	8.7	12.0	9.5	21.1	17.9	16.4	17.1	20.4	18.4	5.0	6.3	.5
	n 151	219	261	211	342	1,184	397	456	440	440	559	2,292			
Sweden	% 5.1	5.7	6.0	8.0	9.0	6.9	11.7	11.0	11.1	14.5	12.3	12.3	15.4	16.5	1.5
	n 97	123	195	304	180	899	216	243	361	553	260	1,633			
Switzerland	% 8.6	11.0	10.8	10.5	10.6	10.3	17.4	15.2	17.1	18.1	14.6	16.4	8.7	10.4	1.8
	n 186	241	343	324	394	1,488	404	352	565	588	536	2,445			
Countries 2002–2018	% 7.5	9.0	10.2	11.6	12.2	10.2	17.2	18.0	17.4	21.0	18.8	18.5			
Austria	% 9.7	14.3	14.5	14.5		13.2	15.7	21.6	20.6	20.6		19.6	7.1	7.8	.9
	n 210	330	350	226		1,116	337	524	529	375		1,765			
Croatia	% 6.2	8.5	9.6	11.9		9.2	10.1	14.1	14.0	18.6		14.4	4.5	5.2	1.6
	n 135	205	279	320		939	231	358	462	516		1,567			
Czech Republic	% 9.8	10.6	14.3	16.8		12.8	21.3	22.5	21.6	27.8		23.4	4.5	5.1	.4
	n 236	248	300	405		1,189	557	534	491	744		2,326			
Finland	% 5.4	7.1	8.1	8.0		7.2	11.8	11.7	12.6	17.8		13.5	5.8	7.0	.7
	n 143	174	257	228		802	311	315	429	528		1,583			
France	% 7.3	6.9	6.4	6.3		6.8	16.2	13.8	12.9	12.4		14.1	13	13.6	.9
	n 293	246	194	177		910	666	488	395	343		1,892			
Germany	% 7.1	10.0	11.4	12.1		10.9	17.2	17.2	18.4	21.3		18.8	13.6	14.7	4.0
	n 44	323	273	360		1,000	103	555	469	623		1,750			
Israel	% 12.3	9.3	17.3	20.9		15.1	26.9	20.4	24.2	29.4		25.3	23.5	27.7	3.9
	n 297	195	324	527		1,343	794	591	539	860		2,784			
Macedonia	% 5.5	7.9	6.9	10.0		7.7	9.6	10.4	9.1	13.5		10.6	12.1	12.5	.6
	n 106	204	135	205		650	199	281	178	278		936			
Norway	% 8.5	9.4	11.9	13.7		10.5	18.2	17.7	22.2	22.6		19.9	18.7	19.6	2.8
	n 213	224	252	206		895	448	391	458	357		1,654			
Portugal	% 3.7	6.8	7.1	9.0		7.0	10.3	13.0	12.3	13.0		12.4	6.8	7.0	1.2
	n 53	125	130	212		520	150	269	276	332		1,027			
Russia	% 4.4	7.7	7.5	8.7		6.8	14.5	16.9	16.4	21.3		16.9	11.3	11.5	.4
	n 165	301	194	169		829	627	740	428	540		2,335			
Spain	% 8.9	11.5	11.5	12.8		11.4	13.7	14.4	15.8	16.5		15.2	15	17.2	1.5
	n 255	425	271	669		1,620	398	627	427	944		2,396			
Ukraine	% 4.1	6.5	5.0	8.7		6.0	14.7	15.8	14.3	19.5		16.0	9.4	9.9	1.1
	n 76	149	136	180		541	338	437	435	479		1,689			
Countries 2002–2014	% 7.2	9.0	9.9	11.8		9.5	15.7	16.0	16.2	19.4		16.8			
Hungary	% 14.1	14.8	16.3	16.4		15.4		26.2	24.6	28.6	28.3	26.7	8.8	10.1	1.1
	n 231	328	312	287		1,158		478	631	542	558	2,209			
Slovakia	% 7.5	12.2	14.6	15.2		12.8		12.4	17.4	25.5	22.0	19.9	11.1	11.7	1.9
	n 133	303	436	351		1,223		258	480	770	476	1,984			
Luxembourg	% 13.2	15.1	17.0			14.9		19.5	21.1	21.7		20.7	11.4	12.9	1.6
	n 279	302	243			824		419	430	358		1,207			
All countries	% 7.5	9.2	10.4	12.1	12.8	10.2	16.3	16.9	17.2	20.6	19.7	18.0			

Table A in the supplementary materials displays the prevalence rates of WRB by age. Among boys, in 15 of the 26 countries, the prevalence of WRB decreased with age, mainly between 13 and 15 years. Among girls, we observed an opposite trend, with the prevalence in WRB increasing with age in all countries, except in Slovakia. In nine of the 26 countries, the difference in prevalence was greater than 10% between 11- and 15-year-olds

(the Czech Republic, Denmark, Greece, Italy, Luxembourg, Norway, Poland, Slovenia, and Spain).

