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Inaccurate Weight Perception Is Associated With Extreme Weight-Management Practices in US High School Students

*Chadi Ibrahim, †Samer S. El-Kamary, *Jason Bailey, and *Diane M. St George

ABSTRACT

Objective: The objective of the present study was to examine whether adolescents' weight perception accuracy (WPA) was associated with extreme weight-management practices (EWPs) in differing body mass index (BMI) categories.

Methods: WPA, overassessment, and underassessment were determined by comparing self-reported BMI and weight perception among US high school students in the 2009 National Youth Risk Behavior Survey. BMI was classified as follows: underweight (<5th percentile), healthy weight (5th to <85th), overweight (≥85th to <95th), and obese (≥95th). WPA was considered inaccurate if BMI and weight perception were discordant. Overassessors thought they were heavier than they were (among underweight/healthy groups); underassessors thought they were lighter than they were (among healthy/overweight/obese groups). EWPs included ≥1 of fasting, use of diet pills, or purging/laxative use. Logit models were fitted for different BMI sex strata.

Results: In the final sample of 14,722 US high school students with complete data, 20.2%, 85.7%, 5.8%, and 80.9% of those who were underweight, healthy weight, overweight, and obese, inaccurately assessed their weight, respectively. In turn, 11.4% and 17.6% of accurate and inaccurate assessors engaged in EWPs, respectively. After adjustment, underweight girls who overassessed their weight had 12.6 times higher odds of EWPs (95% confidence interval 3.4–46.6). Moreover, there were elevated odds of EWPs among healthy weight students who overassessed their weight.

Conclusions: Overassessing healthy weight students and underweight girls had higher odds of ≥1 EWPs, likely related to an unhealthy desire to lose weight. The present study demonstrates a need to further educate clinicians on WPA and its relation to EWPs even among those of healthy weight who may be seen as not at risk.

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From the *Department of Epidemiology and Public Health, and the †Department of Pediatrics, University of Maryland School of Medicine, Baltimore, MD.

Address correspondence and reprint requests to Chadi Ibrahim, MD, PhD, Department of Epidemiology and Public Health, University of Maryland School of Medicine, 660 West Redwood Street, Howard Hall, 102B, Baltimore, MD 21201 (e-mail: cibrahim@epi.umaryland.edu).

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According to the 2009 Youth Risk Behavior Survey (YRBS) of the Centers for Disease Control and Prevention (CDC), close to half of all high school students in the United States are trying to lose weight (1). A group of these students resort to extreme behaviors such as fasting for >24 hours, taking nonprescription diet supplements, and purging to lose weight (1). These extreme weight-management practices (EWPs) may indicate eating disorders such as bulimia nervosa or anorexia nervosa, which are common chronic illnesses of childhood among all age groups (2,3), with the crude mortality rate for each being approximately 18% (2,3).

To our knowledge, only 1 study has investigated the association between weight perception accuracy (WPA) and EWPs, although its focus was on overweight adolescents, rather than students of all body mass index (BMI) percentile categories (4). Although it is of obvious health relevance to examine the association of WPA with EWPs in underweight adolescents because of eating disorders, it is also important to explore these associations in healthy and overweight adolescents. Because eating disorders commonly start out as supposedly innocent dieting behaviors (5), examining adolescents' sense of accurate weight perception may allow earlier recognition of EWPs and associated eating disorders. Higher degrees of inaccuracy may indicate a distorted sense of reality and underlying psychopathology. It is also important to look at EWPs as a group of behaviors rather than considering fasting, diet pill intake, or laxative use independently because these practices all represent EWPs and stem from similar weight-losing intentions.

Therefore, determining the association of WPA with EWPs in different weight groups is warranted. Because both sex and race/ethnicity have been previously shown to differentially influence WPA (6), it is of interest to investigate the effects of these variables on this association. In the present study, we aimed to determine the prevalence of accurate and inaccurate weight perception among US high school students in all BMI categories; investigate the association of WPA with EWPs; and determine the effect of sex, high school grade, and/or race/ethnicity on the association between WPA and EWPs.

