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Secular trends in weight status and weight-related attitudes and behaviors in adolescents from 1999 to 2010

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ABSTRACT

Objective. To examine secular trends from 1999 to 2010 in weight status and weight-related attitudes and behaviors among adolescents.

Methods. A repeated cross-sectional design was used. Participants were from Minneapolis/St. Paul middle schools and high schools and included 3072 adolescents in 1999 (mean age14.6 ± 1.8) and 2793 adolescents in 2010 (mean age14.4 ± 2.0). Trends in weight-related variables were examined using inverse probability weighting to control for changes in socio-demographics over time.

Results. The prevalence of obesity among boys increased by 7.8% from 1999 to 2010, with large ethnic/racial disparities. In black boys the prevalence of obesity increased from 14.4% to 21.5% and among Hispanic boys, obesity prevalence increased from 19.7% to 33.6%. Trends were more positive among girls: weight status did not significantly increase, perceptions of overweight status were more accurate, the use of healthy weight control behaviors remained high, dieting decreased by 6.7%, unhealthy weight control behaviors decreased by 8.2% and extreme weight control behaviors decreased by 4.5%.

Conclusions. Trends indicate a need to intensify efforts to prevent obesity and other weight-related problems, particularly for boys from ethnic/racial minorities. The decreases in unhealthy weight control behaviors among girls are encouraging.

Over the past decade there has been increased attention on obesity in the scientific community and the popular media (Barry et al., 2011; Kim and Willis, 2007; Lawrence, 2004; Saguy and Almeling, 2008; Saguy and Gruys, 2010). Adolescents may be vulnerable to messages about weight, given the central role of body image during this lifestage, and their frequent use of different media with messages about obesity, cultural ideals of thinness, and both healthy and unhealthy weight management strategies (Rideout et al., 2010). Therefore, an important question is: How have weight status and weight-related attitudes and behaviors changed in adolescents over the past decade?

The current study examines secular trends in weight status and weight-related attitudes and behaviors from 1999 to 2010. This study expands upon previous studies (Broyles et al., 2010; Chao et al., 2008; Delva et al., 2006; Eaton et al., 2010; Foti and Lowry, 2010; Lowry et al., 2005; Ogden et al., 2010) by exploring trends in a broad array of weight-related variables in girls and boys. Because of ethnic/racial disparities in weight-related health (Chao et al., 2008; Delva et al., 2006; Neumark-Sztainer et al., 2002a), interactions with ethnicity/race are examined. Findings have implications for the development of interventions to prevent obesity and other weight-related problems in youth.

Methods

Study design and population

A repeated cross-sectional study design was used to compare weight-related variables between 1999 and 2010 among adolescent participants in Project EAT (Eating and Activity in Teens). Data from 1999 are from Project EAT-I, the first wave of a longitudinal study following adolescents into young adulthood (Neumark-Sztainer et al., 2002a, 2002b, 2006). Data from 2010 are from EAT 2010, a multi-level study examining weight-related outcomes in adolescents. Study procedures were approved by the University of Minnesota's Institutional Review Board Human Subjects Committee and by the research boards of the participating school districts.

In Project EAT-I, students from 31 public middle schools and high schools in the Minneapolis/St. Paul metropolitan area completed surveys and anthropometric measures (Neumark-Sztainer et al., 2002a, 2002b). For EAT 2010, a new cohort of students from 20 public schools in the same metropolitan area completed similar surveys and anthropometric measures. To facilitate the examination of secular

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trends, the earlier study sample was restricted to 27 schools from the two urban school districts that participated at both time points. The study sample includes 3072 adolescents from 1999 and 2793 adolescents from 2010 (See Table 1 for socio-demographic characteristics).

Survey development and measures

Survey development was guided by a theoretical framework (Bandura, 1986; Sallis et al., 2008; Story et al., 2008), expert review, qualitative input from adolescents (Neumark-Sztainer et al., 1999), and pilot testing. Test–retest reliability was assessed in diverse adolescent samples at EAT-I (n = 161) and at EAT 2010 (n = 129); psychometric properties from 2010 are reported here. This subsample was 70% non-Hispanic white and equally divided on gender. All of the following non-anthropometric data were based on adolescent report on the EAT surveys.

