Int J Obes (Lond). Author manuscript; available in PMC 2018 January 09.

Published in final edited form as:

Int J Obes (Lond). 2008 June ; 32(6): 1008–1015. doi:10.1038/ijo.2008.15.

Do you see what I see? Weight status misperception and exposure to obesity among children and adolescents

K Maximova[1], **JJ McGrath**[2], **T Barnett**[3,4], **J O'Loughlin**[3,5], **G Paradis**[1], and **M Lambert**[6]

[1]Department of Epidemiology and Biostatistics, McGill University, Montréal, Canada

[2]Department of Psychology, Concordia University, Montréal, Canada

[3]Department of Social and Preventive Medicine, Université de Montréal, Montréal, Canada

[4]Centre de recherche de Centre hospitalier de Ste-Justine Hospital, Montréal, Canada

[5]Centre de recherche de Centre hospitalier de l'Université de Montréal, Montréal, Canada

[6]Department of Pediatrics, Université de Montréal & Ste-Justine Hospital, Montréal, Canada

Abstract

Objective—Obesity prevention in childhood is important. However, changing children's lifestyle behaviors to reduce overweight is a substantial challenge. Accurately perceiving oneself as overweight/obese has been linked to greater motivation to change lifestyle behaviors. Children and adolescents may be less likely to perceive themselves as overweight/obese if they are exposed to overweight/obese people in their immediate environments. This study examined whether youth who are exposed to overweight parents and schoolmates were more likely to misperceive their own weight status.

Design—The Quebec Child and Adolescent Health and Social Survey was a provincially representative, school-based survey of children and adolescents conducted between January and May 1999.

Subjects—3665 children and adolescents (age 9, $n = 1267$; age 13, $n = 1186$; age 16, $n = 1212$) from 178 schools. Mean body mass index (BMI) was 17.5, 20.6 and 22.2 kg/m^2, respectively.

Measurements—The misperception score was calculated as the standardized difference between self-perception of weight status (Stunkard Body Rating Scale) and actual BMI (from measured height and weight). Exposure to obesity was based on parent and schoolmate BMI.

Results—Overweight and obese youth were significantly more likely to misperceive their weight compared with non-overweight youth ($P<0.001$). Multilevel modeling indicated that greater parent

Correspondence: K Maximova, Department of Epidemiology, Biostatistics, and Occupational Health, McGill University, Purvis Hall, 1020 Pine Avenue West, Montréal, QC, Canada H3A 1A2. katerina.maximova@mcgill.ca.

Contributions

KM designed the analysis, analyzed the data and drafted and revised the manuscript. JMG assisted in conceptualizing the design, the study variables and the analysis, and participated in writing the manuscript. TB assisted with statistical analyses, interpretation of the findings, and manuscript development. JOL, GP and ML designed the original study from which the data were drawn, obtained funding for the original study, supervised collection and reviewed drafts of the manuscript.

and schoolmate BMI were significantly associated with greater misperception (underestimation) of weight status among children and adolescents.

Conclusion—Children and adolescents who live in environments in which people they see on a daily basis, such as parents and schoolmates, are overweight/obese may develop inaccurate perceptions of what constitutes appropriate weight status. Targeting misperception may facilitate the adoption of healthy lifestyle behaviors and improve the effectiveness of obesity prevention interventions.

Keywords

overweight; weight misperception; children; parent; schoolmate; multilevel modeling

Introduction

Over the last two decades, alarming increases in the prevalence of obesity worldwide have propelled this issue to the forefront of the public policy agenda, with obesity prevention becoming a top public health priority.[1,2] The prevalence of childhood obesity has increased almost threefold during this time.[3,4] Obesity prevention during childhood and adolescence is particularly important because obesity tracks into adulthood,[5] leading to elevated risks for hypertension, type 2 diabetes, osteoarthritis, coronary heart disease, congestive heart failure, stroke, breast and colon cancer, and premature death.[6,7]

These dramatic increases in obesity are largely attributable to lifestyle behaviors including poor diet, physical inactivity and sedentary behavior.[8] Obesity prevention interventions targeting these lifestyle behaviors (that is, increasing physical activity and improving diet) have had limited success, as the establishment of healthy behaviors is difficult to sustain in the long term.[9–11] In a recent Cochrane review of 22 randomized controlled trials, Summerbell *et al.*[9] found that childhood obesity prevention interventions resulted in no reduction of overweight (that is, body mass index (BMI)) and only modest improvements in changing diet or exercise behaviors in the short term.[9] Nonetheless, modification of these lifestyle behaviors continues to be recommended for obesity prevention in children.[12,13]