METHODS

Study Population and Design

We analyzed the 2009 national YRBS, which reports data from September 2008 to December 2009 (7). The design of the YRBS, a cross-sectional survey, has been described in detail

elsewhere (7,8). The overall goal of the YRBS is to monitor health and risk behaviors in youth. Briefly, the YRBS is a school-based survey developed by the CDC and has been conducted biennially since 1991 (1). The YRBS has undergone numerous validity studies, including those for test-retest reliability (1991 and 1999 versions); assessment of self-reported height and weight; testing the effect of changing the race/ethnicity question; and examination of the effects of varying honesty appeals, question wording, data-editing protocol, and modes and settings of survey administration on prevalence estimates (9). The YRBS is administered by trained data collectors using a standardized script and procedures, and uses a 3-stage clustered sampling design with the objective of obtaining a nationally representative sample of US high school students in grades 9 to 12. Each grade was included in each school sampled, and there was an equal proportion of participants in each grade, and students of both sexes were represented equally. The overall response rate was 68%, school response rate was 81%, and student response rate was 88% (1). Privacy of student participants was maximized via anonymous participation and sealed booklets when possible. The YRBS is subjected to frequent laboratory and field testing, including a revision before each biennial cycle (1,8). The YRBS has been approved by the institutional review board of the CDC. This secondary analysis of this deidentified dataset was formally reviewed by the University of Maryland School of Medicine institutional review board and determined to be non-human subject research that did not require their approval.

Measures

Demographics

Demographic characteristics included in the present study were sex, race/ethnicity, and high school grade level and were explored as covariates (10–12). Race/ethnicities were categorized as non-Hispanic whites, non-Hispanic blacks, Hispanics, and others comprising Native Americans, Asians, Native Hawaiians, and multiracial non-Hispanics.

BMI

Self-reported weight and height were used to calculate BMI (kg/m^2), which were 4 categories based on age- and sex-specific growth curves and standard CDC criteria: underweight (<5th percentile), healthy weight (5th to <85th percentile), overweight (≥85th to <95th percentile), and obese (≥95th) (13).

Weight Perception

Weight perception was determined by asking the question ''How do you describe your weight?'' Five responses were possible: ''extremely underweight,'' ''slightly underweight,'' ''about the right weight,'' ''slightly overweight,'' and ''extremely overweight.''

Degree of WPA

WPA was determined by comparing answers about weight perception to their BMI category. Based on the degree of concordance between the weight perception variable and the BMI category variable, a student's degree of WPA was operationalized in a manner similar to that described by Eichen et al (14). Students were considered accurate assessors if both variables were approximately concordant and inaccurate if they were approximately discordant. Thus, students who were underweight and thought they were ''slightly underweight'' or ''extremely underweight'' were considered accurate assessors. Those who were of healthy weight and who thought they were ''about the right weight'' were considered accurate assessors. Those who were overweight and thought they were ''slightly overweight'' or ''extremely overweight'' were also considered accurate assessors. Finally, those who were obese and thought they were ''extremely overweight'' were considered accurate assessors. Otherwise, all of the other groups were considered inaccurate assessors.

Direction of Inaccuracy

It is important to not only know whether there is an inaccuracy of weight perception but also the direction of this inaccuracy, that is, whether the student is over- or underestimating his or her weight. Direction is relevant because overestimating or overassessing weight are expected to increase a student's engagement in activities to reduce weight, including EWPs, whereas underassessing weight may lead to fewer weight-reducing activities.

This was operationalized as ''overassessing'' if a student was underweight and thought they were ''about the right weight,'' ''slightly overweight,'' or ''extremely overweight;'' and of healthy weight and thought they were ''slightly overweight,'' or ''extremely overweight.'' Similarly, students were considered ''underassessing'' if they were of healthy weight and thought they were ''slightly underweight'' or ''extremely underweight;'' overweight and thought they were ''about the right weight,'' ''slightly underweight,'' or ''extremely underweight;'' or obese and thought they were ''about the right weight,'' ''slightly underweight,'' or ''extremely underweight.'' Everyone else was considered ''accurately assessing.''

Extreme Weight-Management Practices

The specific self-reported EWPs in the present study included the following activities performed within the past 30 days with the intention to lose or maintain weight (ie, not for religious or medical reasons): fasting for ≥24 hours; taking diet pills, powders, or liquids (nonprescription); and/or vomiting or laxative intake. These were 3 separate ''yes'' or ''no'' questions on the YRBS. EWP was considered a dichotomous variable so that if a student answered yes to any of the above questions, he or she was considered to have engaged in EWPs.