In both genders, most adolescents perceived themselves correctly as being of normal weight (Table 2). This accurate perception was more prevalent among boys (mean 71.3%, from 66.1% in Luxembourg to 80.9% in Russia) than in girls (mean 62.6%, from 50.3% in Poland to 78.8% in Russia). In all the



**Figure 1.** Age-adjusted weight loss behavior prevalence, by gender.

countries except Macedonia, we observed a decreasing trend of accurate perception with increasing age, mainly among girls. As shown in Table 2, the percentage of adolescents who perceived themselves as fat despite being either normal or underweight (Group 3) was more frequent among girls (26.4%) than in boys (11.8%). The lowest and highest prevalence values were in Russia (5.8%) and the Netherlands (17.8%) among boys and in Slovakia (18.1%) and Poland (40.9%) among girls. Overestimation of weight status increased with age in girls from 19.4% in 11-year-olds to 27.9% in 13-year-olds and 31.8% in 15-year-olds (Table 2). Macedonia was the only country in which there was an

opposite trend among girls. In boys, overestimation appeared substantially more stable across the age groups (12.0%, 13.2%, and 10.4% in the three age groups, respectively).

Tables 3 and 4 show the results of the multivariate logistic regression models.

Among boys, trends of increased prevalence of WRB over time were shown in all age groups in Greece, Israel, Italy, Latvia, Spain, and Poland, whereas France, the Netherlands, and Russia were the only three countries with a stable prevalence among all three age categories, and no country showed trends of a decreasing prevalence of WRB. Considering age categories, significant trends were observed in 11, 17, and 16 countries among 11-, 13-, and 15-year-old boys, respectively (Table 3).

Among girls, Finland was the only country to show a significant increasing time trend in all age groups, whereas eight countries (Austria, Hungary, Luxembourg, Portugal, Russia, Sweden, Slovenia, and Ukraine) appeared stable among all three age categories. In France and Switzerland, a decreasing trend was observed in 11- and 15-year-old girls, respectively. Considering age groups, significant increasing trends were observed in nine, seven, and seven countries among 11-, 13-, and 15-year old girls, respectively (Table 4).

The interaction between the wave of data collection and gender was examined separately by age group (Tables 3 and 4). A significant interaction with gender was noted in France and Israel among 11-year-olds, only in Israel for 13-year-olds, and in six of the 26 countries among 15-year-olds (Italy, Latvia, Switzerland, Israel, Macedonia, and Portugal). In all these countries, the increasing prevalence of WRBs was greater for boys (from 3% in Switzerland to 9% in Portugal) than for girls, among whom the prevalence showed stable or decreasing rates (France and Switzerland).

Considering both girls and boys, an increasing BMI raised the probability of WRB. In both genders, the association was always positive. Among boys, in four of the 10 countries with data from 2002 to 2018 (Greece, Italy, Poland, and Sweden) and in two of the countries with incomplete data (Slovakia and Spain), a higher BMI showed a significant association with WRB in all age groups. Among girls, in all but two (Slovenia and Sweden) of the 10 countries with data over the entire period and in seven of the countries with incomplete data (Hungary, Slovakia, Croatia, the Czech Republic, France, Israel, and Portugal), a higher BMI had a statistically significant relationship with the likelihood of WRB in all three age groups.

In addition, the congruence between reported and perceived body weight played a key role: compared with those who perceived themselves as “the right size” and whose BMI status did not indicate overweight or obesity, both boys and girls who perceived themselves as overweight/obese but who were not (overestimation) were more likely to engage in WRB in all age groups, except in Slovakia among 15-year-old girls. Among 11-, 13-, and 15-year-old boys, odds ratios ranged, respectively, from 2.4 (Macedonia), 4.2 (Slovakia), and 5.0 (the Netherlands) to 16.9 (Portugal), 19.9 (Norway), and 21.1 (Denmark). In girls, odds ratio ranged from 2.5 (Macedonia) to 20.9 (the Netherlands) among 11-year-olds, from 2.9 (Macedonia) to 9.9 (Norway) among 13-year-olds, and from 3.3 (Greece and the Czech Republic) to 10.2 (Portugal) among the oldest students.

## Discussion

This study presents data on changes in the prevalence of WRB among adolescents aged 11, 13, and 15 years from 26 European

