



# Self-Weighing Throughout Adolescence and Young Adulthood: Implications for Well-Being

Carly R. Pacanowski, PhD, RD; Katie A. Loth, PhD, RD; Peter J. Hannan, MStat;  
Jennifer A. Linde, PhD; Dianne R. Neumark-Sztainer, PhD, MPH, RD

## ABSTRACT

**Objective:** To describe the prevalence of self-weighing in the transition period from adolescence to young adulthood and examine cross-sectional and longitudinal associations between self-weighing and weight status, psychological, and behavioral outcomes.

**Design:** *Project Eating and Activity in Teens and Young Adults*, a longitudinal cohort study that assessed variables 3 times over 10 years.

**Participants:** A total of 1,868 adolescents and young adults.

**Main Outcome Measures:** Weight, body mass index, weight disparity, body satisfaction, weight concern, self-esteem, depression, and unhealthy weight control behaviors.

**Analysis:** Cross-sectional and longitudinal.

**Results:** Significant positive correlations were found at each time point between self-weighing and weight concern for both genders. Self-weighing was significantly inversely related to self-esteem at each time point in female participants. Increases in endorsement of self-weighing were significantly related to decreases in body satisfaction and self-esteem and increases in weight concern and depression in female participants and to increases in weight concern in male participants.

**Conclusions and Implications:** Findings suggest that self-weighing may not be an innocuous behavior for young people, particularly women. Interventions should assess potential harmful consequences of self-weighing in addition to any potential benefits. It may be appropriate for clinicians to ask about self-weighing, and if it is frequent, to explore motivations, perceived benefits, and potential adverse correlates or consequences.

**Key Words:** self-weighing, weight, well-being, psychological, self-esteem, adolescent (*J Nutr Educ Behav*. 2015;47:506-515.)

Accepted August 10, 2015.

## INTRODUCTION

Obesity in adolescents is a public health concern, and because obesity tracks from adolescence into adulthood,<sup>1</sup> cost-effective ways are needed to prevent excessive weight gain during this critical life transition. Body dissatisfaction and weight concerns, 2 predictors of disordered eating behaviors,<sup>2</sup> are also elevated among adolescents,<sup>2</sup> which makes it crucial that

interventions aimed at obesity prevention among adolescents also take care to not exacerbate predictors of disordered eating behaviors. There is some evidence suggesting that self-weighing may facilitate weight control in some adults and not be psychologically detrimental.<sup>3,4</sup> However, there is reason to believe that self-weighing may not be advisable for certain adults<sup>5</sup> or other age groups, such as adolescents and young adults.<sup>4,6</sup> Thus,

it is important to determine whether self-weighing can be helpful for weight management in adolescents, while simultaneously not contributing to poor well-being, by developing a better understanding of the long-term outcomes of self-weighing for both weight management and behavioral or psychosocial outcomes.

There is scarce literature exploring self-weighing in adolescents and young adults and findings are inconsistent. Two cross-sectional studies found associations between self-weighing and less chance of weight regain in adolescents,<sup>7,8</sup> but for current weight, findings have been mixed. In 1 study, self-weighing was positively associated with body mass index (BMI)<sup>9</sup> whereas 2 others found no relationship<sup>10,11</sup> and 1 study found an inverse association.<sup>8</sup> Two longitudinal studies also reported inconsistent results: Self-weighing frequency was positively associated with prospective weight

---

Department of Epidemiology and Community Health, School of Public Health, University of Minnesota, Minneapolis, MN

*Conflict of Interest Disclosure:* The authors' conflict of interest disclosures can be found online with this article on [www.jneb.org](http://www.jneb.org).

Address for correspondence: Carly R. Pacanowski, PhD, RD, Department of Epidemiology and Community Health, School of Public Health, University of Minnesota, West Bank Office Bldg, 1300 South 2nd St, Ste 300, Minneapolis, MN 55415; Phone: (215) 630-0397; E-mail: [cpcanow@umn.edu](mailto:cpcanow@umn.edu)

Published by Elsevier, Inc. on behalf of the Society for Nutrition Education and Behavior <http://dx.doi.org/10.1016/j.jneb.2015.08.008>

gain in one study<sup>12</sup> but in another study, no association was found.<sup>10</sup> Regarding well-being, self-weighing has been found to be associated with higher depressive symptomatology, lower self-esteem, and lower body satisfaction, with some differences across gender.<sup>9,11,13</sup> Considering behaviors, self-weighing has been found to be associated with both healthy (eg, eating fewer foods with little nutritional value) and unhealthy (eg, skipping meals) weight control behaviors in 3 studies.<sup>10,11,13</sup> However, 1 study found no association between frequency of self-weighing and unhealthy weight control behaviors.<sup>8</sup>