Statistical Analysis

To adjust for the complex sampling design of the YRBS, all of the data used in our analysis were weighted. This was done by applying a weight generally based on the sex of the student, grade, and race/ethnicity, which adjusted for school and student nonresponse and made the data representative of the population of students from which the sample was drawn (9). All weighting was done using SAS Survey Procedures, which incorporate the design variables of the surveys (strata and cluster statements) and generalized estimating equations to estimate accurate standard errors. The Pearson χ^2 test of homogeneity was used to identify the presence of any significant differences in the cell values for each covariate, using 2-sided P values with a preset α level of 0.05. Logistic regression was used for multivariable analyses. Effect modification was assessed by stratified crosstab analysis and interaction terms. Potential confounding between the covariate and the primary independent (WPA) and dependent (EWPs) variables was assessed using the χ^2 tests. If the covariate was

associated with both primary variables, then it was considered a potential confounder and was placed into the initial logistic regression model. Two logit models were created for each sex/BMI category group, with EWP as the dependent variable in both cases: 1 for WPA as a binary predictor (accurate vs inaccurate) and 1 with direction of weight perception (accurate vs underassessor vs overassessor) as the predictor. High school grade and race/ethnicity were removed from the final logit model because they were not significantly associated with the primary variables whether as confounders or effect modifiers. No other covariates were, thus, included in the final logit models.

RESULTS

Of 16,410 eligible students, 1688 were excluded because of missing values for components of the primary predictor variable of degree of WPA, leaving a total of 14,722 students in the final analysis. Students were 47.3% girls, with 59.6% white non-Hispanic, 14.1% black non-Hispanic, 18.2% Hispanic, and 8.1% other. Most (70.2%) were in the healthy BMI category. Based on the definition of WPA described above, the majority (62.1%) of the students accurately assessed their weight and 13.7% of the students engaged in ≥1 EWPs (Table 1). How WPA was operationalized, based on BMI category and weight perception among boys and girls, was described in the Methods section.

In the unadjusted analysis, inaccuracy of weight perception was strongly associated with greater engagement in EWPs, with 17.6% of inaccurate and 11.4% of accurate assessors engaging in ≥1 EWPs, respectively ($P < 0.0001$) (Table 2). Furthermore, the rate of EWPs varied significantly by the more specific weight assessment categories of underassessment (13.5%), accurate assessment (11.4%), and overassessment (29.0%) ($P < 0.0001$) (Table 2). The vast majority of students were of healthy weight (70.2%) and a minority was underweight (Table 1). Compared with girls, there were a higher proportion of boys who were underweight (2.6% of boys vs 1.7% of girls) or obese (15.2% of boys vs 8.3% of girls) ($P < 0.0001$) (Table 3). Sex and BMI category were found to be effect modifiers in stratified analyses (data not shown) and we, thus, constructed separate models according to the strata of these variables (Tables 4–6).

Among students of both sexes, 33.9% of underweight, 29.1% of healthy weight, 44.7% of overweight, and 80.9% of students with obesity were inaccurate assessors (Table 4). There were significantly higher proportions of overweight boys and boys with obesity who were inaccurate assessors compared with girls ($P < 0.0001$) (Table 4). Underweight girls were more likely to overassess their weight than underweight boys (41.5% vs 29.5%) (Table 5). In contrast, overweight/obese boys were more likely to underassess their weight than their female counterparts (72.4% vs 43.1%). Similarly, among those of healthy weight, boys more frequently underassessed their weight than girls, who in turn were more likely to overassess (Table 5).

In adjusted analysis, inaccurate weight perception led to a significantly greater odds of engaging in EWPs compared with accurate weight perception among students of both sexes and healthy weight (Table 6). Underweight girls who were inaccurate assessors had a 12.6 times higher odds of EWPs compared with accurate assessors, whereas no significant difference was found among underweight boys (Table 6). Among overweight students and those with obesity, no significant difference (at the 0.05 α level) in EWPs was found between inaccurate and accurate assessors (Table 6).

