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Article

An analysis of weight perception and physical activity and dietary behaviours among youth in the COMPASS study

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ABSTRACT

Purpose: Weight misperceptions appear common among youth, potentially influencing their motivation to engage in health-related behaviours; however, the direction of impact remains unclear. The current study examined how weight perception influences physical activity (PA) and diet among youth.

Methods: This study used 2-year linked data of 19,322 grade 9–12 students from Year 2 (Y_2:2013-2014) and 3 (Y_3:2014-2015) of the COMPASS study. Generalized Estimating Equation models tested the effect of Y_3 weight perception on the various Y_3 PA and dietary behaviour measures, adjusting for Y_3 covariates (grade, race/ethnicity, weekly spending money), school cluster, school area median household income, and the Y_2 outcome. Models were stratified by gender and body mass index (BMI) classification.

Results: Regardless of BMI status, overweight perceptions among boys and girls were associated with lower likelihoods of playing school sports, physical education class enrollment, meeting resistance exercise recommendations, eating breakfast regularly, and less vigorous-intensity PA, and among boys only, lower odds of meeting PA guidelines, compared to their peers who perceived their weight as "about right". In boys with normal-weight BMIs, underweight perceptions predicted less vigorous-intensity PA, and lower odds of physical education class enrollment, and of meeting PA and resistance exercise recommendations, than "about right" perceptions. Among girls, underweight perceptions predicted lower likelihoods of engaging in adequate resistance exercise and playing intramurals, and greater odds of eating fast food on weekends, purchasing snacks, and drinking energy drinks and sugar-sweetened beverages. Girls with overweight/obese BMIs who perceived their weight as such were less likely to consume adequate fruits and vegetables relative to their counterparts with "about right" weight perceptions.

Conclusions: Overall, weight perceptions of "about right" appear more favourable for health behaviours among youth across the weight range. Results suggest obesity prevention strategies aiming to increase awareness of weight status may have unintended effects.

1. Introduction

Weight misperceptions – defined as discrepancies between objective indicators of weight and individuals' perceptions of their weight status – appear common among youth. Roughly one-third of adolescents misperceive their weight (Brener, Eaton, Lowry, & McManus, 2004; Edwards, Pettingell, & Borowsky, 2010; Patte, Laxer, Qian, & Leatherdale, 2016). Overall, underestimations are more common than the alternative, although gender variations exist, with girls more inclined to overestimate, and boys tending to underestimate (Fan, Jin, & Khubchandani, 2014; Jackson, Johnson, Crocker, & Wardle, 2015; Patte et al., 2016). While misperceptions of being overweight have long been a focus in the eating disorder field, more recently, researchers have expressed concerns that individuals with obesity who underestimate their weight may lack motivation to engage in health behaviour changes (Deschamps, Salanave, Chan-Chee, Vernay, & Castetbon, 2015; Duncan et al., 2011; Fan et al., 2014; Jackson et al., 2015). Indeed, weight perceptions have been shown to predict weight-control intentions, regardless of objective weight status (Duncan et al., 2011; Edwards et al., 2010; Patte et al., 2016); however, given the difficulties inherent to weight management, and behaviour change in general, intentions may not translate into healthy behaviours. Considering the low proportion of youth that meet guidelines for nutrition and physical activity (PA), and the persistently high obesity rates (Leatherdale & Rynard, 2013), understanding how weight perceptions impact health behaviours is critical and has

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important implications for health promotion strategies.

Given the extensive media and public health attention to obesity, individuals of any size who perceive their weight to be "normal" may fail to appreciate the need to improve their eating and PA habits. These individuals could plausibly disregard messages about nutrition and exercise as not relevant to them, since these campaigns are often framed in the context of weight loss. In fact, people who perceived their weight as healthy were reportedly more likely have poor diets (Skinner, Weinberger, Mulvaney, Schlundt, & Rothman, 2008), and less likely to be physically active (Duncan et al., 2011; Murillo, Ali, Carmack, & Doss, 2016; Skinner et al., 2008) or to see a need to increase their PA (Lechner, Bolman & van Dijke, 2006). In response, approaches to correct weight misperceptions have been advised to improve buy-in for obesity prevention efforts (Deschamps et al., 2015; Duncan et al., 2011; Fan et al., 2014; Jackson et al., 2015).

Conflicting views caution that addressing weight misperceptions could prove detrimental among heavier individuals (Burke, Heiland, & Nadler, 2010; Frisco, Houle, & Martin, 2010; Sonneville, Thurston, Milliren, Gooding, & Richmond, 2016). Not only does perceived weight appear to account for many of the adverse psychosocial consequences of obesity (e.g., depression, suicidal ideation; Duncan et al., 2011; Minor, Ali, & Rizzo, 2016; Roberts & Duong, 2013; ter Bogt et al., 2006), but emerging evidence suggests that increasing recognition of overweight/obesity may discourage health behaviours, potentially through internalized obesity stigma and/or body dissatisfaction. For instance, among youth with weights in the overweight or obese range, accurate weight perceivers consumed more fast food and soft drinks (Khambalia, Hardy, & Bauman, 2012), and were less likely to meet recommendations for PA and fruit and vegetable intakes (Edwards et al., 2010; Fredrickson, Kremer, Swinburn, de Silva, & McCabe, 2015), compared to their peers who underestimated their weight. Likewise, in a large sample of Canadian youth with a range of body weights, perceptions of being overweight were positively associated with low PA and high sedentary behaviour (Wong & Leatherdale, 2009).