**Table 2**  
Body weight congruence (BWC) among adolescents from 26 countries by age and gender (percentage)

Country	BWC Group	11-year-olds			13-year-olds			15-year-olds		
		Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
Austria	0	70.7	66.1	68.1	65.2	55.3	60.1	67.1	52.0	59.1
	3	15.2	22.0	18.6	17.9	33.7	25.9	15.1	37.8	27.1
Belgium (Flemish)	0	72.7	63.8	68.2	70.3	52.3	60.1	71.6	46.6	59.1
	3	17.4	26.7	22.2	18.5	37.5	28.3	15.4	43.0	27.1
Croatia	0	70.4	73.4	71.9	71.1	68.2	69.7	73.0	65.0	68.9
	3	8.6	12.0	10.3	9.8	20.3	15.0	6.8	25.7	16.5
Czech Republic	0	70.8	71.1	71.0	70.1	64.9	67.4	73.4	63.3	68.3
	3	11.2	16.9	14.1	15.2	24.3	18.3	8.0	26.3	17.3
Denmark	0	74.1	67.6	70.7	74.5	56.8	63.3	74.3	53.1	66.6
	3	15.6	23.0	19.4	16.7	34.6	26.0	12.9	37.5	23.6
Spain	0	68.4	68.2	68.3	66.2	61.2	63.6	69.2	54.1	61.3
	3	10.1	15.0	12.6	13.1	25.6	19.4	11.1	33.8	23.0
Finland	0	71.6	63.7	67.6	69.8	55.9	62.8	63.7	55.3	63.4
	3	10.6	23.1	17.0	11.8	31.5	21.8	23.1	33.0	21.6
France	0	76.7	70.6	73.7	73.4	63.7	68.5	75.9	59.0	67.4
	3	11.8	19.5	15.6	14.0	27.2	20.5	10.7	31.6	21.2
Germany	0	70.8	64.2	67.7	63.7	50.8	57.3	66.5	48.4	57.1
	3	16.1	25.8	20.8	20.5	38.8	29.5	15.3	39.4	27.8
Greece	0	69.3	69.6	69.5	69.0	66.6	67.7	66.7	64.3	65.5
	3	7.7	13.0	10.4	7.5	18.8	13.3	6.6	23.7	15.3
Hungary	0	67.6	64.3	65.9	68.4	59.5	63.8	72.9	58.0	64.7
	3	13.1	21.9	17.6	11.5	28.0	20.1	8.3	30.3	20.6
Israel	0	73.8	73.8	73.3	68.4	68.4	69.2	65.6	65.6	67.6
	3	13.0	16.6	14.8	12.8	20.9	17.2	11.2	24.4	18.4
Italy	0	67.7	71.0	69.3	69.3	65.0	67.2	70.9	62.1	66.4
	3	8.0	13.9	10.9	8.0	21.5	14.7	6.9	28.1	17.8
Latvia	0	74.4	69.7	71.9	74.5	64.1	69.2	78.6	58.6	67.9
	3	10.8	18.8	15.0	10.8	25.7	18.4	8.4	33.5	21.9
Luxembourg	0	68.1	61.8	65.0	64.4	54.2	59.2	66.3	49.4	57.8
	3	17.0	25.2	21.1	17.2	34.0	25.8	14.9	37.6	26.4
Macedonia	0	58.3	63.3	60.8	60.8	64.7	62.8	73.7	79.0	76.3
	3	17.6	21.1	19.3	17.4	22.5	20.0	5.1	11.7	8.4
The Netherlands	0	74.5	66.1	70.3	73.3	55.2	63.3	72.9	50.8	61.9
	3	17.7	26.9	22.2	13.3	37.5	28.3	16.3	40.5	28.4
Norway	0	77.8	73.5	75.7	73.3	62.3	67.9	71.2	52.7	62.3
	3	10.3	17.8	14.0	13.3	29.1	21.2	12.4	37.9	24.7
Poland	0	64.8	58.1	61.5	65.6	48.4	56.9	71.7	45.6	58.1
	3	16.0	29.7	22.8	16.5	42.0	29.4	12.4	47.6	31.2
Portugal	0	65.1	64.9	65.0	67.7	59.6	63.5	69.2	53.6	60.7
	3	11.7	16.2	14.0	12.4	24.2	18.6	11.5	31.8	22.5
Russia	0	78.9	79.4	79.2	81.5	79.2	80.3	82.1	77.8	79.8
	3	5.6	10.2	8.0	6.1	3.9	10.3	5.6	16.6	11.6
Slovakia	0	74.4	76.4	75.4	73.2	70.8	72.0	77.0	71.6	74.3
	3	6.9	12.5	9.8	8.4	20.5	14.6	6.8	20.5	13.6
Slovenia	0	67.4	61.5	64.6	65.1	52.5	58.8	67.1	48.1	57.6
	3	12.7	24.5	18.6	14.2	34.8	24.6	11.2	39.8	25.5
Spain	0	68.4	68.2	68.3	66.2	61.2	63.6	69.2	54.1	61.3
	3	10.1	15.0	12.6	13.1	25.6	19.4	11.1	33.8	23.0
Sweden	0	78.5	73.3	75.9	73.2	61.4	67.2	72.5	53.4	62.9
	3	8.8	16.6	12.6	12.6	28.6	20.7	10.9	36.3	23.7
Switzerland	0	77.2	71.5	74.4	72.4	62.3	67.3	72.2	57.0	64.7
	3	14.2	21.6	17.9	15.2	30.8	23.0	12.6	34.9	23.6
Ukraine	0	79.4	75.4	77.4	80.3	73.4	76.8	82.5	69.5	75.8
	3	8.2	15.3	11.8	8.3	20.1	14.2	5.7	24.4	15.4

Group 0: adolescents who perceived themselves as not OwO (perceived not fat and not OwO weight).

Group 3: adolescents who overestimated their weight status (perceived fat and not OwO weight).

countries between 2002 and 2018. The impact of the overestimation of weight on WRB among adolescents is also presented.

WRB is common among adolescents, especially among girls [15]. However, an increase in the prevalence of WRB over time was found for boys in 11 (11-year-olds), 17 (13-year-olds), and 16 (15-year-olds) countries. In most countries, no significant changes were observed for girls. Thus, the gender difference is narrowing, and boys are becoming a high-risk group for WRB.

Comparison of our data with other studies is difficult, as most European studies use HBSC data. A comparable data set outside Europe is the Youth Risk Behavior Study, a U.S. based study that showed a significant linear increase in the overall prevalence who reported trying to lose weight between 1991 and 2017 (from 41.8% to 47.1%) [36], but no significant changes between two last rounds of the survey (2015: 45.6%; and 2017: 47.1%) [36]. Notably, the overall prevalence of WRB was almost three times lower in our findings than in American studies [36,37]. European studies,