When we looked at the direction of inaccuracy, this varied by sex and BMI group. Among the underweight group who overassessed, only girls had increased odds of EWPs (Tables 6 and 7); however, among those of healthy (normal) weight, both overassessing boys and girls had increased odds of engaging in EWPs (with similar strengths of association). Among those who were overweight/obese who underassessed their weight, only girls had a significantly reduced odds of engaging in EWPs compared with those who accurately assessed (Table 7).

TABLE 1. Participant characteristics (N = 14,722)

Characteristic	No.	% (SE)*
Sex		
Female	7417	47.3 (1.3)
Male	7305	52.7 (1.3)
Race/ethnicity†		
White non-Hispanic	6446	59.6 (3.1)
Black non-Hispanic	2555	14.1 (1.5)
Hispanic	4270	18.2 (1.5)
Other	1451	8.1 (1.6)
BMI percentile category‡		
Underweight	306	2.2 (0.2)
Healthy weight	10,160	70.2 (0.7)
Overweight	2413	15.6 (0.6)
Obese	1843	12.0 (0.5)
Grade		
9th	3630	27.2 (0.8)
10th	3538	26.3 (0.6)
11th	3767	23.9 (0.4)
12th	3781	22.6 (0.7)
Ungraded	6	0.04
WPA§		
Accurate assessors	9079	62.1 (0.5)
Inaccurate assessors	5643	37.9 (0.5)
Direction of weight perception§		
Accurate assessment	9079	62.1 (0.5)
Underassessment	4157	27.8 (0.5)
Overassessment	1486	10.1 (0.4)
EWPs‖		
One or more	2151	13.7 (0.6)
None	12,571	86.3 (0.6)

BMI = body mass index; EWPs = extreme weight-management practices; SE = standard error; WPA = weight perception accuracy.

* Percentages are weighted.

† Hispanic includes multiracial Hispanic; other includes American Indian, Asian, Native Hawaiian, and multiracial non-Hispanic.

‡ BMI categories are based on the Centers for Disease Control and Prevention standard criteria as follows: underweight students were those <5th percentile; healthy weight students were ≥5th to <85th percentile; overweight students were ≥85th to <95th percentile; and students with obesity ≥95th percentile.

§ See main text for description of how WPA and direction of weight perception variables were constructed.

‖ Included fasting for ≥24 hours; taking diet pills, powders, or liquids (nonprescription); and/or vomiting or laxative intake, provided that these were done within the past 30 days to lose or maintain weight (not for religious or medical reasons).

DISCUSSION

The prevalence of underweight and overweight students is similar to that observed in previous reports (15), with higher proportions of underweight boys and boys with obesity than girls (after survey weighting) (16). We found similar rates and higher rates of inaccurate weight perception among healthy weight students (29.1%) and overweight students/students with obesity

TABLE 2. Percentages* of US high school students surveyed in the 2009 YRBS who participated in EWPs among those with different degrees of WPA and directions of weight perception (N = 14,722)

	≥1 EWPs†, n % (SE) n = 2151	0 EWPs, n % (SE) n = 12,571	P (χ^2)
WPA‡			<0.0001
Accurate assessors (n = 4237)	1094 11.4 (0.6)	7985 88.6 (0.6)	
Inaccurate assessors (n = 10,485)	1057 17.6 (0.9)	4586 82.4 (0.9)	
Direction of weight perception			<0.0001
Accurate assessment (n = 3112)	1094 11.4 (0.6)	7.985 88.6 (0.6)	
Underassessment (n = 1833)	627 13.5 (0.7)	3530 86.5 (0.7)	
Overassessment (n = 8652)	71 29.0 (1.8)	1056 71.0 (1.8)	

EWP = extreme weight-management practice; SE = standard error; WPA = weight perception accuracy; YRBS = Youth Risk Behavior Survey.
* Percentages are weighted (see text).
† Included fasting for ≥24 hours; taking diet pills, powders, or liquids (nonprescription); and/or vomiting or laxative intake, provided that these were done within the past 30 days to lose or maintain weight (not for religious or medical reasons).
‡ See main text for description of how WPA and direction of weight perception variables were constructed.

(60.8% [sum of overweight and obese]) (Table 4) compared with 29.4% and 33.4%, respectively, in another analysis in the prior YRBS (2007) (14). A 2000 YRBS analysis reported the lower rates of inaccurate assessment among underweight students (20.0% vs our 33.9%) and among overweight students/students with obesity (46.2% vs our 60.8%) (17).