To date, the literature has been inconsistent regarding the direction of impact between weight perceptions and health behaviours. That is, no consensus has been reached on whether perceptions of being overweight – or underweight, for that matter – foster or discourage PA and healthy eating. As the majority of weight perception research is from the eating disorder or body image field, the focus has primarily been on extreme weight loss strategies (e.g., purging, fasting), for which under-perceptions of overweight/obesity appear protective (Fan et al., 2014; Jiang, Kempner, & Loucks, 2014; Sonneville et al., 2016). Weight perception research involving PA and general nutrition are scarce, while longitudinal studies are essentially absent. Extant cross-sectional reports demonstrate conflicting results by both specific behaviours and gender (Edwards et al., 2010; Khambalia et al., 2012; Mardiyati et al., 2015; Murillo et al., 2016), not surprisingly given varying aesthetic ideals (Murray, Griffiths, & Mond, 2016) and preferences for physical activities (Corder, Atkin, Ekelund, & van Sluijs, 2013) between boys and girls. To address these gaps, the current study examined how weight perceptions predict several PA and dietary behaviours among youth, using linked data from a large prospective study of secondary school students to test models stratified by gender and weight status.

2. Methods

2.1. Design

The COMPASS study was designed to collect hierarchical longitudinal data from a cohort of secondary school students in grades 9 through 12 and the schools they attend in Ontario and Alberta, Canada (Leatherdale et al., 2014). The current study used linked student-level data from Year 2 (Y_2:2013-2014) and Year 3 (Y_3:2014-2015). A full description of COMPASS and its methods are available in print (Leatherdale et al., 2014) or online (www.compass.uwaterloo.ca). All procedures were approved by the University of Waterloo Office of Research Ethics and appropriate school board committees.

2.2. Participants

School boards and schools were purposefully selected based on whether they permitted active-information passive-consent parental permission protocols (Leatherdale et al., 2014), which is critical for collecting robust data among youth (White, Hill, & Effendi, 2004). Eligible schools were approached after board approval.

For the purpose of the current paper, only students successfully linked on data for Y_2 and Y_3 were included. In Y_2, data were collected from 45,298 students (80.1% participation rate) in 79 Ontario and 10 Alberta secondary schools. In Y_3, data were collected from 42,355 youth (79.3% participation rate) in 86 of these same schools, as three schools dropped out and one was added. Students could decline to participate at any time. Missing respondents resulted primarily from scheduled free/study periods or absenteeism during data collection.

Y_2 and Y_3 student-level data were linked within schools. The process of linking student data across waves is described in more detail by Qian, Battista, Bredin, Brown, and Leatherdale (2015). Due to the rolling sample design (Leatherdale et al., 2014), it was not possible to link the grade 12 students in Y_2 that graduated, or the grade 9 students that were newly admitted to participating schools in Y_3. The other main reasons for non-linkage included students transferring schools or dropping out, students not providing data for grade or gender, students on scheduled free/study periods or absent during data collection, or inaccurate data provided in the linkage measures. A total of 19,781 students were successfully linked between Y_2 and Y_3.

Students with missing Y_3 weight perception data were removed (n=459), leaving a final sample of 19,322. For students missing Y_3 height and/or weight data for calculating BMI (n=3,418), multiple imputation (MI) chained equations were used to impute missing Y_3 BMI values under the assumption of missing at random (MAR). Age, gender, race/ethnicity, Y_2 BMI, weight perception, and other variables included in the current study were added to the imputation model to generate five imputed datasets. Analyses on imputed datasets were pooled according to Rubin's (1987) procedures, using PROC MIANALYZE in SAS 9.4.

2.3. Data collection tool

The student-level questionnaire for COMPASS (Cq) collects individual student data pertaining to multiple behavioural domains (e.g., substance use, PA, diet), correlates (e.g., bullying, academic achievement), and demographic characteristics. In each school, the Cq was used to collect whole-school samples during class time. The Cq items were based on national standards or current national public health guidelines as described elsewhere (Leatherdale et al., 2014). The cover page contains measures to create a unique self-generated code for each respondent in a school to ensure the anonymity of participants, while still allowing COMPASS researchers to link each student's anonymous identifier data over multiple years.

2.4. Measures

2.4.1. Weight perception

Weight perception was assessed by asking "how do you describe your weight?" Response options included: "very underweight," "slightly underweight," "about the right weight," "slightly overweight," and "very overweight". Categories were collapsed into very/slightly underweight, about right, and slightly/very overweight to adequately power the models. This method of measuring weight perception is common in previous studies (e.g., Patte et al., 2016; Wong & Leatherdale, 2009).

2.4.2. Physical activity measures

To assess PA, respondents were asked how many minutes of vigorous and moderate intensity PA they engaged in on each of the last 7 days. These measures have been previously validated (Leatherdale, Laxer, & Faulkner, 2014). Consistent with the Canadian PA guidelines for youth (Canadian Society for Exercise Physiology, 2016), students were classified as inactive if they had not performed 60 minutes of moderate-to-vigorous PA daily and vigorous-intensity PA on at least three of the last 7 days. Similarly, respondents were categorized based on whether they met the three times weekly recommendation for resistance exercise (CSEP, 2016), by the question "on how many days in the last 7 days did you do exercises to strengthen or tone your muscles (e.g., push-ups, sit-ups, weight training)?" Other PA items assessed whether respondents were taking a physical education course in school,[2] and if they participated in competitive sports teams against other schools (e.g., varsity sports), league or team sports outside of school, and school-organized PA at noon, before, or after school (e.g., intramurals, non-competitive clubs).