One of the components of effective behavior change may be recognition on the part of the individual that their weight status exceeds normal weight and poses a health risk. Individuals may need to perceive themselves to be at risk and recognize their overweight to be a health problem to change their lifestyle behaviors. Accurately perceiving oneself as overweight or obese is considered an important cue for action and change and has been linked to greater motivation to engage in healthy lifestyle behaviors.[14,15] Growing evidence suggests that actual weight and perception of weight status often do not coincide, and that deviations between actual and perceived weight status are more common among overweight and obese individuals.[16–19] Among overweight adults, 43% of men and 18% of women perceived themselves to be of ‘healthy weight or underweight’. [16–18] Among overweight youth, 58% of boys and 34% of girls perceived their weight to be ‘about right’.[19] These studies underscore that significant proportions of individuals misperceive their overweight status. However, these studies were limited to cross-tabulations of weight status and BMI categories; and thus they were unable to evaluate the determinants of misperception.

Misperception of overweight may be one explanation for the limited success of obesity prevention interventions. Theoretical models of health behavior change (cf. Health Belief Model,[20] Transtheoretical Model of Behavior Change,[21] Decisional Balance[22]) emphasize the necessity of perceiving oneself 'at risk' as a prerequisite to behavior change. A recent application of the Transtheoretical Model demonstrated that the majority of children and adolescents were not ready for an obesity prevention intervention.[23] Not only were they not participating in healthy lifestyle behaviors, but they also did not meet national recommendations for physical activity or for fruit and vegetable consumption, and most did not realize they needed to adopt these healthy behaviors. Healthy lifestyle behavior changes may be more likely to occur if youth recognize themselves as overweight or obese.

Owing to the widespread media preoccupation with thinness and dieting, as well as the serious health problem of eating disorders, public health messages have emphasized healthy body images encouraging body acceptance.[24] Paradoxically, these messages may promote acceptance of overweight and obesity and conflict with the basic tenets of behavioral change theories. Irrespective of ideal body-size preferences, when overweight youth misperceive their weight status and do not consider their weight to pose a health risk, they may be less likely to heed public health messages or to implement lifestyle behavior modifications.[16]

It is unclear what factors may influence misperception of weight status. It is plausible that youth may underestimate their weight status when they are exposed to overweight/obese people in their immediate environments at home and in school, resulting in a perceptual bias. In other words, when children's parents and schoolmates are overweight or obese, their own overweight status may seem normal by comparison. Recent evidence indicates that having a social network with a high prevalence of overweight is associated with weight gain among adults.[25] Obesogenic environment at home, defined as an environment that promotes excessive food intake and discourages physical activity,[26,27] has also been linked to adolescent weight status.[28,29] Adolescents who live in families that permit or model behaviors associated with excessive weight (for example, poor diet, physical inactivity, considerable television viewing) are at increased risk for overweight and obesity in young adulthood. [29] However, little is known about how social contexts (for example, school) influence youth's misperception of weight status. No research to date has examined whether exposure to overweight/obese people among those at home and in school is associated with greater misperception of weight status.

In this study, we aim to investigate whether children and adolescents who live with overweight parents and attend schools with overweight schoolmates are more likely to misperceive (or underestimate) their weight status. Using a population-based sample, the specific study objectives were to assess (1) the extent to which children and adolescents' perception of their weight status concurs with measured weight and (2) whether being exposed to overweight/obese people at home or in school is associated with misperception. We hypothesized that misperception would be more common among overweight and obese youth and that misperception would be greater among those exposed to overweight/obesity at home and in school.

Method

The Quebec Child and Adolescent Health and Social Survey was a provincially representative, school-based survey of children and adolescents aged 9, 13 and 16 years, conducted between January and May 1999. The Quebec Child and Adolescent Health and Social Survey was originally developed to assess the general health and social well-being of youth in Quebec. Data were collected in age-specific, selfreported questionnaires for children and adolescents administered at school, and a self-reported parent questionnaire administered at home, which assessed family and social environment, parental education and other sociodemographic information. Study procedures were approved by the ethics committees of the Direction Santé Québec of the Institut de la Statistique du Québec, the Ministére de l'Éducation du Québec and Ste-Justine Hospital. A detailed description of the survey design and methodology has been published previously.[30] The final sample included 3665 children and adolescents (age 9, $n = 1267$; age 13, $n = 1186$; age 16, $n = 1212$) from 178 schools, with response proportions of 83, 79 and 78% for each age group, respectively.

Measures

Perceived weight status—Self-report of current weight status was assessed using the Stunkard Body Rating Scale,[31] a visual analog scale consisting of seven sex-specific silhouettes of the same height, with weight ranging from underweight to obese. Participants selected the figure they perceived best corresponded to their current appearance.