These findings may be an indication of a change among underweight and overweight students since 2000 that warrants validation with comparable studies. Analyses of the Third National Health and Nutritional Examination Survey (NHANES III) demonstrated a greater proportion of inaccurate assessors among ''normal'' (<85th percentile) weight adolescent girls (52%) and boys (25%) compared with that in our study in which girls were similar to boys (29.0% and 29.3%) (Table 4) (18). There may be several reasons for this discrepancy. The sample of the NHANES is for all of the adolescents, whereas the YRBS is for adolescent students who may be exposed to greater peer pressure; the participants were younger than those in the YRBS (including 12- and 13-year-olds and not 17 years and older); the survey data were collected approximately 2 decades earlier; and,

TABLE 3. Participant characteristics by sex (N = 14,722)

	Boys, N = 7305		Girls, N = 7417		
Characteristic	No.	% (SE)*	No.	% (SE)*	P†
Race/ethnicity‡					
White non-Hispanic	3273	61.3 (3.6)	3,173	57.7 (2.8)	0.0527
Black non-Hispanic	1234	13.4 (1.7)	1,321	14.9 (1.9)	
Hispanic	2105	17.6 (1.7)	2,165	18.8 (1.5)	
Other	693	7.6 (1.4)	758	8.7 (1.8)	
BMI percentile category§					
Underweight	183	2.6 (0.3)	123	1.7 (0.2)	<0.0001
Healthy weight	4768	66.6 (1.2)	5392	74.3 (0.7)	
Overweight	1194	15.6 (0.8)	1219	15.7 (0.6)	
Obese	1160	15.2 (1.0)	683	8.3 (0.4)	
WPA‖					
Accurate assessors	4175	57.6 (0.9)	4904	67.2 (0.6)	<0.0001
Inaccurate assessors	3130	42.4 (0.9)	2513	32.8 (0.6)	
Direction of weight perception‖					
Accurate assessment	4175	57.6 (0.9)	4904	67.2 (0.6)	<0.0001
Underassessment	2721	37.0 (0.9)	1436	17.6 (0.5)	
Overassessment	409	5.4 (0.3)	1077	15.2 (0.6)	
EWPs¶					
One or more	739	9.1 (0.6)	1412	18.9 (0.7)	<0.0001
None	6566	90.9 (0.6)	6005	81.1 (0.7)	

BMI = body mass index; EWPs = extreme weight-management practices; SE = standard error; WPA = weight perception accuracy.
* Percentages are weighted.
† Based on the χ^2 test.
‡ Hispanic includes multiracial Hispanic; other includes American Indian, Asian, Native Hawaiian, and multiracial non-Hispanic.
§ Underweight students are those <5th percentile; healthy weight students were ≥5th to <85th percentile; overweight students were ≥85th to <95th percentile; and students with obesity ≥95th percentile.
‖ See main text for description of how WPA and direction of weight perception variables were constructed.
¶ Included fasting for ≥24 hours; taking diet pills, powders, or liquids (nonprescription); and/or vomiting or laxative intake, provided that these were done within the past 30 days to lose or maintain weight (not for religious or medical reasons).

TABLE 4. Percentages of US high-school students in the 2009 YRBS within each BMI category having accurate and inaccurate weight perception[†] stratified by sex and overall (N = 14,722)[*]

BMI index category[‡]	Boys, n = 7305 % (SE)[¶]	Girls, n = 7417 % (SE)[¶]	Both N = 14,722 % (SE)[¶]	P[§]
Underweight	2.6% of boys	1.7% of girls	2.2% of total	0.132
Accurate	123	74	197	
	70.5 (5.6)	58.5 (5.2)	66.1 (4.0)	
Inaccurate	60	49	109	
	29.5 (5.6)	41.5 (5.2)	33.9 (4.0)	
Subtotal	183	123	306	
	100	100	100	
Healthy weight	66.6% of boys	74.3% of girls	70.2% of total	0.793
Accurate	3415	3797	7212	
	71.0 (1.0)	70.7 (0.8)	70.9 (0.7)	
Inaccurate	1353	1595	2948	
	29.0 (1.0)	29.3 (0.8)	29.1 (0.7)	
Subtotal	4768	5392	10,160	
	100	100	100	
Overweight	15.6% of boys	15.7% of girls	15.6% of total	<0.0001
Accurate	491	839	1330	
	41.1 (2.1)	71.0 (1.6)	55.3 (1.4)	
Inaccurate	703	380	1083	
	58.9 (2.1)	29.0 (1.6)	44.7 (1.4)	
Subtotal	1194	1219	2413	
	100	100	100	
Obese	15.2% of boys	8.3% of girls	12.0% of total	<0.0001
Accurate	146	194	340	
	13.8 (1.4)	30.1 (2.4)	19.1 (1.2)	
Inaccurate	1014	489	1503	
	86.2 (1.4)	70.0 (2.4)	80.9 (1.2)	
Subtotal	1160	683	1843	
	100	100	100	