Weight status

Measured heights and weights were taken following the same standardized procedures at both time points (Gibson, 1990). Body mass index (BMI) values were calculated and sex- and age-specific cutoff points used to classify respondents as overweight (≥85th percentile) and obese (BMI ≥95th percentile) were based on reference data from the Centers for Disease Control and Prevention growth tables (Kuczmarski et al., 2000).

Weight-related attitudes

Perceived weight status was assessed with the question: "At this time do you feel that you are … very underweight, somewhat underweight, about the right weight, somewhat overweight or very overweight?" Adolescents responding that they were somewhat or very overweight were coded as perceiving themselves as overweight (test–retest agreement [perceived overweight versus non overweight] = 90%). Participants with BMI values ≥85th percentile who perceived themselves as overweight were coded as having an *accurate perception of overweight status*. Conversely, participants with BMI values<85th percentile who perceived themselves to be overweight were coded as having an *inaccurate perception of overweight status*.

Body dissatisfaction was assessed with a modified version of the Body Shape Satisfaction Scale (Pingitore et al., 1997). Adolescents reported satisfaction with 10 body parts using five Likert response categories ranging from very dissatisfied to very satisfied. Item responses were summed with higher scores indicative of greater body dissatisfaction (score range: 10–50; Cronbach's $\alpha = 0.93$; test–retest r = 0.65).

Weight-related behaviors

Trying to lose weight was assessed with the question: "Are you currently trying to… 'lose weight,' 'stay the same weight,' 'gain weight,' or 'I am not trying to do anything about my weight'?" (test–retest agreement = 82%).

Dieting was assessed with the question "How often have you gone on a diet during the last year? By 'diet' we mean changing the way you eat so you can lose weight." Responses were dichotomized into non dieters (responded never) and dieters (other responses) (test–retest agreement [non dieter versus dieter] = 82%).

Healthy weight control behaviors were assessed with the question: "Have you done any of the following things in order to lose weight or keep from gaining weight during the past year?" (yes/no for each method). Behaviors included: exercise, ate more fruits and vegetables, ate less high-fat foods, and ate less sweets. Responses for this measure were modified for the 2010 survey (never/rarely/sometimes/on a regular basis) and those reporting the use of one or more weight control behavior "sometimes" or "on a regular basis" were coded as using healthy weight control behaviors (test–retest agreement [never/rarely versus sometimes/regular basis] = 88%).

Unhealthy and extreme weight control behaviors were assessed with the question: "Have you done any of the following things in order to lose weight or keep from gaining weight during the past year?" (yes/no for each method). Behaviors categorized as unhealthy included: fasted, ate very little food, used a food substitute (powder or a special drink), skipped meals, and smoked more cigarettes. Behaviors categorized as extreme included: took diet pills, made myself vomit, used laxatives, and used diuretics (test–retest agreement = 85% for unhealthy behaviors and 96% for extreme behaviors).

Binge eating was assessed with the question: "In the past year, have you ever eaten so much food in a short period of time that you would be embarrassed if others saw you (binge eating)" (yes/no). If participants responded yes, they were asked, "During the times when you ate this way, did you feel you couldn't stop eating or control what or how much you were eating" (yes/no) (test–retest agreement = 90% [first question] and 75% [second question]).

Self-weighing was assessed by asking adolescents to indicate how strongly they agreed with the statement, "I weigh myself often" (strongly disagree, disagree, agree, strongly agree) (test–retest agreement [agree versus disagree] = 85%).

Socio-demographic characteristics

Ethnicity/race was assessed with the question: "Do you think of yourself as…? (1) White, (2) Black or African American, (3) Hispanic or Latino, (4) Asian American, (5) Native Hawaiian or Pacific Islander, (6) American Indian or Native American, or (7) Other" (test–retest agreement = 98–100%). Since very few adolescents reported "Hawaiian or Pacific Islander", or did not report their ethnicity/race, they were coded as "mixed/other".