Actual weight status—Anthropometric data, including measures of height and weight, were collected at school by 10 teams of pediatric nurses, kinesiologists and trained interviewers. Measurements were taken twice; a third measurement was taken if the first two differed by >0.5cm for height or >0.2 kg for weight.[30] The average of the two closest measures was used for data analyses. BMI, calculated as weight/height^2 (kg/m^2), was used as the measure of actual weight status.

Misperception score—Although the Stunkard Body Rating Scale is not directly matched to BMI percentiles, the silhouettes are highly correlated ($r = 0.7$) with BMI percentiles. [32,33] Therefore, to assess misperception of weight status, deviation of perceived weight status from the actual weight status was obtained by standardizing both measures in the following three-step approach:

1. Values from the seven-item visual analog scale (Stunkard Body Rating Scale) of perceived weight status were assigned corresponding *Z*-scores (−3, −2, −1, 0, 1, 2, 3). Thus, the three silhouettes in the middle (−1, 0, 1) were equivalent to being within 1 standard deviation of the mean and represent 'normal' body weight. The remaining silhouettes were 2 and 3 standard deviations above and below the mean and represented the 'overweight' and 'underweight' categories, respectively.
2. BMI values were transformed into *Z*-scores using ageand sex-specific cutoffs of the 2000 Centers for Disease Control and Prevention pediatric growth charts as a reference population.[34] The standardized BMI score indicates how many

standard deviation units apart a child's BMI is from the mean BMI of the reference group for their age and sex.

3. Misperception score was calculated as the arithmetic difference between the perceived weight *Z*-score and the BMI *Z*-score: (Misperception = $Z_{\text{perceived weight}} - Z_{\text{BMI}}$).

A positive misperception score indicated an overestimation of weight status (that is, participants perceived themselves to be heavier than their measured BMI). A negative misperception score indicated an underestimation of weight status (that is, participants perceived themselves to be thinner than their measured BMI).

Exposure to overweight/obesity at home: parent weight status—Selfreport of height and weight was provided by the parent completing the questionnaire (78% of parent questionnaires were completed by mothers). BMI values were calculated as weight/height^2 (kg/m^2).

Exposure to overweight/obesity in school: schoolmate weight status— Schoolmate weight status was calculated as the average BMI of all the Quebec Child and Adolescent Health and Social Survey students attending the participant's school. Thus, an aggregate BMI was created for each school. On average, there were 20 students per school in 178 schools, ranging from 11 to 43 students per school. Average BMI for all students (*N* = 3591) was 20 kg/m2 and this average BMI varied ±2 kg/m^2 between schools and ±3 kg/m^2 within schools.

Statistical analyses

To test the hypothesis that overweight and obese participants would misperceive their weight status, compared with non-overweight youth, we computed an analysis-of-variance test with follow-up comparisons. To test the hypothesis that exposure to obesity at home and in school is associated with greater misperception of weight status, we analyzed the data using multilevel linear regression modeling (SAS 9.1 PROC MIXED). This analytical approach was preferred, as it permitted nested data (participant) within each school. Fixed effects (parent, schoolmate BMI) could be accounted for, while simultaneously including a standard covariate (gender); and random effects (intercept) allowed for misperception to vary between schools. A total of 1049, 1170 and 1144 students of age 9, 13 and 16 from 69, 104 and 61 schools, respectively, had data on the misperception score and were available for the analysis.

The effects of parent and schoolmate weight status were evaluated singularly and simultaneously, while controlling for gender, using three separate models. The base model, including gender and the random intercept, was created to adjust for the effect of gender. Second, parent BMI was added to the base model (Model 1). Third, schoolmate BMI was added to the base model (Model 2). Finally, to simultaneously test the effects of parent and schoolmate BMI, both were added to the base model (Model 3). These models were tested for each age group separately as the school-based sampling procedure, where 9-, 13- and 16-year-olds were derived from separate samples of schools, precluded using the entire data set

with age as a covariate due to multicollinearity between school and age variables. For all models, parent and schoolmate BMI were grand mean centered to facilitate interpretation of the results. Centering a variable about its grand mean yields an intercept that is interpreted as the estimate at the mean of a given variable, rather than at zero. Centering does not change the values or the significance levels of the estimated coefficients.[35] We present separate models by age.