2.4.3. Dietary behaviour measures

Using a previously validated measure (Leatherdale & Laxer, 2013), respondents were asked how many servings of each food group they eat on a usual day. Based on the Canada Food Guide recommendations for adolescents (Health Canada, 2013), inadequate fruit and vegetable consumption was defined as less than eight and less than seven servings per day for boys and girls, respectively. For breakfast skipping, respondents were considered to have breakfast regularly if they reported eating breakfast at least 5 times per week. Consumption of sugar-sweetened beverages, high-energy drinks, and snacks purchased from vending machines, corner stores, snack bars, or canteens off school property in the past week were also assessed. Lastly, students were asked the number of days they ate fast food or at a restaurant on the weekend, and how many days during the school week they purchased lunch from one of these places.

2.4.4. Correlate and stratifying measures

Models were adjusted for student-level demographic variables of grade, race/ethnicity, and weekly spending money. Age was not included due to the high correlation with grade, which is likely a more meaningful indicator for school-based prevention planning. Student-reported weekly spending money was included as an indicator of socio-economic status (SES).

School area median household income was also added to the models as a second indicator of SES. This information was generated using census divisions that corresponded with school postal codes and data from the 2011 National Household Survey (Statistics Canada, 2011).

Regression models were stratified by gender and body mass index (BMI; kg/m^2) category. BMI classifications were determined based on student-reported height and weight (Leatherdale & Laxer, 2013), and the World Health Organization (WHO, 2007) age- and sex-adjusted cut-points (recoded as underweight, normal-weight, overweight/obese). The weight status measure has been found to be reliable, valid, and valuable for use when objective methods are not feasible (Leatherdale & Laxer, 2013).

2.5. Analyses

All analyses were performed using the statistical package SAS 9.4. Descriptive statistics were calculated by weight status and gender. Generalized Estimating Equations (GEE) models were used to test the effect of Y_3 weight perception (underweight, overweight, "about right") on the various Y_3 outcome measures of PA and dietary behaviours, adjusting for Y_3 covariates (grade, race/ethnicity, weekly spending money, school area median household income) and the Y_2 outcome health behaviour. Models were stratified by gender and BMI status. In other words, the models included Y_3 data for the predictor, covariate, and outcome measures, and adjusted for the outcome measure from Y_2 data, in order to strengthen inferences. The GEE model is an extension of generalized linear models to correlated data, simply modelling the mean response and treating covariance as nuisance. It produces consistent estimates for regression parameters and can be used for continuous, categorical (including binary), and ordinal measurements. In our analyses, we specified identity link function for continuous outcomes, logit for binary outcomes and cumulative logit for ordinal outcomes. Schools were included in the models as clusters to take account of within-school correlation. Squared root transformation was used for continuous outcome variables to meet model assumptions.

3. Results

3.1. Descriptive statistics

For students without missing Y_3 BMI data, based on age- and sex-adjusted cut-offs (WHO, 2007), 1.2% (n=100) of girls and 1.6% (n=123) of boys were underweight, 78.6% (n=6,566) of girls and 65.7% (n=4,959) of boys had normal-weight BMIs, and 20.2% (n=1,690) of girls and 32.7% (n=2,466) of boys had BMIs in the overweight/obese range. For students with imputed BMI values, averaging the five generated datasets, 7.0% students were classified as underweight, 56.2% as normal-weight, and 36.8% as having overweight/obese BMIs. In comparison to non-imputed participants, imputed students were less likely to be classified as normal-weight. Students classified as underweight were excluded from analyses as there were too few in this category to provide adequate power. Given that five datasets were generated using MI, descriptive statistics are only reported for students with non-imputed Y_3 BMI data. Descriptive statistics of the Y_3 covariate measures are reported in Table 1 by gender and BMI classification. Descriptive statistics of the Y_3 predictor and outcome measures are reported in Tables 2 and 3 by weight status for girls and boys, respectively.

3.2. GEE models

The results of the PA and dietary behaviour models are presented in Tables 4 and 5, respectively. All models adjusted for grade, race/ethnicity, weekly spending money, school-area median household income, school cluster, and the outcome PA or dietary behaviour from the previous year. Results for youth with underweight perceptions and overweight/obese BMIs are not reported due to the small number of students in this category. Also, only GEE results obtained after MI are reported, as findings were similar when using list-wise deletion.

3.2.1. Physical activity models

Among boys and girls with normal-weight BMIs, perceptions of being overweight predicted less engagement in vigorous PA, and lower likelihoods of reporting in adequate resistance exercise, taking a physical education class, and participating in both varsity and intramural sports, relative to weight perceptions of "about right". Normal-weight boys with overweight perceptions were also less likely to meet PA guidelines than boys with "about right" perceptions.

Similarly, among boys and girls with overweight/obese BMIs, perceptions of being overweight predicted less vigorous PA (minutes/day), and lower odds of taking a physical education class, playing varsity sports, and engaging in adequate resistance exercise, and among girls only, less moderate-intensity PA (minutes/day), and lower likelihoods of meeting PA guidelines, and participating in intramurals

[2] In Ontario, one health and physical education course credit is required to obtain a secondary school diploma. Students can complete this credit in any grade. In Alberta, students are required to complete one three-credit physical education course in grade 10 prior to graduation.

Table 1
Descriptive statistics of covariate measures among youth in the COMPASS study (Y_3 data 2014/2015).