These disparate and inconsistent findings call for further investigation, notably more research studies with long-term follow-up. *Project Eating and Activity in Teens and Young Adults (EAT)*, a longitudinal cohort study in a population-based sample of female and male adolescents and young adults, presents an opportunity to further explore self-weighing and its relationship with body weight and other psychosocial outcomes while investigating how these variables changed over a 10-year period. This study expands on previous analyses from *Project EAT*<sup>11-13</sup> by assessing self-weighing and outcomes indicative of well-being at 3 time points over 10 years. The current study has 3 objectives: (1) to describe the prevalence of self-weighing during the transition from adolescence to young adulthood; (2) to examine cross-sectional associations between self-weighing and selected outcomes; and (3) to investigate contemporaneous changes in self-weighing with changes in weight status, psychological, and behavioral outcomes over 10 years. Based on previous work, the authors hypothesized that more frequent self-weighing would be associated with poorer psychological status (greater body dissatisfaction and depressive symptoms, and lower self-esteem) and greater likelihood of engaging in unhealthy weight control behaviors.

## METHODS

### Study Design, Participants, and Recruitment

The researchers drew data for these analyses from *Project EAT-I*, *-II*, and *-III*, 3 waves of a 10-year longitudinal study designed to examine dietary

intake, physical activity, weight control behaviors, weight status, and factors associated with these outcomes among young people. In *Project EAT-I* (1998–1999), middle school and senior high school students at 31 public schools in the Minneapolis/St Paul metropolitan area completed surveys and anthropometric measures.<sup>14,15</sup> In *Project EAT-II* (2003–2004), original participants were mailed follow-up surveys.<sup>16,17</sup> *Project EAT-III* (2008–2009) observed participants as they progressed from adolescence to young adulthood. The University of Minnesota Institutional Review Board Human Subjects Committee approved all protocols.

The analytic sample used in this article to address objectives 1 and 2 includes the 1,902 young adults who responded at all 3 time points. There were 819 male participants (43%) and 1,083 female participants (57%) who completed surveys for *EAT-I* (time 1), *EAT-II* (time 2), and *EAT-III* (time 3). To address objective 3, participants had to respond to the self-weighing item at all 3 time points, which slightly decreased the analytic sample to 1,868 (female participants,  $n = 1,058$ ; male participants,  $n = 810$ ).

Because attrition from the time 1 sample did not occur at random, data were weighted using the response propensity method.<sup>18</sup> Response propensities (ie, the probability of responding to the *Project EAT-III* survey) were estimated using a logistic regression of response at time 3 on a large number of predictor variables from *EAT-I*. Weights were calibrated so that the weighted total sample sizes used in analyses for each gender cohort accurately reflect the actual observed sample sizes in those groups. The weighting method resulted in estimates representative of the demographic makeup of the original school-based sample, thereby allowing results to be more generalizable to the population of young people in the Minneapolis/St Paul metropolitan area.

### Measures

**Self-weighing.** The authors assessed engagement in self-weighing by asking participants to respond to the statement, “I weigh myself often.” Participants responded at each survey time point using a 4-point Likert scale

in which 1 = *strongly disagree* and 4 = *strongly agree* (test-retest agreement [agree vs disagree] = 85%<sup>19</sup>). A small study comparing the assessment of self-weighing used in the current article with a more objective assessment yielded a correlation of  $r = .60$ .<sup>12</sup>

**Weight status variables: weight and BMI.** At time 1, trained research assistants following standardized procedures measured height and weight, from which BMI was calculated. Body mass index at later time points was calculated from self-reported height and weight; validation of self-reports is described elsewhere.<sup>20</sup> Age and gender were assessed via self-report.