Results

Sample characteristics

The sample characteristics are presented in Table 1. Average BMI for 9-, 13- and 16-year-olds was 17.5, 20.6 and 22.2 kg/m^2, respectively. According to the Centers for Disease Control and Prevention BMI growth charts, 14% of students were overweight (≥ 85th to <95th percentile) and 9% were obese (≥ 95th percentile). Average parent BMI was 25 kg/m^2 (s.d. = 4.6) and average schoolmate BMI was 20 kg/m^2 (s.d. = 4.3). These BMI values are consistent with those previously reported for adult and youth populations.[36,37]

Misperception of weight status

The distribution of participants' perceived weight status on the Stunkard Body Rating scale by age and gender is presented in Table 2. Although 24% of children and adolescents were overweight or obese, only 1.6% perceived themselves as having excess weight, selecting overweight silhouettes (6 and 7). The overweight youth were significantly more likely to misperceive their weight (M = 1.19, s.d. = 0.67) compared with the non-overweight youth (M = 0.53, s.d. = 0.96, F = 214.25, P<0.001). Similar results were found for the obese youth (M = 1.27, s.d. = 0.78, F = 177.35, P<0.001). The distribution of the misperception scores by actual weight status (BMI) is presented in Table 3. For the total sample, 38.5% of the misperception scores were 1–3 standard deviations below the mean, indicating that many youth underestimated their weight status (that is, $Z_{\text{perception}}$ was 1–3 standard deviations lower than Z_{BMI}). For non-overweight youth, 30.0% underestimated their BMI. In contrast, 71.4% of overweight and 59.4% of obese youth underestimated their weight status.

Exposure to overweight/obesity

There was significant variation between schools in the misperception score (Table 4). Gender was significant for 13- and 16-year-olds (Table 4, base model). At age 13, boys overestimated their weight status (misperception score was more positive) compared with girls; in contrast, at age 16, girls overestimated their weight status. The effect of parent BMI was significant and negative for each age group (Table 4, Model 1). As parent BMI increased, participants underestimated their weight status (misperception score was more negative). Schoolmate BMI was significant and negative for each age group (Table 4, Model 2). As schoolmate BMI increased, participants underestimated their weight status (misperception score was more negative). Parent and schoolmate BMI remained significant and negative predictors of misperception for each age group, with the exception of parent BMI among 13-year-olds (Table 4, Model 3). For all three age groups, schoolmate BMI consistently had the strongest association with the misperception score.

Post hoc analyses

Post hoc analyses included models with parent overweight status and percentage of overweight schoolmates. To control for potential confounding of the relationship between exposure to overweight/obesity and misperception by socioeconomic factors, our *post hoc* analyses also included measures of socioeconomic status at both the student level (household income and parental education) and school level (an aggregate measure based on the percentage of mothers in a given school area without high school education), as well as interactions of the variables in the above models. The models with these covariates did not differ from the original models. The effects of socioeconomic factors at either the student or the school levels were not associated with the degree of misperception.

Discussion

This study assessed whether children and adolescents' misperception of their weight status was associated with exposure to overweight/obesity at home and in school. In accordance with our first hypothesis, we found that many youth misperceived their weight status, and the extent of this misperception was greater among overweight and obese children and adolescents. More specifically, overweight and obese youth were more likely to considerably underestimate their actual weight status compared with non-overweight youth. This finding is consistent with the previously reported literature.[16–19] The results also supported our second hypothesis such that youth exposed to overweight/obesity at home and in school, whose parents and schoolmates had higher BMI, were more likely to misperceive (underestimate) their weight status. This finding provides new information and extends the current literature regarding factors that influence misperception of weight status.

The mechanism underlying the role of exposure to overweight/obesity on misperception of weight status may differ across childhood and adolescence. Exposure to overweight/obesity both at home and in school appears to play an important role and exerts independent effects on the perception of weight status. As it is evident by the multilevel models with parent and schoolmate BMI entered singularly, children living with overweight/obese parents or attending school with overweight/obese schoolmates were more likely to underestimate their size. When both were entered into the model simultaneously, neither the direction nor the magnitude of the estimates changed, indicating that they both exerted independent effects. Interestingly, schoolmates' BMI exerted greater influence on the misperception score than parents' BMI.

It is possible that being exposed to overweight/obesity at home and in school plays a dynamic role in influencing misperception of weight status across development. The youngest children (9 years old) were particularly vulnerable to this influence both at home and in school. This is not surprising, as the social milieu of children at this age is largely represented by their parents and schoolmates. Compared with the other age groups, 13-year-olds were least vulnerable to the influence of home and school, and parents played a negligible role when considered simultaneously with the effects of schoolmates. This lack of effect of parents among 13-year-olds is not surprising. Some researchers have recently noted that parents seem to play a lesser role in influencing their children's behavior during young adolescence, when peers and schoolmates may have a more influential role.[38,39]

Furthermore, during later adolescence (16 years old), although there was a reemergence of the effect of home and school, their influence was nonetheless not to the extent observed in the youngest children. It is possible that youth's perceptions are influenced by a broader social context including media as well as societal and cultural norms.

Misperception also differed by gender. It was not surprising that boys overestimated their weight status at age 13, whereas girls overestimated at age 16. It is possible that gender differences in the maturation process (that is, puberty) largely contribute to these findings across the two age groups. Specifically, boys at age 13 overestimate their weight status because they may want to appear bigger and more mature, whereas girls at age 16 overestimate their weight status because they may be more susceptible to cultural and societal pressures to be thin.