	BMI classification[a]		
Girls	**Normal weight** % (n)[b] (n=6,566)	**Overweight/Obese** % (n) (n=1,690)	Chi-square
Grade			
9	5 (0.1)	1 (0.1)	p=.9869
10	2295 (35.0)	597 (35.3)	
11	2322 (35.4)	593 (35.1)	
12	1944 (29.6)	499 (29.5)	
Weekly spending money			
$0	791 (12.0)	254 (15.0)	**p=.0012**
$1-20	1663 (25.3)	446 (26.4)	
$21-100	2081 (31.7)	467 (27.6)	
$100+	1284 (19.6)	342 (20.2)	
I don't know/not stated	747 (11.4)	181 (10.7)	
Race/ethnicity			
White	5263 (80.2)	1306 (77.3)	**p < .0001**
Black	138 (2.1)	55 (3.3)	
Off-reserve Aboriginal	363 (5.5)	60 (3.6)	
Asian	122 (1.9)	53 (3.1)	
Hispanic	102 (1.6)	27 (1.6)	
Mixed/other/missing	578 (8.8)	189 (11.2)	
Boys	(n=4959)	(n=2466)	
Grade			
9	9 (0.2)	3 (0.1)	p=.3424
10	1877 (37.9)	926 (37.6)	
11	1622 (32.7)	852 (34.5)	
12	1451 (29.3)	685 (27.8)	
Weekly spending money			
$0	707 (14.3)	362 (14.7)	p=.5537
$1-20	1249 (25.2)	602 (24.4)	
$21-100	1388 (30.0)	658 (26.7)	
$100+	1152 (23.2)	599 (24.3)	
I don't know/not stated	463 (9.3)	245 (9.9)	
Race/ethnicity			
White	3927 (79.2)	1884 (76.4)	**p=.0071**
Black	184 (3.7)	97 (3.9)	
Off-reserve Aboriginal	225 (4.5)	122 (4.9)	
Asian	98 (2.0)	81 (3.3)	
Hispanic	82 (1.7)	38 (1.6)	
Mixed/other/missing	443 (8.9)	244 (9.9)	

Note: descriptive statistics only reported for student with non-imputed Y_3 BMI data
[a] BMI classification based on self-reported height and weight and age- and sex-adjusted cut-offs.
[b] Numbers may not add to total due to rounding and/or missing data.

Table 2
Descriptive statistics for predictor and outcome measures among girls in the COMPASS study (Y_3 data 2014/2015).

	BMI classification[a]		
	Normal weight (n=6,566) Mean (SD)	**Overweight/ Obese** (n=1,690) Mean (SD)	T-test
Vigorous physical activity (PA; average minutes/day)	54.17 (47.61)	47.78 (45.12)	**p < .0001**
Moderate-intensity PA (average minutes/ day)	51.01 (44.81)	53.04 (48.43)	p=.1234
	% (n)[b]	% (n)	Chi-square
Weight Perception			
Very/slightly underweight	10.6 (695)	0.7 (12)	**p < .0001**
"About right"	69.4 (4554)	21.8 (368)	**p < .0001**
Very/slightly overweight	20.1 (1317)	77.5 (1310)	**p < .0001**
Physical education class enrollment			
Yes	21.9 (1431)	16.7 (281)	**p < .0001**
No	78.1 (5114)	83.3 (1402)	
School-organized PA (e.g., intramurals)			
Yes	38.5 (2526)	32.2 (543)	**p < .0001**
No	61.5 (4031)	67.8 (1143)	
School league/team sports (e.g., varsity)			
Yes	42.1 (2759)	32.6 (550)	**p < .0001**
No	57.9 (3794)	67.4 (1137)	
League/team sports outside of school			
Yes	45.3 (2969)	39.9 (671)	**p < .0001**
No	54.7 (3580)	60.1 (1012)	
Meets PA guidelines[c]			
Yes	39.1 (2535)	37.7 (630)	p=.2807
No	60.9 (3941)	62.3 (1041)	
Meets resistance exercise guidelines[c]			
Yes	50.9 (3334)	42.0 (709)	**p < .0001**
No	49.1 (3217)	58.0 (981)	
Adequate fruit and vegetable intake[d]			
Yes	5.1 (331)	4.6 (77)	p=.4399
No	94.9 (6188)	95.4 (1591)	
Sugar-sweetened beverages (days/ week)			
0	35.6 (2304)	33.2 (555)	p=.0830
1–3	43.6 (2820)	45.2 (755)	p=.2016
4–7	20.9 (1351)	21.6 (361)	p=.4776
Consumed energy drink(s) in past week			
Yes	92.3 (5965)	89.7 (1497)	
No	7.7 (501)	10.3 (172)	**p=.0007**
Breakfast skipping			
Skips 3 or more days/ week	40.8 (2657)	48.1 (806)	**p < .0001**
Eats breakfast regularly (5–7/week)	59.2 (3858)	51.9 (870)	
Weekday lunches from fast food/restaurants			

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and team sports outside of school, relative to their BMI counterparts with weight perceptions of "about right".

Boys who perceived their weight to be underweight but had normal-weight BMIs engaged in less vigorous PA, were less likely to be taking physical education classes, and had lower odds of meeting PA and resistance exercise guidelines, than those with "about right" weight perceptions. Among girls with normal-weight BMIs, underweight perceptions also predicted a lower likelihood of meeting resistance training recommendations, as well as participating in intramurals, than weight perceptions of "about right".

3.2.2. Dietary behaviour models

Among youth classified as normal-weight, perceptions of being underweight predicted reports of skipping breakfast and buying snacks from vending machines or stores, and among girls only, consuming fast food on weekends, and sugar-sweetened beverages and energy drinks in the past week, in comparison to weight perceptions of "about right". Overweight perceptions also predicted regular breakfast skipping

Table 2 *(continued)*

	BMI classification[a]		
	Normal weight (n=6,566) Mean (SD)	**Overweight/ Obese** (n=1,690) Mean (SD)	T-test
0	60.9 (3968)	63.4 (1065)	p=.0520
1-2	31.8 (2073)	30.9 (518)	p=.4669
3-5	7.3 (474)	5.7 (96)	**p=.0261**
Fast food/restaurants on weekends			
Yes	51.8 (3381)	51.2 (858)	**p=.0267**
No	48.2 (3141)	48.8 (818)	
Vending machine/store snacks (days/week)			
0	76.0 (4915)	75.3 (1257)	p=.6875
1–3	22.1 (1429)	23.1 (385)	p=.3677
4–7	1.9 (123)	1.6 (27)	p=.4493

Note: descriptive statistics only reported for student with non-imputed Y_3 BMI data

[a] BMI classification based on self-reported height and weight and age- and sex-adjusted cut-offs.