**Psychological variables: weight disparity, body satisfaction, weight concern, depression, and self-esteem.** The researchers calculated weight disparity by comparing self-assessed ideal weight and self-reported current weight. Participants responded to the question, *At what weight do you think you would look best?*<sup>2,15</sup> This value was divided by self-reported weight and multiplied by 100 to make a percentage (repeat correlation at *EAT-III* = 0.95). Body satisfaction was assessed using items based on the Body Shape Satisfaction scale.<sup>21</sup> Participants described level of satisfaction related to 10 different body parts using a 5-point Likert scale (Cronbach  $\alpha = .92$ ). Weight concern was assessed with 2 items: *I think a lot about being thinner* and *I am worried about gaining weight* (4-point Likert scale, *strongly disagree* to *strongly agree*) (Cronbach  $\alpha = .87$ ).<sup>2,14</sup> Depressive symptoms were assessed using 6 items from the Kandel and Davies Depressive Mood scale<sup>22</sup> (Cronbach  $\alpha = .82$ ). The researchers assessed self-esteem using 6 items from the Rosenberg Self-esteem scale<sup>23</sup> (Cronbach  $\alpha = .79$ ).

**Behavioral variables: less extreme and extreme unhealthy weight control behaviors.** Participants were asked to indicate whether they had engaged in each of 9 behaviors for reducing weight in the past year (yes/no).<sup>2,15</sup> Five of these behaviors constituted less extreme unhealthy weight control behaviors: fasted, ate very little food, used a food substitute, skipped meals, or smoked more

cigarettes (test-retest agreement = 83%). The remaining 4 behaviors constituted extreme unhealthy weight control behaviors: used laxatives, pills, diuretics, or vomited (test-retest agreement = 96%). Less extreme and extreme unhealthy weight control behavior variables were dichotomized into individuals reporting any of the behaviors vs none.

**Data Analysis**

The researchers calculated the percentage of male and female participants choosing each response option for the self-weighing variable at *EAT-I*, *EAT-II*, and *EAT-III*. To explore relationships between self-weighing and outcomes at *EAT-I*, *EAT-II*, and *EAT-III*, cross-sectional Spearman rank-order correlations were used.

To examine contemporaneous changes in self-weighing and outcomes, models were developed according to the type of outcome (continuous or dichotomous). Compound symmetry of variance components was included in the models to account for the correlation between repeated measures on the same person. The researchers employed decomposition of the repeated self-weighing into an average level and deviation from that average at the 3 surveys. This decomposes the repeated measures into the orthogonal dimensions of between-person associations and within-person contemporaneous change. Although it does not allow an inference of causality, a contemporaneous change in outcome and in self-weighing is stronger evidence of possible causalities (of ambiguous directionality) than the cross-sectional relationship. The model included a linear time effect (slope) modeled as a random slope per person. Effect size<sup>24</sup> is presented, which is the change in the outcome as a fraction of the SD of the outcome associated with a unit change in the independent variable.

For dichotomous outcomes, a similar model was used, but with logit link function and binomial error distribution. Expected logits were inverted to yield an estimate (in each gender) of the change in the probability of using any extreme weight control behavior associated with a contemporaneous change of 1 unit

in the scale of self-weighing (eg, moving from *disagree* to *agree*). Odds ratios are presented.

All analyses were weighted as described earlier. Attention is drawn to statistical  $P \leq .001$  because multiple tests were run. Younger and older cohorts appeared to follow the same pattern of self-weighing frequency reporting over time; a statistical interaction between age-cohort (2 categories) and survey (3 time points) was tested and found to be nonsignificant. Consequently, the age cohorts were combined. Analyses were not controlled for covariates to portray the true prevalence of the outcomes assessed; although associations may differ across potential covariates, this article is descriptive in nature and presents prevalence numbers free of additional adjustments.

**RESULTS**

Table 1 outlines participant characteristics for the *Project EAT* study at time 1. At *EAT-I*, more than two thirds of both female participants and male participants were of non-overweight

status. In the overall sample, about one third of participants were in middle school and two thirds were in high school. The sample was both ethnically and socioeconomically diverse, as displayed in Table 1. Socioeconomic status was determined using the highest parental level of education, described in detail elsewhere.<sup>14</sup>