The key strength and contribution of this study is the unique conceptualization of weight status misperception. Previous research on misperception was limited to crosstabulations of perceived weight status (for example, about right, too heavy, too light) and BMI classification categories. Our misperception score has the advantage of being a continuous measure of misperception and allowing for greater measurement precision. Further, our misperception score is suitable for regression analyses to help researchers understand what factors are associated with weight status misperception. Second, the conceptualization of exposure to overweight/obesity using a multilevel framework with parent and schoolmate BMI was an important methodological strength as it exploited the nested structure of the data. Other strengths included the use of a representative population- based random sample and measured height and weight. Many previous studies relied on self-reported height and weight for BMI calculation to model the deviation between individuals' own perceptions of their weight status and BMI.[17,40]

The first limitation of our study was the use of parents' selfreport of height and weight. Although self-reports provide only an estimate of actual, measured height and weight, research shows that adults closely approximate their height and weight, even though they are poor at identifying their weight status classification.[18] However, those who err tend to underestimate their height and weight;[17] and thus parents' self-reports in this study provided a conservative estimate of their BMI. Second, although the measurement of schoolmate BMI was a strength of the study and served as a proxy for exposure to overweight/obesity in school, it was not feasible to assess the BMI of every schoolmate for each participant. Likewise, no measures of sibling, friends or neighborhood BMI existed. Lastly, although we compared the strength of the associations across distinct age groups, it was not possible to evaluate the main effect of age due to the sampling strategy. We also could not assess ethnic variations in misperception in our study, as our sample was predominantly French Canadian (78.9%).

Future research might also consider examining whether misperception is linked to parental recognition of their child's overweight status. Studies evaluating parental involvement in obesity prevention among children suggest that parents are better facilitators of behavior modification than children themselves and that both parents and children need to be ready for change.[8] Parents' recognition that their children's weight was in excess and presented a

health risk was found to be key to parental readiness to encourage lifestyle changes in their children.[15] However, although more than 25% of Canadian children aged 2–17 are overweight or obese, only 9% of parents believe their child to be overweight or obese.[41]

Results of this study suggest that children and youth exposed to overweight/obesity in their immediate environments in which people they see on a daily basis, such as parents and schoolmates, are overweight or obese may develop false perceptions of what constitutes an appropriate weight status. As familial (parents) and school (schoolmates) context influences children's perceptions of normal weight status, it becomes an important public health concern that youth's perceptions correspond to their actual body weight. It is also important that parents have an accurate perception of their child's body weight, as parental awareness is key to behavioral change in children and adolescents.[8,15,41] Previous research has shown that one's weight status perception develops early in life, reportedly as early as age 9.[42,43] Our finding that variation in misperception was attributable to schoolmate and parent BMI in children as young as age 9 further highlights the need for obesity prevention early in the life course. It is important that healthy lifestyle behaviors be adopted early in life when habits are being established and may be more malleable.

The prevalence of childhood obesity shows no signs of decline, and prevention interventions to date have only limited success.[8–10] To improve the effectiveness of obesity prevention interventions, it may be prudent to help youth recognize they are at risk and correct their misperceptions. Incorporating misperception awareness as a component of obesity prevention interventions may prime youth to be more receptive to adopting healthy lifestyle behaviors.

Acknowledgments

We thank the principals, teachers, students and administrative personnel at the data collection sites. The survey was funded by the Quebec Ministry of Health and Social Services and by Health Canada. While conducting this research, KM was supported by a Doctoral Fellowship award from the Canadian Institutes of Health Research. JOL holds a Canada Research Chair in Early Determinants of Adult Chronic Disease. TB is a recipient of a Postdoctoral Fellowship award from the Canadian Institutes of Health Research. An earlier version of this paper was presented at the American Public Health Association (APHA) 134th Annual Meeting and Exposition, Boston, MA, November 4–8, 2006.

References

1. Shields M, Tjepkema M. Trends in adult obesity. Statistics Canada, Catalogue 82-003-XIE. Health Reports. 2006; 17:53–60. [PubMed: 16981486]
2. World Health Organization. WHO Technical Report Series. World Health Organization; Geneva: 2000. Obesity: Preventing and Managing the Global Epidemic Report on a WHO Consultation.
3. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999–2000. J Am Med Assoc. 2002; 288:1728–1732.
4. Shields M. Overweight and obesity among children and youth. Statistics Canada, Catalogue 82-003-XIE. Health Reports. 2006; 17:27–42. [PubMed: 16981484]
5. Deshmukh-Taskar P, Nicklas TA, Morales M, Yang SJ, Zakeri I, Berenson GS. Tracking of overweight status from childhood to young adulthood: the Bogalusa Heart Study. Eur J Clin Nutr. 2006; 60:48–57. [PubMed: 16132057]
6. Janssen I, Katzmarzyk PT, Srinivasan SR, Chen W, Malina RM, Bouchard C, et al. Utility of childhood BMI in the prediction of adulthood disease: comparison of national and international references. Obes Res. 2005; 13:1106–1115. [PubMed: 15976154]