**Table 3**  
Weight reduction behavior (WRB) trend in males

	11-year-olds			13-year-olds			15-year-olds		
	BMI	BWC <sup>a</sup>	Survey year	BMI	BWC <sup>a</sup>	Survey year	BMI	BWC <sup>a</sup>	Survey year
	OR (99% CI)	OR (99% CI)	OR (99% CI)	OR (99% CI)	OR (99% CI)	OR (99% CI)	OR (99% CI)	OR (99% CI)	OR (99% CI)
Countries with data from 2002 to 2018									
Belgium Flemish	<b>1.11</b> (1.03–1.20)	<b>8.2</b> (5.3–12.5)	<b>1.04</b> (1.01–1.08)	1.05 (.99–1.12)	<b>10.2</b> (6.0–17.3)	1.03 (.99–1.07)	1.06 (.99–1.14)	<b>8.0</b> (5.1–12.6)	<b>1.05</b> (1.02–1.09)
Denmark	<b>1.21</b> (1.08–1.36)	<b>12.6</b> (8.6–18.3)	<b>1.02</b> (1.01–1.05)	<b>1.18</b> (1.06–1.30)	<b>11.1</b> (7.4–16.6)	<b>1.04</b> (1.01–1.07)	1.08 (.97–1.20)	<b>21.1</b> (12.3–36.2)	1.03 (.98–1.07)
Greece	<b>1.14</b> (1.06–1.23)	<b>3.3</b> (2.0–5.5)	<b>1.06</b> (1.03–1.09)	<b>1.10</b> (1.02–1.18)	<b>5.9</b> (3.7–9.3)	<b>1.05</b> (1.02–1.08)	<b>1.11</b> (1.02–1.20)	<b>6.3</b> (3.7–10.6)	<b>1.04</b> (1.01–1.07)
Hungary <sup>b</sup>	<b>1.14</b> (1.05–1.24)	<b>9.1</b> (5.4–15.4)	1.02 (.97–1.06)	1.06 (.98–1.14)	<b>13.1</b> (8.0–21.4)	1.02 (.98–1.06)	<b>1.11</b> (1.03–1.20)	<b>12.0</b> (6.8–21.2)	1.01 (.96–1.07)
Italy	<b>1.18</b> (1.09–1.27)	<b>4.4</b> (2.8–6.9)	<b>1.06</b> (1.03–1.09)	<b>1.16</b> (1.07–1.27)	<b>7.6</b> (4.5–12.7)	<b>1.05</b> (1.02–1.08)	<b>1.10</b> (1.02–1.18)	<b>8.0</b> (4.7–13.5)	<b>1.05<sup>c</sup></b> (1.02–1.08)
Latvia	<b>1.08</b> (1.01–1.16)	<b>3.4</b> (2.3–5.2)	<b>1.04</b> (1.02–1.07)	1.06 (.99–1.13)	<b>4.9</b> (3.2–7.7)	<b>1.04</b> (1.01–1.07)	<b>1.10</b> (1.01–1.19)	<b>5.4</b> (3.1–9.3)	<b>1.06<sup>c</sup></b> (1.02–1.10)
The Netherlands	<b>1.15</b> (1.02–1.29)	<b>8.3</b> (4.1–16.7)	1.02 (.97–1.06)	1.13 (.99–1.28)	<b>11.8</b> (6.0–23.3)	1.01 (.97–1.06)	1.09 (.96–1.24)	<b>5.0</b> (2.6–9.6)	1.00 (.95–1.05)
Poland	<b>1.13</b> (1.06–1.21)	<b>7.4</b> (5.0–10.8)	<b>1.03</b> (1.01–1.05)	<b>1.09</b> (1.02–1.16)	<b>7.5</b> (5.1–10.9)	<b>1.04</b> (1.01–1.07)	<b>1.14</b> (1.06–1.23)	<b>8.9</b> (5.9–13.3)	<b>1.04</b> (1.01–1.06)
Slovakia <sup>b</sup>	<b>1.10</b> (1.02–1.19)	<b>4.5</b> (2.7–7.8)	1.03 (.99–1.07)	<b>1.17</b> (1.08–1.29)	<b>4.2</b> (2.6–6.6)	<b>1.06</b> (1.02–1.09)	<b>1.15</b> (1.04–1.26)	<b>6.6</b> (3.9–13.4)	1.02 (.98–1.06)
Slovenia	<b>1.13</b> (1.05–1.21)	<b>8.7</b> (5.5–13.8)	1.02 (.99–1.05)	<b>1.08</b> (1.01–1.14)	<b>9.5</b> (6.2–14.6)	<b>1.04</b> (1.01–1.07)	1.04 (.98–1.10)	<b>12.8</b> (7.7–21.2)	1.02 (.98–1.06)
Sweden	<b>1.17</b> (1.08–1.28)	<b>5.5</b> (3.3–9.4)	<b>1.05</b> (1.01–1.10)	<b>1.08</b> (1.01–1.17)	<b>8.0</b> (4.9–13.2)	1.02 (.98–1.06)	<b>1.15</b> (1.06–1.23)	<b>13.3</b> (7.7–22.9)	<b>1.06</b> (1.02–1.10)
Switzerland	<b>1.17</b> (1.08–1.28)	<b>8.7</b> (6.1–12.5)	.99 (.96–1.01)	1.05 (.99–1.12)	<b>11.1</b> (7.6–16.2)	1.00 (.98–1.03)	<b>1.18</b> (1.10–1.27)	<b>10.6</b> (7.1–15.8)	<b>1.03<sup>c</sup></b> (1.01–1.06)