BMI = body mass index; SE = standard error; YRBS = Youth Risk Behavior Survey.
[*] All percentages are weighted (see text).
[†] See main text for description of how weight perception accuracy was constructed.
[‡] Underweight students are those <5th percentile; healthy weight students were ≥5th to <85th percentile; overweight students were ≥85th to <95th percentile; and students with obesity ≥95th percentile.
[§] Statistical testing was done using the χ^2 test to assess weight perception by sex in each BMI category.
[¶] Total percentages may not add up to 100% as a result of rounding.

perhaps most important, it was a racially different sample, with 56.8% white, 38.5% black, and 4.8% Hispanic versus 43.8%, 17.4%, and 29.0%, respectively, in our study (18).

The presence of inaccurate weight perception among overweight adolescents in our study is similar to reported findings in another NHANES study, which showed that boys (61%) had a greater tendency to inaccurately assess their weight compared with girls (40%) (6,19). When we compared our findings with those of a recent NHANES (2005–2010) analysis by Chung et al (20), among 12 to 15 years (which is comparable with grades 9 and 10 in our study, ie, 14 or 15 years old) some findings were similar. In their study, only 33.9% and 7.7% overassessed their weight in those underweight and of normal weight, respectively, compared with 41.5% and 14.5% in our study. Among those overweight, 46.0% underassessed their weight, which was similar to 43.1% in our study (Table 5). Among boys, 37.5% and 2.8% overassessed their weight in those underweight and of normal weight, respectively, compared with 29.5% and 4.7% in our study. Among those overweight, 58.9% underassessed their weight, which was substantially less than 72.4% in our study. Most evidently, it appears that a higher proportion of normal weight girls overassessed and overweight boys underassessed in our study, which may be a reflection of the different age demographic as explained.

Another important finding in our study is that inaccurate weight perception among US high school students of healthy weight (boys/girls) or underweight (girls) was associated with increased frequency of EWPs (Table 6). Although high school grade and race/ethnicity of the student did not influence this relation, BMI percentile category and sex did. Underweight girls (but not boys) who overassessed their weight had increased odds of EWPs compared with accurate assessors, which is expected given that underweight girls are known to be at greater risk for eating disorders (Table 7) (21). Interestingly, among those of healthy weight, significantly greater odds of EWPs were seen among inaccurate assessors in both sexes except among girls who thought they were underweight (underassessors). This confirmed a bivariate analysis on the 1999 YRBS conducted by Forman-Hoffman (22), in which overassessors had a higher odds of EWPs in contrast to underassessors as we found in our study. We found that underassessing boys of healthy weight had a higher odds of EWPs (Table 7). This likely reflects that inaccurate weight perception in and of itself regardless of direction of inaccuracy may lead to EWPs. Although the study by Forman-Hoffman analyzed the direction of inaccurate weight perception with EWPs, the investigator did not stratify by or adjust for sex. Moreover, the investigator used slightly different criteria for determination of

TABLE 5. Percentages* of US high-school students in the 2009 YRBS who accurately assess, underassess, or overassess their weight† within each BMI category by sex (N = 14,722)