7. Dietz WH. Health consequences of obesity in youth: childhood predictors of adult disease. Pediatrics. 1998; 101:518–525. [PubMed: 12224658]
8. Edmunds L, Waters E, Elliott EJ. Evidence based paediatricsF evidence based management of childhood obesity. BMJ. 2001; 323:916–919. [PubMed: 11668139]
9. Summerbell CD, Waters E, Edmunds LD, Kelly S, Brown T, Campbell KJ. Interventions for preventing obesity in children. Cochrane Database Syst Rev. 2005; 20:CD001871.
10. Flodmark CE, Marcus C, Britton M. Interventions to prevent obesity in children and adolescents: a systematic literature review. Int J Obes. 2006; 30:579–589.
11. Stice E, Shaw H, Marti CN. A meta-analytic review of obesity prevention programs for children and adolescents: the skinny on interventions that work. Psychol Bull. 2006; 132:667–691. [PubMed: 16910747]
12. Barlow SE. Expert Committee. Expert committee recommendations on the assessment, prevention, and treatment of child and adolescent overweight and obesity: summary report. Pediatrics. 2007; 120(Suppl 4):S164–S192. [PubMed: 18055651]
13. Lau DCW, Douketis JD, Morrison KM, Hramiak IM, Sharma AM, Ur E. 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children. Can Med Assoc J. 2007; 176:S1–S13.
14. Baranowski T, Cullen KW, Nicklas T, Thompson D, Baranowski J. Are current health behavioral change models helpful in guiding prevention of weight gain efforts? Obes Res. 2003; 11:23S–43S. [PubMed: 14569036]
15. Rhee KE, Delago CW, Arscott-Mills T, Mehta SD, Davis RK. Factors associated with parental readiness to make changes for overweight children. Pediatrics. 2005; 116:E94–E101. [PubMed: 15995022]
16. Kuchler F, Variyam JN. Mistakes were made: misperception as a barrier to reducing overweight. Int J Obes. 2003; 27:856–861.
17. Paeratakul S, White MA, Williamson DA, Ryan DH, Bray GA. Sex, race/ethnicity, socioeconomic status, and BMI in relation to selfperception of overweight. Obes Res. 2002; 10:345–350. [PubMed: 12006633]
18. Truesdale K, Stevens J. Do the obese know they are obese? Experimental Biology 2006. FASEB J. 2006; 20:A1313.
19. Viner RM, Haines MM, Taylor SJC, Head J, Booy R, Stansfeld S. Body mass, weight control behaviours, weight perception and emotional well being in a multiethnic sample of early adolescents. Int J Obes. 2006; 30:1514–1521.
20. Rosenstock IM, Strecher VJ, Becker MH. Social-learning theory and the health belief model. Health Educ Q. 1988; 15:175–183. [PubMed: 3378902]
21. Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. Am J Health Promot. 1997; 12:38–48. [PubMed: 10170434]
22. Prochaska JO, Velicer WF, Rossi JS, Goldstein MG, Marcus BH, Rakowski W, et al. Stages of change and decisional balance for 12 problem behaviors. Health Psychol. 1994; 13:39–46. [PubMed: 8168470]
23. Mauriello, LM., Driskell, MM., Castle, PH., Johnson, JL., Evers, KE., Johnson, SS., et al. Application of the Transtheoretical Model to Behaviors Related to Obesity Prevention among Middle School Students. Pro-Change Behavior Systems, Inc; West Kingston, RI: 2005.
24. Bergstrom RL, Neighbors C. Body image disturbance and the social norms approach: an integrative review of the literature. J Soc Clin Psychol. 2006; 25:975–1000.
25. Christakis NA, Fowler JH. The spread of obesity in a large social network over 32 years. N Engl J Med. 2007; 357:370–379. [PubMed: 17652652]
26. Hill JO, Peters JC. Environmental contributions to the obesity epidemic. Science. 1998; 280:1371–1374. [PubMed: 9603719]
27. Swinburn B, Egger G, Raza F. Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. Prev Med. 1999; 29:563–570. [PubMed: 10600438]
28. Beck S, Terry K. A comparison of obese and normal-weight families psychological characteristics. Am J Fam Ther. 1985; 13:55–59.