Countries with data from 2002 to 2014									
Austria	<b>1.18</b> (1.07–1.31)	<b>7.4</b> (4.5–12.2)	<b>1.06</b> (1.02–1.11)	1.02 (.95–1.09)	<b>12.8</b> (8.2–20.3)	1.03 (.99–1.07)	<b>1.11</b> (1.04–1.19)	<b>10.3</b> (6.2–17.0)	1.01 (.97–1.06)
Croatia	<b>1.08</b> (1.01–1.16)	<b>5.2</b> (3.3–8.3)	1.03 (.99–1.08)	1.06 (.98–1.15)	<b>6.2</b> (3.7–10.3)	<b>1.05</b> (1.01–1.09)	<b>1.18</b> (1.08–1.28)	<b>8.2</b> (4.4–15.2)	<b>1.10</b> (1.04–1.16)
Czech Republic	<b>1.16</b> (1.07–1.25)	<b>5.4</b> (3.4–8.6)	1.02 (.98–1.06)	<b>1.11</b> (1.03–1.19)	<b>5.9</b> (3.9–9.0)	1.03 (.99–1.07)	<b>1.17</b> (1.08–1.27)	<b>8.2</b> (5.3–12.9)	<b>1.07</b> (1.03–1.12)
Finland	1.05 (.98–1.13)	<b>5.3</b> (3.3–8.4)	1.02 (.99–1.06)	<b>1.09</b> (1.02–1.17)	<b>6.2</b> (3.6–10.6)	<b>1.05</b> (1.01–1.10)	<b>1.11</b> (1.03–1.20)	<b>9.8</b> (5.4–18.1)	<b>1.06</b> (1.01–1.12)
France	1.07 (.99–1.15)	<b>12.0</b> (7.3–19.8)	1.00 <sup>c</sup> (.96–1.05)	<b>1.17</b> (1.06–1.28)	<b>10.9</b> (6.3–19.0)	1.00 (.94–1.03)	1.09 (.99–1.19)	<b>12.4</b> (6.7–23.2)	1.00 (.94–1.05)
Germany	<b>1.21</b> (1.08–1.35)	<b>9.7</b> (6.0–15.6)	1.04 (.99–1.09)	<b>1.11</b> (1.01–1.22)	<b>14.1</b> (8.0–24.8)	<b>1.06</b> (1.01–1.11)	1.04 (.98–1.09)	<b>9.8</b> (5.7–17.1)	<b>1.10</b> (1.05–1.16)
Israel	1.02 (.96–1.09)	<b>5.1</b> (3.4–7.6)	<b>1.07<sup>c</sup></b> (1.02–1.12)	<b>1.07</b> (1.01–1.15)	<b>8.3</b> (5.5–12.68)	<b>1.06<sup>c</sup></b> (1.01–1.10)	<b>1.14</b> (1.05–1.22)	<b>5.2</b> (3.2–8.6)	<b>1.08<sup>c</sup></b> (1.04–1.13)
Luxembourg <sup>b</sup>	1.07 (.96–1.19)	<b>7.0</b> (4.2–11.8)	1.05 (.98–1.13)	1.08 (.99–1.17)	<b>9.4</b> (5.6–15.7)	<b>1.08</b> (1.01–1.14)	<b>1.08</b> (1.01–1.15)	<b>10.7</b> (6.2–18.5)	1.01 (.95–1.08)
Macedonia	1.04 (.96–1.13)	<b>2.4</b> (1.1–5.6)	1.02 (.96–1.08)	1.08 (.99–1.18)	<b>5.0</b> (2.4–10.7)	<b>1.09</b> (1.03–1.16)	1.09 (.99–1.21)	<b>5.5</b> (2.5–11.8)	<b>1.07<sup>c</sup></b> (1.02–1.13)
Norway	1.03 (.96–1.10)	<b>16.9</b> (10.5–26.6)	<b>1.07</b> (1.02–1.11)	1.09 (.99–1.18)	<b>19.9</b> (11.3–35.5)	<b>1.06</b> (1.01–1.11)	1.05 (.97–1.13)	<b>16.1</b> (9.1–28.4)	1.05 (.99–1.10)
Portugal	1.05 (.98–1.13)	<b>16.9</b> (8.5–33.8)	1.06 (.99–1.12)	<b>1.15</b> (1.02–1.30)	<b>8.7</b> (4.4–17.1)	<b>1.07</b> (1.01–1.12)	<b>1.14</b> (1.03–1.26)	<b>8.3</b> (3.7–18.8)	<b>1.09<sup>c</sup></b> (1.02–1.16)
Russia	<b>1.12</b> (1.04–1.21)	<b>4.5</b> (2.5–8.0)	1.03 (.98–1.08)	<b>1.09</b> (1.01–1.18)	<b>7.6</b> (4.3–13.2)	1.01 (.96–1.06)	1.02 (.94–1.11)	<b>6.9</b> (3.8–12.4)	1.03 (.99–1.08)
Spain	<b>1.16</b> (1.06–1.26)	<b>2.8</b> (1.7–4.5)	<b>1.05</b> (1.01–1.09)	<b>1.11</b> (1.03–1.20)	<b>5.5</b> (3.5–8.8)	<b>1.05</b> (1.02–1.09)	<b>1.09</b> (1.01–1.18)	<b>6.4</b> (3.8–10.9)	<b>1.07</b> (1.02–1.12)
Ukraine	1.01 (.91–1.11)	<b>5.2</b> (2.9–9.4)	<b>1.07</b> (1.01–1.14)	1.03 (.94–1.14)	<b>9.0</b> (5.0–16.2)	1.03 (.98–1.09)	1.00 (.90–1.11)	<b>10.2</b> (5.2–20.0)	1.04 (.98–1.11)