[b] Numbers may not add to total due to rounding and/or missing data.

[c] based on CSEP (2016) guidelines for youth of 60 minutes of moderate/vigorous physical activity a day and strengthening exercises at least 3 days a week.

[d] based on Canada's Food Guide recommendations of 7 and 8 servings for girls and boys, respectively.

among boys and girls with normal-weight BMIs and boys with overweight/obese BMIs, relative to "about right" perceptions. Lastly, girls with BMIs classified as overweight/obese who perceived themselves as such were less likely to report adequate fruit and vegetable consumption, in comparison to their BMI counterparts with "about right" weight perceptions.

4. Discussion

The purpose of the current study was to examine weight perception as a predictor of various measures of diet and PA among a large cohort of youth. In general, weight perceptions of "about right" were associated with healthier diet and PA behaviours in both girls and boys, regardless of weight status. Given the potential of overweight perceptions to discourage PA and healthy dietary practices, as well as the psychosocial risks demonstrated by previous research (Minor, Ali, & Rizzo, 2016; Roberts & Duong, 2013; ter Bogt et al., 2006), results suggest obesity prevention strategies aiming to increase awareness of weight status may have unintended effects.

4.1. Physical activity

Perceptions of being overweight deterred several forms of PA participation relative to "about right" perceptions. These relationships were consistent across BMI classification and gender for many of the PA measures, including engagement in adequate resistance exercise, daily duration of vigorous-intensity PA, school sports participation, and enrollment in physical education classes. Overall, the current study adds to literature suggesting that youth with overweight/obese BMIs who perceive themselves as such tend to be more sedentary (Wong & Leatherdale, 2009), and engage less PA and strength training (Fredrickson et al., 2015), than their peers who underestimate their weight status. While a number of divergent reports also exist (Duncan et al., 2011; Murillo et al., 2016), previous research has been limited to cross-sectional designs. In the handful of past longitudinal studies, perceptions of being overweight were predictive of weight gain overtime (Duong & Roberts, 2014; Neumark-Sztainer et al., 2007). These reports seem to coincide with our findings, and challenge notions that

Table 3
Descriptive statistics for predictor and outcome measures among boys in the COMPASS study (Y_3 data 2014/2015).

	BMI classification[a]		
	Normal weight (n=4,959) Mean (SD)	**Overweight/ Obese** (n=2,466) Mean (SD)	T-test
Vigorous physical activity (PA; average minutes/day)	77.33 (55.46)	77.72 (58.51)	p=.7865
Moderate-intensity PA (average minutes/ day)	60.99 (53.15)	60.72 (53.40)	p=.8350
	% (n)[b]	% (n)	Chi-square
Weight Perception			
Very/slightly underweight	30.8 (1529)	3.1 (76)	**p < .0001**
"About right"	63.0 (3125)	41.5 (1024)	**p < .0001**
Very/slightly overweight	6.2 (305)	55.4 (1366)	**p < .0001**
Physical education class enrollment			
Yes	21.9 (1431)	16.7 (281)	**p < .0001**
No	78.1 (5114)	83.3 (1402)	
School-organized PA (e.g., intramurals)			
Yes	29.6 (1465)	28.8 (706)	p=.4557
No	70.4 (3479)	71.2 (1746)	
School league/team sports (e.g., varsity)			
Yes	54.1 (2678)	49.8 (1225)	**p=.0005**
No	45.9 (2270)	50.2 (1233)	
League/team sports outside of school			
Yes	58.1 (2870)	56.2 (1378)	p=.1158
No	41.9 (2072)	43.8 (1076)	
Meets PA guidelines[c]			
Yes	56.9 (2785)	56.3 (1361)	p=.6213
No	43.1 (2108)	43.7 (1056)	
Meets resistance exercise guidelines[c]			
Yes	59.7 (2905)	59.3 (1454)	p=.6147
No	41.3 (2045)	40.7 (998)	
Adequate fruit and vegetable intake[d]			
Yes	4.7 (230)	4.6 (110)	p=.7839
No	95.3 (4649)	95.4 (2297)	
Sugar-sweetened beverages (days/ week)			
0	18.4 (896)	19.4 (466)	p=.3848
1-3	48.3 (2109)	42.9 (1030)	p=.5320
4-7	38.3 (1865)	37.6 (903)	p=.4059
Consumed energy drink(s) in past week			
Yes	82.7 (4043)	80.8 (1948)	**p=.0409**
No	17.3 (843)	19.2 (463)	
Breakfast skipping			
Skips 3 or more days/ week	32.0 (1572)	37.0 (895)	**p < .0001**
Eats breakfast regularly (5-7/week)	68.0 (3339)	63.0 (1527)	
Weekday lunches from fast food/restaurants			

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Table 3 *(continued)*

	BMI classification[a]		
	Normal weight (n=4,959) Mean (SD)	**Overweight/ Obese** (n=2,466) Mean (SD)	T-test
0	48.8 (2396)	52.6 (1272)	**p=.0080**
1-2	36.2 (1774)	34.2 (826)	p=.0526
3-5	15.0 (735)	13.2 (320)	**p=.0320**
Fast food on weekends			
Yes	50.3 (2470)	49.2 (1190)	p=.3841
No	49.7 (2441)	50.8 (1228)	
Vending machine/store snacks (days/week)			
0	66.9 (3251)	67.7 (1626)	p=.7459
1-3	29.3 (1422)	28.4 (681)	p=.3399
4-7	3.8 (183)	4.0 (95)	p=.7289

Note: descriptive statistics only reported for student with non-imputed Y_3 BMI data

[a] BMI classification based on self-reported height and weight and age- and sex-adjusted cut-offs.