	Boys, n = 7305 (49.6%), No. % (SE)	Girls, n = 7417 (50.4%), No. % (SE)	P‡
Direction of weight perception in underweight			<0.0001
Accurate assessment (reference)	123	74	
	70.5 (5.6)	58.5 (5.2)	
Overassessment	60	49	
	29.5 (5.6)	41.5 (5.2)	
Direction of weight perception in healthy weight			<0.0001
Accurate assessment (reference)	3415	3797	
	47.3 (1.0)	52.6 (0.7)	
Underassessment	1004	567	
	14.6 (0.8)	7.3 (0.5)	
Overassessment	3764	1028	
	4.7 (0.3)	14.5 (0.6)	
Direction of weight perception in overweight/obese			<0.0001
Accurate assessment (reference)	637	1033	
	27.6 (1.3)	56.9 (1.2)	
Underassessment	1717	869	
	72.4 (1.3)	43.1 (1.2)	

BMI = body mass index; SE = standard error; YRBS = Youth Risk Behavior Survey.
* Percentages are weighted (see text).
† See main text for description of how weight perception accuracy was constructed.
‡ Statistical testing was done using the χ^2 test to assess weight perception within each sex in each BMI category.

under- and overassessment. Nevertheless, the general picture can be inferred.

Thus, students of healthy weight could be at risk for EWPs and thus eating disorders if they overassessed or underassessed (boys only) their weight. It is important to emphasize that we found boys, not only girls, to be at risk for EWPs.

In overweight/obese students who underassessed their weight, the results were more intuitive: there was no positive association found between inaccurate weight perception and EWPs, because those who underestimated their weight would not be expected to engage in further weight-reducing behaviors such as EWPs. Indeed, in girls, such underassessment significantly reduced the odds of EWPs. This confirms what is in the literature wherein overweight underassessors were ''protected'' from attempts to lose weight, EWPs, bullying victimization, and suicide attempts compared with accurate assessors (14,23).

Chung et al (20) also looked at weight control behaviors that are similar to EWPs. In general, similar to our results, they found that among overweight adolescents, underassessors were less likely to engage in weight control behaviors in contrast with accurate

TABLE 6. Adjusted odds ratios for the association between WPA* and direction and prevalence of EWPs among male and female US high school students surveyed in the 2009 YRBS (N = 14,722)

BMI percentile category and WPA	EWPs† among boys, OR (95% CI)	EWPs among girls, OR (95% CI)
WPA of those who were underweight (<5th percentile)		
Accurate (reference category)	1.0	1.0
Inaccurate	1.1 (0.4–3.1)	12.6 (3.4–46.6)‡
WPA of those with healthy weight (≥5th to <85 percentile)		
Accurate (reference category)	1.0	1.0
Inaccurate	1.9 (1.5–2.3)‡	2.7 (2.2–3.3)‡
WPA of those who were overweight (≥85th to <95th percentile)		
Accurate (reference category)	1.0	1.0
Inaccurate	0.7 (0.5–1.0)‡	0.7 (0.5–1.0)‡
WPA of those who were obese (≥95th percentile)		
Accurate (reference category)	1.0	1.0
Inaccurate	1.0 (0.6–1.7)	0.7 (0.5–1.0)

BMI = body mass index; EWPs = extreme weight-management practices; OR (95% CI) = odds ratio (95% confidence interval); WPA = weight perception accuracy.
* See main text for description of how the WPA variable was constructed.
† Included fasting for ≥24 hours; taking diet pills, powders, or liquids (nonprescription); and/or vomiting or laxative intake, provided that these were done within the past 30 days to lose or maintain weight (not for religious or medical reasons).
‡ Statistically significant ($P < 0.05$).

TABLE 7. Adjusted odds ratios for the association between direction of weight perception inaccuracy* and prevalence of EWP† among male and female US high school students surveyed in the 2009 YRBS (N = 14,722)

BMI percentile category and WPA	EWP among boys, OR (95% CI)	EWP among girls, OR (95% CI)
Direction of weight perception in underweight		
Accurate assessment (reference)	1.0	1.0
Overassessment	1.1 (0.4–3.1)	12.6 (3.4–46.6)‡
Direction of weight perception in healthy weight		
Accurate assessment (reference)	1.0	1.0
Underassessment	1.4 (1.1–1.9)‡	1.0 (0.6–1.4)
Overassessment	3.5 (2.4–5.2)‡	3.8 (3.1–4.7)‡
Direction of weight perception in overweight/obese		
Accurate assessment (reference)	1.0	1.0
Underassessment	0.9 (0.6–1.2)	0.8 (0.6–0.9)‡

BMI = body mass index; EWPs = extreme weight-management practices; OR (95% CI) = odds ratio (95% confidence interval); WPA = weight perception accuracy.