Socioeconomic status (SES) was determined primarily using the higher education level of either parent and secondarily using family eligibility for public assistance, eligibility for free or reduced-cost school meals, and parental employment status (Neumark-Sztainer et al., 2002b; Sherwood et al., 2009).

Statistical analysis

To test for secular changes in weight-related outcomes, it was important to control for demographic shifts in the study population from 1999 to 2010. Taking the demographic make-up of the 2010 sample as the reference, inverse probability weighting was used for the 1999 sample (Robins et al., 2000). Weights for the 1999 sample were created using predicted odds from a logistic regression of the 2010 or 1999 indicator on age, race, SES, gender and two-way interactions. Adolescents' weights for the 1999 sample were set equal to the predicted odds of being in the 2010 sample rescaled to the sum of the total sample size in 1999; weights for the 2010 sample were fixed at 1. Proper control of the demographic shift using the weights was achieved as evidenced by the non-significant differences in the weighted 1999 sample compared to the 2010 sample (Table 1). For analyses stratified by ethnicity/race, additional inverse probability weights were created using similar methodology to ensure balance of age and SES between 1999 and 2010 within each ethnic/racial group.

Tests for secular trends in continuous and dichotomous outcome variables were conducted using two sample t-tests and chi-square tests, respectively, with the inverse probability weights incorporated for the 1999 sample. All analyses were stratified by gender. Levels of missing data were low and individuals with missing data on certain outcomes were deleted from the respective analysis. In 2010, missing data per survey variable ranged from 0.2% to 3.6%, while in 1999 the range was 2.0%–8.3%. Missing data for observed weight status was 1.7% in 2010 and 13.8% in 1999. Differences over time are due to improved data collection by a more experienced research team. Although there were some differences by year, tests for differential missing found no systematic differences across gender, race, or SES.

Additional regression analyses tested an ethnicity/race by year interaction for each outcome variable. For cases in which significant interactions were found, we ran additional regressions stratified by ethnicity/race and gender. All analyses were performed in SAS 9.2.

Table 1
Comparisons of socio-demographic characteristics in actual 1999, weighted 1999 and actual 2010 samples from Minneapolis/St. Paul used to examine secular trends in weight-related outcomes[a].

	1999 sample		Weighted 1999 sample		2010 sample		p-value[b]
	n	%	n	%	n	%	
Gender							.968
Boys	1499	48.8	1436	46.7	1307	46.8	
Girls	1573	51.2	1636	53.3	1486	53.2	
Ethnicity/race							.999
White	1029	33.5	587	19.1	525	18.8	
Black	723	23.6	885	28.8	808	28.9	
Asian	753	24.5	615	20.0	555	19.9	
Hispanic	243	7.9	513	16.7	472	16.9	
Native American	133	4.3	110	3.6	102	3.7	
Mixed/other	191	6.2	362	11.8	331	11.8	
Socio-economic status							.999
Low	683	22.2	1168	38.0	1072	38.4	
Low–middle	601	19.5	655	21.3	595	21.3	
Middle	755	24.6	521	16.9	471	16.9	
High–middle	513	16.7	388	12.7	347	12.4	
High	358	11.7	224	7.3	203	7.3	
Not reported	162	5.3	116	3.8	105	3.7	
Age in years: Mean (SD)	3072	14.6 (1.8)	3072	14.5 (1.8)	2793	14.4 (2.0)	.255

BMI = Body Mass Index.

[a] The weighted 1999 sample used inverse probability weighting (Robins et al., 2000) based on the odds of being in the 2010 sample given demographics. Weighting was done to allow for an examination of secular trends in weight-related outcomes independent of demographic shifts in the population (see text in Statistical analysis section). Both the unweighted and weighted 1999 demographics are provided for ease of comparison.

[b] p-values are presented for differences between the weighted 1999 and 2010 samples, based on chi-square tests for gender, ethnicity/race and socio-economic status and t-tests for age.