[b] Numbers may not add to total due to rounding and/or missing data.

[c] based on CSEP (2016) guidelines for youth of 60 minutes of moderate/vigorous physical activity a day and strengthening exercises at least 3 days a week.

[d] based on Canada's Food Guide recommendations of 7 and 8 servings for girls and boys, respectively.

increasing recognition of adiposity will improve health behaviours.

Initially, the current study may appear to contradict the positive association consistently found between overweight perceptions and intentions to lose weight (Chung, Perrin, & Skinner, 2013; Duncan et al., 2011; Fan et al., 2014; Fredrickson et al., 2015; Hwang, Ryu & Park, 2015; Jiang et al., 2014; Khambalia et al., 2012; Patte et al., 2016); however, it is plausible that these intentions do not translate into healthy behaviours, or at least, sustained engagement in them. The mixed findings from a nationally representative study of adolescents with overweight BMIs lend support to this interpretation. As in the current report, boys with accurate perceptions of their weight were less likely to meet recommended levels of PA; yet, when asked if they exercised specifically for the purpose of weight loss, both boys and girls with accurate weight perceptions were more likely to respond positively (Edwards et al., 2010), consistent with research on weight-control intentions. Furthermore, based on a recent analysis of the Youth Risk Behavior Surveillance Survey, adolescents who perceived themselves as overweight had stronger intentions to lose weight, but did not report healthier eating and exercise habits, compared to their gender and weight status counterparts (Fan and Jin, 2015).

Several explanations could account for the influence of overweight perceptions on health behaviours, as well as the apparent discrepancies from the literature on weight-control intention. For one, as individuals with overweight perceptions are at greater risk of using unhealthy weight-control practices (e.g, fasting, purging; Fan et al., 2014; Fan & Jin, 2015; Jiang et al. 2014; Sonneville et al., 2016), their reported efforts to lose weight may reflect these extreme behaviours rather than healthy dietary and PA patterns. Alternatively, given the difficulties inherent to weight loss, individuals trying to improve their diet and/or PA may quit out of frustration if weight management is their primarily goal. One explanation that has been proposed suggests perceptions of being overweight discourage exercise and healthy eating behaviours via weight bias or internalized obesity stigma. Recent evidence indicates weight perception accounts for many of the adverse psychosocial consequences associated with obesity (e.g., depression, suicidal ideation; (Duncan et al., 2011; Minor et al. 2016; Roberts & Duong, 2013; ter Bogt et al., 2006), which in turn, may dissuade healthy behaviours.

Research has focused on perceptions of being overweight, and essentially neglected underweight perceptions, yet they also appear to discourage PA engagement. It is plausible that youth who perceive themselves as underweight do not recognize a need to be more active, given that exercise is often pursued for the purpose of weight loss, particularly among girls (Tergerson & King, 2002). Motivations for strength training exercises tend to be less linked to weight loss concerns than aerobic or cardiovascular activities (Bryan & Rocheleau, 2002; Prichard & Tiggemann, 2008); however, the direction of the relationships were consistent across the different forms of PA included in the current study. Considering male adolescents rate "becoming strong" as the top benefit of PA (Tergerson & King, 2002), it might be expected that boys who perceived themselves as underweight would engage in more resistance training. Indeed, more than 90% of male youth report exercising primarily to increase muscle mass, and two-thirds report making dietary changes with this same goal (Murray et al. 2016). If youth with underweight or overweight perceptions do not feel they fit the "ideal" body type, results potentially reflect a discomfort in participating in PA amongst their peers.

4.2. Dietary behaviours

The results from the nutrition-related models largely resembled those for PA, in that weight perceptions of "about right" generally predicted healthier eating patterns relative to overweight or underweight perceptions. For instance, overweight perceptions predicted lower likelihoods of consuming adequate fruit and vegetable servings among girls with overweight/obese BMIs, relative to perceptions of "about right". Edwards et al. (2010) reported analogous results, but only among boys; whereas, Fredrickson et al. (2015) found no effect. Perceptions of being overweight were also associated with lower odds of eating breakfast regularly among girls with normal-weight BMIs and boys at any weight, relative to "about right" perceptions. In line with research by Jiang et al. (2014), this finding may be indicative of unhealthy weight loss practices, which are associated with perceptions of being overweight (Fan et al., 2014; Jiang et al., 2014; Sonneville et al., 2016). Perceptions of being overweight did not influence student reports of consuming fast food, sugar-sweetened beverages, energy drinks, or buying vending machine snacks. Past findings from cross-sectional studies on these behaviours are mixed (Khambalia et al., 2012; Mardiyati et al.,2015; Skinner et al., 2008).

Interestingly, perceptions of being underweight were disadvantageous for more dietary behaviours than overweight perceptions. These behaviours may reflect attempts to gain weight, consistent with past reports in which underweight perceptions were associated with intentions of gaining weight (Patte et al., 2016). Alternatively, given the plethora of nutrition-related messages directed at weight loss, and the extensive focus on obesity, it is plausible that these students fail to perceive a need to be concerned about their dietary intake. Indeed, adolescents have been shown to view healthy eating as equivalent to dieting; that is, a short-term weight-control practice only necessary to avoid obesity, rather than a long-term health strategy (Stevenson, Doherty, Barnett, Muldoon, & Trew, 2007).