29. Crossman A, Sullivan DA, Benin M. The family environment and American adolescents' risk of obesity as young adults. Soc Sci Med. 2006; 63:2255–2267. [PubMed: 16828216]
30. Paradis G, Lambert M, O'Loughlin J, Lavallee C, Aubin J, Berthiaume P, et al. The Quebec child and adolescent health and social survey: design and methods of a cardiovascular risk factor survey for youth. Can J Cardiol. 2003; 19:523–531. [PubMed: 12717488]
31. Collins ME. Body figure perceptions and preferences among preadolescent children. Int J Eat Disord. 1991; 10:199–208.
32. Mciza Z, Goedecke JH, Steyn NP, Charlton K, Puoane T, Meltzer S, et al. Development and validation of instruments measuring body image and body weight dissatisfaction in South African mothers and their daughters. Public Health Nutr. 2005; 8:509–519. [PubMed: 16153332]
33. Peterson M, Ellenberg D, Crossan S. Body-image perceptions: reliability of a BMI-based Silhouette Matching Test. Am J Health Behav. 2003; 27:355–363. [PubMed: 12882429]
34. Hammer LD, Kraemer HC, Wilson DM, Ritter PL, Dornbusch SM. Standardized percentile curves of body-mass index for children and adolescents. Am J Dis Child. 1991; 145:259–263. [PubMed: 1750869]
35. Raudenbush, SW., Bryk, AS. Hierarchical Linear Models: Applications and Data Analysis Methods. Sage Publications; Thousand Oaks, CA, London: 2002.
36. Tremblay MS, Willms JD. Secular trends in the body mass index of Canadian children. Can Med Assoc J. 2000; 163:1429–1433. [PubMed: 11192647]
37. Tremblay MS, Katzmarzyk PT, Willms JD. Temporal trends in overweight and obesity in Canada, 1981–1996. Int J Obes. 2002; 26:538–543.
38. Chen E, Martin AD, Matthews KA. Socioeconomic status and health: do gradients differ within childhood and adolescence? Soc Sci Med. 2006; 62:2161–2170. [PubMed: 16213644]
39. West P. Health inequalities in the early years: is there equalisation in youth? Soc Sci Med. 1997; 44:833–858. [PubMed: 9080566]
40. Bennett G, Wolin KY. Satisfied or unaware? Racial differences in perceived weight status. Int J Behav Nutr Phys Act. 2006; 3:40. [PubMed: 17096859]
41. Canadian Medical Association (CMA). 6th Annual National Report Card on Health Care. Canadian Medical Association and Ipsos Reid; Ottawa: 2006.
42. Olvera N, Suminski R, Power TG. Intergenerational perceptions of body image in Hispanics: role of BMI, gender, and acculturation. Obes Res. 2005; 13:1970–1979. [PubMed: 16339129]
43. Welch C, Gross SM, Bronner Y, Dewberry-Moore N, Paige DM. Discrepancies in body image perception among fourth-grade public school children from urban, suburban, and rural Maryland. J Am Diet Assoc. 2004; 104:1080–1085. [PubMed: 15215765]

Table 1

Sample characteristics by age

	9 years (*n* = 1049)		13 years(*n* = 1170)		16 years (*n* = 1144)	
	M (%)	**s.d. (*n*)**	**M (%)**	**s.d. (*n*)**	**M (%)**	**s.d. (*n*)**
Girls	(50.6%)	(632)	(49.9%)	(584)	(52.2%)	(597)
BMI	17.5	3.4	20.6	4.1	22.2	3.9
Overweight[a]	(14.1%)	(176)	(13.8%)	(162)	(13.8%)	(158)
Obese[b]	(10.0%)	(125)	(9.8%)	(115)	(7.4%)	(85)
Misperception score (*Z*-score)	−0.4	1.1	−0.9	0.8	−0.7	0.7
Parent BMI	24.7	4.9	24.7	4.5	24.7	4.4
Schoolmate BMI	17.8	0.9	20.3	1.3	22.1	0.8
Education (<HS) (parent)	(16.7%)	(174)	(21.2%)	(214)	(18.9%)	(176)
Education (<HS) (spouse)	(23.6%)	(209)	(26.3%)	(222)	(27.6%)	(215)
Household income (< $20 000)	(14.4%)	(145)	(16.1%)	(154)	(10.6%)	(94)
School socioeconomic status (% mothers <HS per school)	24.6	9.1	23.9	6.9	24.1	7.0