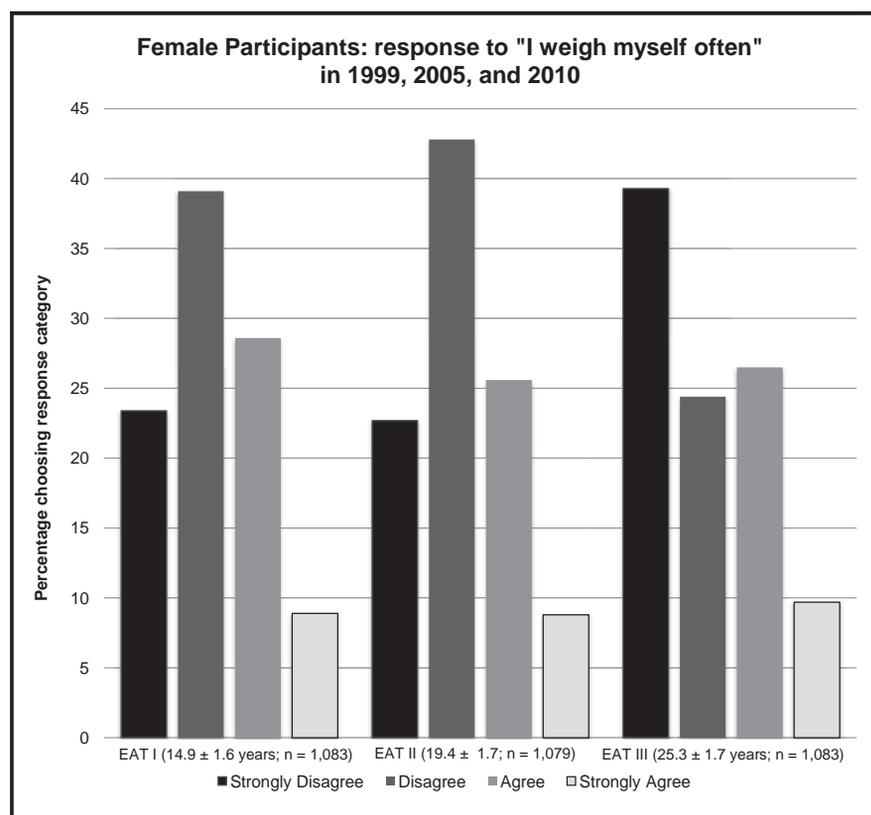
**Objective 1: Prevalence of Endorsement of Self-Weighing Over Time**

In both female and male participants, endorsement of self-weighing, referred to here simply as self-weighing, remained fairly stable over the 10-year period (Figures 1 and 2). At *EAT-I* and *EAT-II*, most female participants disagreed that they weighed themselves often. At *EAT-III*, most still disagreed but the proportion of females who strongly disagreed that they weighed themselves often was higher than at previous time points. For male participants, a similar pattern was seen, with the majority of males disagreeing that they weigh

**Table 1. Project Eating and Activity in Teens and Young Adults–I Study Participant Characteristics**

Variables	Female Participants, n (%)	Male Participants, n (%)
Weight status		
Normal	700 (67.2)	555 (68.8)
Overweight	195 (18.7)	105 (13.1)
Obese	147 (14.1)	147 (18.1)
School level		
In middle school	291 (28.2)	244 (30.3)
In high school	742 (71.8)	561 (69.7)
Race		
White	484 (46.9)	410 (51.1)
Asian	54 (5.2)	46 (5.8)
African American	215 (20.9)	117 (14.6)
Hawaiian/Pacific Islander	5 (0.5)	5 (0.6)
Hispanic	196 (19.0)	165 (20.6)
Native American	33 (3.2)	31 (3.8)
Mixed race	44 (4.3)	28 (3.5)
SES		
Low	183 (18.1)	124 (16.1)
Low-middle	184 (18.2)	160 (20.8)
Middle	277 (27.4)	190 (24.6)
High-middle	229 (22.6)	195 (25.3)
High	139 (13.7)	102 (13.2)

SES indicates socioeconomic status, determined by parent’s education level. Note: These values are weighted for nonresponse.



**Figure 1.** Percentage of female participants strongly disagreeing, disagreeing, agreeing, and strongly agreeing with the statement *I weigh myself often* in 1999, 2005, and 2010. Note: Only those with completed data are included. Data are weighted for nonresponse. *EAT-I*, *EAT-II*, and *EAT-III* indicate three waves of *Eating and Activity in Teens and Young Adults*.

themselves often at the first 2 time points and a larger proportion of males strongly disagreeing that they weighed themselves often at *EAT-III* compared with previous time points.