4.3. Implications

Schools have been recognized as ideal settings for the promotion of PA and healthy eating (Hills, Dengel, & Lubans, 2015). Results suggest approaches targeting physical inactivity or poor diet primarily for the purpose of preventing obesity may leave the health behaviours of normal-weight adolescents overlooked. That is, individuals that perceive their weight to be underweight or "about right" may disregard obesity-focused campaigns, or interpret such strategies to indicate there is no need to modify their health behaviours. Conversely, opponents of obesity prevention programs express concern for encouraging weight bias, weight preoccupation, and/or disordered eating (Carter & Bulik, 2008; Pinhas et al., 2013; Russell-Mayhew, McVey, Bardick, & Ireland, 2012). As opposed to weight-targeted approaches,

Table 4
Weight perception as a predictor of physical activity (PA) among youth in the COMPASS study (2-year linked data), stratified by gender and BMI classification[a].

	Girls		**Boys**	
	BMI classification		**BMI classification**	
	Nonoverweight[b] Est., 95% CI, p-value	**Overweight/obese** Est., 95% CI, p-value	**Nonoverweight** Est., 95% CI, p-value	**Overweight/obese** Est., 95% CI, p-value
Vigorous PA (min/day)				
Overweight[c]	**−0.3, (-0.5,-0.1), p=.0008**	1	**−0.9, (−1.3,−0.5), p < .0001**	1
About right	1	**0.6, (0.3,1.0), p=.0021**	1	**1.1, (0.8,1.4), p < .0001**
Underweight	−0.1, (-0.4,0.1), p=.3257		**−0.3, (−0.5,−0.2), p=.0004**	
Moderate-intensity PA (min/day)				
Overweight	0.0, (-0.2,0.2), p=.8382	1	−0.2, (−0.6,0.2), p=.3735	1
About right	1	0.1, (−0.2,0.4), p=.3801	1	**0.3, (0.0,0.6), p=.0216**
Underweight	0.0, (−0.2,0.3), p=.8687		−0.1, (−0.3,0.1), p=.3474	
	AOR, 95% CI, p-value	AOR, 95% CI, p-value	AOR, 95% CI, p-value	AOR, 95% CI, p-value
Physical education class (enrolled this year vs. not enrolled this year [reference])				
Overweight	**0.8, (0.7,0.9), p=.0026**	1	**0.6, (0.4,0.7), p=.0001**	1
About right		**1.8, (1.4,2.4), p < .0001**	1	**1.4, (1.2,1.6), p=.0005**
Underweight	0.9, (0.8,1.1), p=.3118		**0.8, (0.8,0.9), p=.0010**	
School-organized PA (e.g., intramurals) (yes vs. no [reference])				
Overweight	**0.9, (0.7,1.0), p=.0303**	1	**0.7, (0.5,0.9), p=.0017**	1
About right	1	1.3, (1.0,1.6), p=.0711	1	**1.5, (1.3,1.8), p < .0001**
Underweight	**0.8, (0.7,1.0), p=.0239**		0.9, (0.8,1.1), p=.2200	
School league/team sports (e.g., varsity) (yes vs. no [reference])				
Overweight	**0.8, (0.7,1.0), p=.0136**	1	**0.6, (0.5,0.8), p=.0005**	1
About right	1	**1.5, (1.1,2.1), p=.0272**	1	**1.9, (1.5,2.3), p < .0001**
Underweight	0.9, (0.7,1.1), p=.2466		1.1, (1.0,1.2), p=.2442	
League/team sports outside of school (yes vs. no [reference])				
Overweight	0.9, (0.8,1.0), p=.1327	1	0.7, (0.5,1.0), p=.0528	1
About right	1	1.1, (0.8,1.5), p=.4108	1	**1.6, (1.3,1.9), p=.0001**
Underweight	0.9, (0.8,1.2), p=.5697		1.0, (0.8,1.1), p=.4947	
Moderate/vigorous PA guidelines[c] (meets guidelines of 60 min/day vs. does not meet guidelines [reference])				
Overweight	1.0, (0.9,1.1), p=.8410	1	**0.7, (0.6,1.0), p=.0202**	1
About right	1	1.2, (0.9,1.5), p=.2598	1	**1.5, (1.3,1.8), p < .0001**
Underweight	1.0, (0.9,1.2), p=.9493		**0.9, (0.8,1.0), p=.0335**	
Resistance exercise[c] (meets guidelines of at least 3 days/week vs. does not meet guidelines [reference])				
Overweight	**0.8, (0.7,0.9), p < .0001**	1	**0.6, (0.4,0.7), p < .0001**	1
About right	1	**1.6, (1.3,2.0), p=.0001**	1	**2.1, (1.8,2.5), p < .0001**
Underweight	**0.8, (0.7,0.9), p=.0002**		**0.9, (0.8,1.0), p=.0133**	

Note: Results for underweight perceptions in the overweight/obese category were not reported due to limited power.
[a] Models adjusted for student-level grade, race/ethnicity, weekly spending money, and the outcome measure in the prior year, and for school area median household income and school cluster.
[b] BMI classification based on self-reported height and weight and age- and sex- adjusted cut-offs.
[c] Based on CSEP (2016) guidelines for youth.

the current study adds to the rationale for promoting health behaviours among all youth.

Future investigations should test the mechanisms responsible for the relationship between weight perceptions and health behaviours. If internalized obesity stigma or weight dissatisfaction contribute, body image and weight bias interventions could potentially improve dietary and PA behaviours. Moreover, providing a supportive school environment to increase the comfort of youth may attenuate the effect of weight perception on PA. For instance, school physical environment factors such as change rooms and the presence/absence of gymnasium mirrors are perceived as important to increasing PA among adolescent girls, as is providing a suitable choice of activities (Corder et al., 2013).