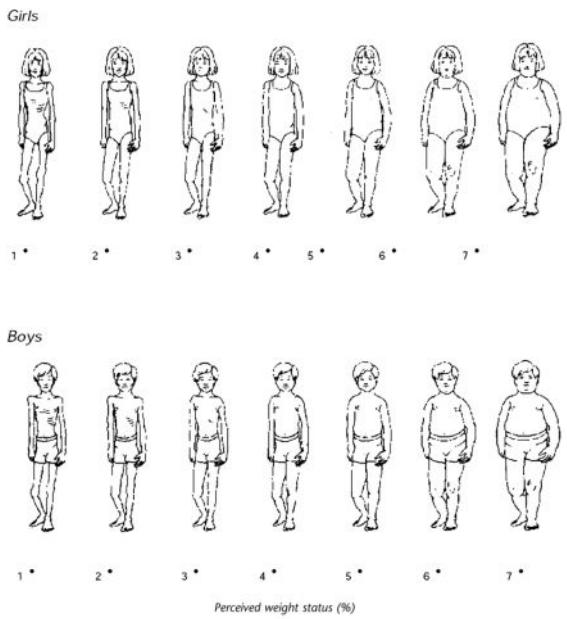
Abbreviations: BMI, body mass index; HS, high school; M, mean.

[a] BMI ≥ 85th and <95th percentile value according to 2000 US CDC growth charts.

[b] BMI ≥ 95th percentile value according to 2000 US CDC growth charts.

Table 2

Distribution of perceived weight status by age and gender



		1	*2*	*3*	*4*	*5*	*6*	*7*
Total		1.5	12.1	36.3	36.6	11.9	1.5	0.1
Boys	9	1.4	4.0	26.1	51.2	15.0	2.3	0.0
	13	1.7	15.0	41.2	27.4	13.4	1.2	0.2
	16	1.1	13.4	40.7	30.3	12.3	2.0	0.2
Girls	9	2.4	8.5	27.3	49.7	11.3	0.9	0.0
	13	1.7	19.5	43.3	26.8	7.8	0.9	0.0
	16	0.3	13.3	40.9	32.1	11.5	1.7	0.2

A separate gendered silhouette series was used for adolescents. *Note*: Figure drawings were developed by Collins[31] and are being reprinted with permission of John Wiley & Sons Inc.

Table 3

Distribution of misperception scores

	Misperception Z-score (%)					
	Underestimate weight			Overestimate weight		
	−3 to −2	−2 to −1	−1 to 0	0 to +1	+1 to +2	+2 to +3
Total	6.1	32.4	42.0	14.8	3.7	1.0
Non-overweight[a] (*N* = 2742)	3.8	26.2	45.1	18.8	4.8	1.3
Overweight[b] (*N* = 496)	14.1	57.3	28.4	0.2	0.0	0.0
Obese[c] (*N* = 325)	13.2	46.2	36.6	4.0	0.0	0.0

[a] BMI <85th percentile value according to 2000 US CDC growth charts.

[b] BMI ≥ 85th and <95th percentile value according to 2000 US CDC growth charts.

[c] BMI ≥ 95th percentile value according to 2000 U.S. CDC growth charts.

Table 4

Multilevel models for exposure to obesity on misperception score by age

	Age 9 (*n* = 1049)				Age 13 (*n* = 1170)				Age 16 (*n* = 1144)			
Model	***β***	**s.e.**	***t***	***P***	***β***	**s.e.**	***t***	***P***	***β***	**s.e.**	***t***	***P***
Base												
Random effects												
Between schools	0.068	0.023	–	–	0.034	0.014	–	–	0.024	0.010	–	–
Within schools	1.211	0.050	–	–	0.655	0.028	–	–	0.543	0.023	–	–
Fixed effects												
Intercept	−0.398	0.044	−8.98	<0.0001	−0.940	0.033	−28.79	<0.0001	−0.738	0.029	−25.02	<.0001
Gender (boy = 1)	0.075	0.059	1.09	NS	0.111	0.052	2.00	<0.05	−0.132	0.049	−2.71	<.01
1												
Parent BMI	−0.040	0.007	−5.75	<0.0001	−0.011	0.006	−1.97	<0.05	−0.016	0.005	−2.96	<0.01
2												
Schoolmate BMI	−0.270	0.033	−8.11	<0.0001	−0.063	0.022	−2.91	<0.001	−0.117	0.030	−3.89	<0.0001
3												
Parent BMI	−0.035	0.007	−5.23	<0.0001	−0.011	0.006	−1.92	NS	−0.015	0.005	−2.83	<0.01
Schoolmate BMI	−0.281	0.035	−7.99	<0.0001	−0.075	0.023	−3.28	<0.001	−0.113	0.035	−3.20	<0.001

Abbreviations: BMI, body mass index; NS, not significant. Model 3, Student level: misperception = $\beta_0+\beta_1$ (gender) $+\beta_2$ (parent BMI)$+ \varepsilon_0$. School-level: $\beta_0 = \gamma_{00}+\gamma_{01}$ (schoolmate BMI)$+\mu_0$. $\beta_1 = \gamma_{10}+\gamma_{11}$ (schoolmate BMI). $\beta_2 = \gamma_{20}$.