Results of regression models by age, adjusted by body mass index, survey year, and body weight congruence (BWC).

OR in bold:  $p < .01$ .

BMI = body mass index; CI = confidence interval; OR = odds ratio.

<sup>a</sup> Body weight congruence: OR (99% CI) of adolescents who perceived themselves as too fat although not overweight/obese (Group 3) versus those who perceived themselves correctly as not OwO (Group 0: reference category).

<sup>b</sup> Hungary and Slovakia: data available from 2006 to 2018; Luxembourg: data from 2006 to 2014.

<sup>c</sup> Significant interaction between survey year and gender ( $p < .01$ ).



**Table 4**  
Weight reduction behavior (WRB) trend in females

	11-year-olds			13-year-olds			15-year-olds		
	BMI	BWC <sup>a</sup>	Survey year	BMI	BWC <sup>a</sup>	Survey year	BMI	BWC <sup>a</sup>	Survey year
	OR (99% CI)	OR (99% CI)	OR (99% CI)	OR (99% CI)	OR (99% CI)	OR (99% CI)	OR (99% CI)	OR (99% CI)	OR (99% CI)
Countries with data from 2002 to 2018									
Belgium Flemish	<b>1.15</b> (1.06–1.24)	<b>7.3</b> (4.7–11.3)	1.02 (.99–1.05)	<b>1.13</b> (1.05–1.21)	<b>8.4</b> (5.6–12.6)	<b>1.06</b> (1.03–1.09)	<b>1.10</b> (1.04–1.16)	<b>7.3</b> (5.1–10.5)	<b>1.02</b> (1.01–1.04)
Denmark	<b>1.29</b> (1.18–1.41)	<b>9.9</b> (7.3–13.3)	<b>1.02</b> (1.01–1.04)	<b>1.27</b> (1.18–1.36)	<b>7.5</b> (5.6–10.0)	1.01 (.99–1.04)	<b>1.16</b> (1.07–1.25)	<b>9.1</b> (7.0–11.9)	1.00 (.98–1.03)
Greece	<b>1.12</b> (1.04–1.21)	<b>4.2</b> (2.9–6.2)	<b>1.03</b> (1.01–1.06)	<b>1.22</b> (1.14–1.31)	<b>3.2</b> (2.3–4.3)	1.02 (.99–1.04)	<b>1.17</b> (1.10–1.26)	<b>3.3</b> (2.5–4.3)	1.00 (.98–1.02)
Hungary <sup>b</sup>	<b>1.18</b> (1.10–1.27)	<b>8.0</b> (5.4–11.9)	1.01 (.98–1.05)	<b>1.20</b> (1.12–1.30)	<b>6.7</b> (4.7–9.4)	.98 (.95–1.02)	<b>1.16</b> (1.03–1.20)	<b>5.9</b> (6.8–21.2)	1.00 (.96–1.07)
Italy	<b>1.14</b> (1.03–1.25)	<b>5.7</b> (3.8–8.7)	<b>1.04</b> (1.01–1.07)	<b>1.22</b> (1.14–1.31)	<b>4.0</b> (3.0–5.3)	<b>1.03</b> (1.01–1.06)	<b>1.12</b> (1.05–1.19)	<b>3.4</b> (2.6–4.4)	1.01 <sup>c</sup> (.99–1.03)
Latvia	<b>1.12</b> (1.05–1.20)	<b>3.9</b> (2.7–5.6)	1.02 (.99–1.05)	<b>1.12</b> (1.06–1.19)	<b>4.0</b> (2.9–5.5)	<b>1.05</b> (1.02–1.08)	<b>1.09</b> (1.02–1.15)	<b>3.7</b> (2.8–4.8)	1.02 <sup>c</sup> (.99–1.04)
The Netherlands	<b>1.18</b> (1.04–1.35)	<b>20.9</b> (9.1–47.9)	1.01 (.97–1.06)	<b>1.21</b> (1.11–1.31)	<b>7.8</b> (4.6–13.2)	1.01 (.97–1.04)	<b>1.19</b> (1.09–1.30)	<b>7.7</b> (4.6–12.9)	1.00 (.96–1.02)
Poland	<b>1.10</b> (1.04–1.17)	<b>7.0</b> (5.0–9.8)	<b>1.03</b> (1.01–1.05)	<b>1.12</b> (1.06–1.19)	<b>6.8</b> (5.0–9.4)	1.01 (.99–1.03)	<b>1.06</b> (1.01–1.12)	<b>7.6</b> (5.9–10.0)	<b>1.03</b> (1.01–1.04)
Slovakia <sup>b</sup>	<b>1.18</b> (1.09–1.29)	<b>4.7</b> (3.1–7.1)	<b>1.07</b> (1.03–1.11)	<b>1.17</b> (1.10–1.25)	<b>3.6</b> (2.6–4.8)	<b>1.07</b> (1.04–1.10)	<b>1.20</b> (1.12–1.29)	2.7 (1.8–4.1)	1.02 (.99–1.06)
Slovenia	<b>1.13</b> (1.04–1.22)	<b>6.9</b> (4.8–9.9)	1.02 (.99–1.05)	<b>1.14</b> (1.08–1.20)	<b>4.9</b> (3.7–6.5)	1.01 (.98–1.03)	1.05 (.99–1.11)	<b>5.4</b> (4.1–7.1)	1.01 (.98–1.03)
Sweden	1.05 (.97–1.15)	<b>12.8</b> (7.6–21.5)	1.04 (1.00–1.08)	<b>1.18</b> (1.10–1.26)	<b>8.4</b> (5.8–12.1)	1.01 (.97–1.05)	<b>1.08</b> (1.03–1.14)	<b>7.4</b> (5.3–10.3)	1.01 (.98–1.04)