4.4. Strengths and limitations

Key strengths of this study include the large sample size, inclusion of several outcome measures, and the linked data. Adjusting for the previous year outcome measure in the models strengthened inferences about the relationship between weight perception and health behaviours. Despite these strengths, results should be considered in the context of a number of limitations. First, the COMPASS study was not intended to be representative. Second, although the COMPASS dietary and PA measures have been previously validated (Leatherdale et al., 2014), retrospective assessments are subject to recall bias. Third, weight status was based on student-reported height and weight. Consequently, results likely reflect a greater concordance between weight perception and weight status than exists. However, time and cost constraints preclude the feasibility of obtaining objective height and weight measures. Fourth, while the weight status and perception categories were collapsed to improve analytic power, variability was likely missed between youth with BMIs in the overweight and obese range, and between those who perceive their weight to be “slightly” or “very” overweight or underweight. Lastly, the reference point that youth used to answer the weight perception question is not entirely clear. That is, it is not known whether respondents were comparing their weight to their ideal body, their peers, a medical standard, or

Table 5
Weight perception as a predictor of dietary behaviours among youth in the COMPASS study (2-year linked data), stratified by gender and BMI classification[a].

	Girls		**Boys**	
	BMI classification		**BMI classification**	
	Nonoverweight[b] AOR, 95% CI, p-value	**Overweight/obese** AOR, 95% CI, p-value	**Nonoverweight** AOR, 95% CI, p-value	**Overweight/obese** AOR, 95% CI, p-value
Fruit and vegetable intake[c] (adequate *vs.* inadequate [reference])				
Overweight[d]	0.9, (0.6,1.2), p=.2993	1	1.1, (0.7,1.9), p=.6228	1
About right	1	**2.2, (1.4,3.5), p=.0011**	1	1.3, (0.9,1.8), p=.1066
Underweight	1.0, (0.7,1.3), p=.7668		0.8, (0.6,1.2), p=.2807	
Sugar-sweetened beverages (4-7, 1-3, *vs.* 0 days/week [reference])				
Overweight	1.0, (0.9,1.2), p=.7581	1	0.9, (0.7,1.2), p=.5445	1
About right	1	1.1, (0.8,1.4), p=.5648	1	1.0, (0.8,1.1), p=.5891
Underweight	**1.4, (1.2,1.6), p=.0001**		1.1, (1.0,1.2), p=.0726	
Consumed energy drink(s) in past week (yes *vs.* no [reference])				
Overweight	1.2, (0.9,1.6), p=.1262	1	1.1, (0.8,1.6), p=.4178	1
About right	1	0.9, (0.6,1.3), p=.5948	1	0.9, (0.7,1.1), p=.1788
Underweight	**1.4, (1.0,1.8), p=.0355**		1.0, (0.8,1.2), p=.8656	
Breakfast skipping (eats breakfast regularly *vs.* skips 3 or more days/week [reference])				
Overweight	**0.7, (0.6,0.8), p= < .0001**	1	**0.8, (0.6,1.0), p=.0237**	1
About right	1	0.9, (0.7,1.3), p=.6908	1	**1.4, (1.1,1.7), p=.0025**
Underweight	**0.8, (0.7,0.9), p=.0050**		**0.9, (0.8,1.0), p=.0286**	
Weekday lunches from fast food/restaurants (3–5, 1–2, *vs.* 0 days/week [reference])				
Overweight	1.0, (0.9,1.2), p=.5535	1	1.1, (0.8,1.3), p=.6617	1
About right	1	1.0, (0.8,1.3), p=.8967	1	1.0, (0.9,1.2), p=.6936
Underweight	1.1, (0.9,1.3), p=.2796		1.0, (0.9,1.2), p=.5955	
Fast food on weekends (yes *vs.* no [reference])				
Overweight	1.1, (1.0,1.3), p=.2302	1	1.2, (0.9,1.5), p=.1641	1
About right	1	0.9, (0.8,1.2), p=.5398	1	0.9, (0.8,1.1), p=.2090
Underweight	**1.2, (1.0,1.4), p=.0374**		1.1, (1.0,1.3), p=.0964	
Vending machine/store snacks (4–7, 1–3, *vs.* 0 days/week [reference])				
Overweight	1.0, (0.9,1.2), p=.9387	1	1.0, (0.7,1.3), p=.7728	1
About right	1	1.0, (0.8,1.3), p=.8273	1	1.0, (0.9,1.2), p=.9501
Underweight	**1.3, (1.1,1.6), p=.0022**			

Note: Results for underweight perceptions in the overweight/obese category were not reported due to limited power

[a] Models adjusted for student-level grade, race/ethnicity, weekly spending money, and the outcome measure in the prior year, and for school area median household income and school cluster.

[b] BMI classification based on self-reported height and weight and age- and sex- adjusted cut-offs.

[c] based on Canada's Food Guide recommendations of 7 and 8 vegetable and fruit servings for girls and boys, respectively.

some other alternative. For instance, responses of "about right" may indicate body satisfaction rather than youths' perception of how their weight compared to an external reference point.

4.5. Conclusion

Results strengthen literature demonstrating perceptions of being overweight, regardless of weight status, are detrimental for PA and healthy nutrition among youth. Likewise, while relatively overlooked in previous research, underweight perceptions predicted less favourable PA and dietary responses. Given that weight perceptions of "about right" were advantageous, the promotion of healthy behaviours among all youth is advised, as weight-targeted approaches may discourage or miss individuals, depending on how they perceive their weight.

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