* See main text for description of how the direction of weight perception variable was constructed.

† Included fasting for ≥24 hours; taking diet pills, powders, or liquids (nonprescription); and/or vomiting or laxative intake, provided that these were done within the past 30 days to lose or maintain weight (not for religious or medical reasons).

‡ Statistically significant ($P < 0.05$).

assessors. To our knowledge, no other study looked at the association or degree between WPA and EWPs among all BMI categories. We identified only 2 studies that looked at the association between WPA and EWPs, but only among overweight students. Similar to our results among this BMI category, they did not find a significant association with EWPs (4,14).

It should be noted that our study has some limitations. Similar to the above-mentioned studies, the study design was cross-sectional; hence, it is not possible to determine whether weight perception inaccuracies led to EWP or vice versa. In the work by Pasch et al (24), among early adolescents with weight misperception, overassessment of weight was found to ''co-occur'' with risk factors such as smoking, alcohol use, depressive symptoms, and fighting, compared with accurate/underassessment. When looked at prospectively, such misperception was, however, not found to lead to these risk factors. Nevertheless, the association between inaccurate weight perception and EWPs is of clinical relevance as a possible risk factor for disordered eating behavior. Furthermore, because this was a survey, there is the potential for response and recall bias. It is possible that students with varying degrees of WPA may be more (or less) willing to report EWPs. Alternatively, it is highly conceivable that a student who has a distorted weight perception may inaccurately report weight. Those who engage in EWPs may be more likely to pay frequent visits to pediatricians or other health care providers who will notify them of their true weight, leading these students to more accurately know and thus report their true weight than those not engaging in EWPs. Nevertheless, because we used wide BMI percentile groups, this is not likely to affect our results. The YRBS uses self-reported weight rather than actual measurements. Nevertheless, the accuracy of self-reported height and weight has been previously shown to be similar to physical measurement. Differences would be found mainly in overweight respondents, particularly girls, underreporting their true weight. Thus, it is likely that there are more overweight students than indicated (17,25–28).

Our study uniquely looked at the effects of WPA degree on EWPs by sex and all BMI groups. Anorexia nervosa and other eating disorders are more prevalent among girls at approximately an 8:1 ratio compared with boys (2). Particularly among girls, the association of inaccurate weight perception with EWPs has been seen to continue after adolescence. Among a mostly average-to-underweight sample of US college students, women with inaccurate weight perception were more than twice as likely as those with accurate weight perception to engage in EWPs (29). In the nationwide sample represented by the Behavioral Risk Factor Surveillance System, nearly half of all American women, at lower BMIs than men, were dieting to lose weight (vs one-third of men) (30). Thus, it is expected that misperception of weight in girls may likely receive more attention than boys. Our study confirmed that underweight and healthy weight girls who inaccurately assess their weight represent an at-risk group; however, it should not be ignored that the association of inaccurate weight perception with EWPs is also present among boys (2). Our study confirms that boys are also engaging in EWPs in association with inaccurate weight perception.

Inaccuracy of weight perception as a risk factor for EWPs may serve as a clinical indicator of an impending eating disorder, particularly among healthy weight adolescents and underweight girls. Health professionals, whether in clinical medicine or public health, should not overlook WPA screening in healthy weight students, including boys. Such students could be commonly missed in screening because they are not seen to be underweight, which is the classic profile of those adolescents at risk for an eating disorder. Healthy weight students may represent a transitional group, who, because of inaccurate weight perception, may soon fall into either dangerously underweight or overweight status. Screening such students should be considered to ensure early detection and perhaps intervention.

Further research to confirm these findings could elucidate whether there are factors in the causal pathway between WPA and EWPs, including for example, low self-esteem, depression, socioeconomic status, family cohesion, and others. Such information was not available in the YRBS. Moreover, although we studied overweight students and showed that inaccurate weight perception is not associated with EWPs, this group needs to be further studied to better understand behaviors that promote obesity, especially in light of the current obesity epidemic in youth. In addition, clinicians should be further educated on WPA and its relation to EWPs even among those of healthy weight who may not be seen as being at risk. Finally, additional studies could identify the most pertinent predictors of EWPs and other unhealthy dietary behaviors, and can then lead to interventional studies.

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