Switzerland	<b>1.16</b> (1.06–1.27)	<b>8.3</b> (5.7–12.0)	1.01 (.98–1.03)	<b>1.15</b> (1.08–1.23)	<b>6.9</b> (5.2–9.1)	.99 (.96–1.01)	<b>1.18</b> (1.11–1.26)	<b>5.1</b> (3.9–6.7)	<b>.97<sup>c</sup></b> (.94–.98)
Countries with data from 2002 to 2014									
Austria	1.07 (.97–1.18)	<b>7.5</b> (4.8–11.8)	1.02 (.97–1.07)	<b>1.12</b> (1.04–1.20)	<b>6.2</b> (4.2–9.1)	1.01 (.98–1.05)	<b>1.08</b> (1.01–1.16)	<b>6.5</b> (4.6–9.1)	.98 (.95–1.02)
Croatia	<b>1.12</b> (1.04–1.21)	<b>5.0</b> (3.2–7.9)	1.04 (.99–1.09)	<b>1.23</b> (1.13–1.33)	<b>3.4</b> (2.4–4.9)	<b>1.08</b> (1.04–1.13)	<b>1.09</b> (1.01–1.16)	<b>4.6</b> (3.5–6.2)	<b>1.04</b> (1.01–1.07)
Czech Republic	<b>1.23</b> (1.14–1.32)	<b>4.5</b> (3.2–6.5)	1.02 (.98–1.06)	<b>1.15</b> (1.08–1.24)	<b>4.3</b> (3.3–5.7)	1.02 (.99–1.06)	<b>1.13</b> (1.06–1.20)	<b>3.3</b> (2.6–4.3)	1.02 (.99–1.05)
Finland	<b>1.08</b> (1.01–1.17)	<b>5.0</b> (3.3–7.9)	<b>1.05</b> (1.01–1.10)	<b>1.09</b> (1.02–1.16)	<b>6.9</b> (4.7–10.0)	<b>1.04</b> (1.01–1.08)	1.05 (.99–1.11)	<b>6.3</b> (4.5–8.7)	<b>1.06</b> (1.02–1.09)
France	<b>1.17</b> (1.05–1.30)	<b>11.3</b> (7.1–18.1)	<b>.93<sup>c</sup></b> (.89–.97)	<b>1.11</b> (1.03–1.19)	<b>6.4</b> (4.5–9.0)	.97 (.94–1.01)	<b>1.14</b> (1.07–1.21)	<b>4.4</b> (3.2–5.9)	.97 (.95–1.00)
Germany	<b>1.13</b> (1.04–1.24)	<b>11.2</b> (6.6–18.7)	<b>1.13</b> (1.04–1.24)	1.05 (.98–1.14)	<b>8.5</b> (5.7–12.6)	1.03 (.99–1.07)	<b>1.16</b> (1.08–1.25)	<b>6.9</b> (4.8–10.0)	<b>1.06</b> (1.02–1.10)
Israel	<b>1.15</b> (1.06–1.25)	<b>4.9</b> (3.4–7.0)	1.01 <sup>c</sup> (.97–1.05)	<b>1.25</b> (1.16–1.36)	<b>4.1</b> (3.0–5.4)	1.00 <sup>c</sup> (.97–1.04)	<b>1.13</b> (1.04–1.23)	<b>3.4</b> (2.6–4.6)	1.02 <sup>c</sup> (.99–1.05)
Luxembourg <sup>b</sup>	1.07 (.96–1.20)	<b>10.4</b> (5.7–19.2)	1.04 (.95–1.13)	<b>1.11</b> (1.03–1.21)	<b>6.1</b> (3.7–9.9)	1.00 (.95–1.06)	1.07 (.99–1.16)	<b>6.5</b> (4.4–9.7)	1.01 (.96–1.06)
Macedonia	1.07 (.99–1.15)	<b>2.5</b> (1.2–5.3)	1.01 (.95–1.07)	<b>1.20</b> (1.10–1.32)	<b>2.9</b> (1.7–5.0)	<b>1.07</b> (1.02–1.12)	<b>1.16</b> (1.06–1.26)	<b>3.6</b> (2.3–5.6)	1.01 <sup>c</sup> (.97–1.05)
Norway	<b>1.09</b> (1.01–1.18)	<b>10.7</b> (6.6–17.3)	<b>1.08</b> (1.03–1.13)	1.05 (.97–1.14)	<b>9.9</b> (6.6–14.7)	1.02 (.97–1.06)	<b>1.07</b> (1.01–1.13)	<b>8.7</b> (6.0–12.8)	<b>1.03</b> (1.01–1.06)
Portugal	<b>1.08</b> (1.01–1.15)	<b>13.2</b> (7.0–25.0)	1.04 (.99–1.09)	<b>1.13</b> (1.02–1.26)	<b>8.8</b> (4.9–15.8)	1.03 (.98–1.08)	<b>1.09</b> (1.01–1.18)	<b>10.2</b> (6.2–16.9)	1.00 <sup>c</sup> (.97–1.04)
Russia	1.05 (.99–1.13)	<b>4.8</b> (3.3–6.9)	1.00 (.95–1.03)	<b>1.21</b> (1.13–1.30)	<b>3.4</b> (2.5–4.6)	.98 (.95–1.01)	<b>1.15</b> (1.09–1.22)	<b>3.7</b> (2.8–4.9)	1.00 (.97–1.03)
Spain	1.10 (.98–1.24)	<b>5.2</b> (2.9–9.4)	<b>1.06</b> (1.02–1.11)	<b>1.11</b> (1.03–1.21)	<b>6.1</b> (4.1–8.8)	1.02 (.99–1.05)	<b>1.16</b> (1.07–1.25)	<b>6.6</b> (4.6–9.59)	<b>1.03</b> (1.01–1.06)
Ukraine	1.03 (.97–1.10)	<b>5.1</b> (3.5–7.4)	1.00 (.95–1.04)	1.08 (1.00–1.17)	<b>6.8</b> (4.6–9.8)	.98 (.94–1.01)	<b>1.08</b> (1.01–1.15)	<b>4.9</b> (3.7–6.6)	1.01 (.98–1.05)

OR in bold:  $p < .01$ .

Results of regression models by age, adjusted by BMI, survey year, and body weight congruence (BWC).

<sup>a</sup> Body weight congruence: OR (99% CI) of adolescents who perceived themselves as too fat although not overweight/obese (Group 3) versus those who perceived themselves correctly as not OwO (Group 0; reference category).

<sup>b</sup> Hungary and Slovakia: data available from 2006 to 2018; Luxembourg: data from 2006 to 2014.

<sup>c</sup> Significant interaction between survey year and gender ( $p < .01$ ).

based on HBSC data, show a significant decreasing trend in the WRB prevalence among overweight girls and significant increasing trend among overweight boys during the period 2002–2010 [3]. Among nonoverweight adolescents, WRB rates remained relatively constant over time analyzed [3].

When analyzing how the prevalence of WRB has been changing in subsequent rounds of the HBSC study, it should be noted that a significant upward trend has been occurring in an increasing number of countries since 2014. One possible explanation is the dynamic proliferation of social media in the last decade. Social media expose adolescents to appearance-related messages (e.g., receiving feedback or watching selected and edited pictures), mechanisms to control or change one's body [38,39], and/or unrealistic body shapes. These can contribute to excessive concentration on the body and trigger the need to try to change it even if this is not justified by health reasons. Studies confirm the relation of social media use with body image and eating habits [39,40], disordered eating [40], and weight loss attempts [41].

Dissatisfaction with one's own body and appearance increases the risk of weight loss attempts. Numerous studies of gender-specific differences in body image indicate a tendency to idealize a thin body among girls and a muscular body among boys [42]. The lack of significant changes or even the decreasing trend in WRB among girls found in our study may be because of a stable prevalence of body dissatisfaction related to the desire for thinness [43]. On the other hand, the increase in the prevalence of WRB in boys may result from increasing pressure on males to conform to body ideals intensified by treating men's bodies as objects, which is increasingly observed in the media, in marketing strategies, and in the cultural space [44]. Moreover, researchers pay attention to femininity and masculinity as a culturally based perspective that emphasizes a normative approach to gender role beliefs [45,46]. Griffith [46] demonstrates that conforming to the feminine norm is a risk factor for body dissatisfaction and disordered eating in women, but this may also be generalized to men. The emergence of a societal focus on appearance and body ideals for men may translate into increased body self-awareness among boys and result in behavioral consequences.

Our study supports existing studies that demonstrate that higher BMI and overestimation of body weight increases the probability of WRB [47] and body dissatisfaction [48], and that for those who overestimate their weight, the risk is much greater [4,49]. Our work adds to the literature by clearly showing that the differences in WRB and body image by gender are narrowing. It should be noted that in countries where significant increases in WRB were observed, taking into account gender and age, the percentage of adolescents overestimating their body weight was higher than in the other countries.

We found no strong evidence that family affluence is related to the risk of WRB. However, other studies demonstrate a social class effect [50,51].

Although at first glance WRB might be seen as a reasonable strategy to lose weight, and the increasing prevalence of WRB may, therefore, be understood as a positive sign of an increasing awareness of excess weight as a health problem, this could be naïve, even among adolescents who are overweight. Longitudinal studies have shown that unsupervised WRB is neither a healthy nor a successful strategy for weight control in adolescence. On the contrary, WRB in adolescence may lead to long-term increases in BMI, independent of initial weight status [52]. Thus, the high prevalence of WRB in most countries should be of concern.

When the relationship between WRB and BMI and overestimation of body weight is being analyzed, attention should be paid to the limitations of self-reported height and weight. However, the self-reported measures have been shown to be reliable for a classification based on BMI in extensive surveys [53]. A further limitation may be the construction of the WRB questions, which makes it impossible to determine the techniques used to lose weight and whether specialist care is received when losing weight. Nevertheless, validation studies show that this question is reliable [54]. Finally, 10 countries had data from 2002 to 2018, 13 countries had data from 2002 to 2014, two countries had data from 2006 to 2018, and one country had data from 2006 to 2014, which might influence the analyzed perception. The difference relates to countries choosing to include or exclude the WRB questions across survey cycles.

The high prevalence of obesity, coupled with the promotion of healthy body weight, may have exaggerated the importance of appearance and increased the stigmatization of overweight and social pressure to change the shape of one's body, especially among young people. For this reason, while preventing undesirable behavior associated with weight loss by adolescents, approaches should be directed at the factors that influence the acceptance of their own body and the promotion of a healthy lifestyle. The gender-specific patterns in body image and WRB in this study clearly show the need to focus on the risk factors for WRB and body image by gender and whether interventions and health promotion initiatives should be gender specific.

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## Supplementary Data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.jadohealth.2020.03.008>.

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