### Objective 2: Cross-Sectional Relationships Between Self-Weighing and Outcome Variables

For female participants, no significant associations were found between self-weighing and either weight or BMI at any of the 3 time points (Table 2). Self-weighing was inversely but weakly related to weight disparity, a measure of how ideal weight compares with actual weight, at *EAT-II* ( $r = -.14$ ;  $P < .001$ ). Self-weighing was associated with lower body satisfaction at *EAT-I* and *EAT-III* ( $r = -.17$  and  $-.17$ , respectively;  $P < .001$ ). The authors found a consistently positive correlation between self-weighing and weight

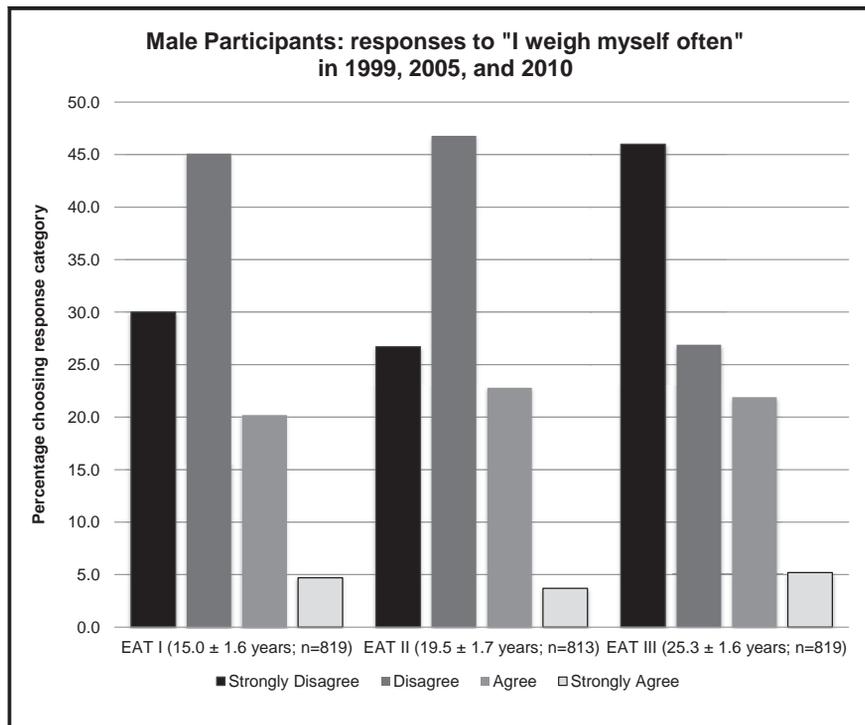
concern at the 3 time points ( $r = .30$ ,  $.34$ , and  $.34$ ;  $P < .001$ ). More frequent self-weighing was associated with more depressive symptoms at *EAT-I* ( $r = .14$ ;  $P < .001$ ). More frequent self-weighing was consistently inversely related to self-esteem ( $r = -.18$ ,  $-.19$ , and  $-.15$ ;  $P < .001$ ). For behavioral variables, Table 3 lists the percentage of female participants showing agreement with the self-weighing question and engaging in less extreme and extreme unhealthy weight control behaviors at each time point. At *EAT-I*, of the female participants who strongly agreed with weighing themselves often, 80.9% reported engaging in at least 1 less extreme unhealthy weight control behavior and 20.8% reported engaging in at least 1 extreme unhealthy weight control behavior. At *EAT-II*, of the female participants who strongly agreed with weighing themselves often, 81.3% reported engaging in at least 1 less extreme un-

healthy weight control behavior and 39.7% reported engaging in at least 1 extreme unhealthy weight control behavior. At *EAT-III*, these values were 74.8% and 39.1%, respectively.

In male participants, fewer significant relationships were found between self-weighing and selected variables (Tables 2 and 3). Self-weighing and weight status variables (weight and BMI) were not significantly associated any time point. The researchers found no relationship between self-weighing and weight disparity or body satisfaction. Self-weighing and weight concern showed a positive and significant relationship at all time points (*EAT-I*,  $r = .24$ ; *EAT-II*,  $r = .27$ ; and *EAT-III*,  $r = .28$ ;  $P < .001$ ). Self-weighing was not associated with depression or self-esteem at any time point. For behavioral variables, Table 3 lists the percentage of male participants engaging in less extreme and extreme unhealthy weight control behaviors. At *EAT-I*, of the male participants who strongly agreed with weighing themselves often, 44.5% reported engaging in at least 1 less extreme unhealthy weight control behavior (eg, fasted) and 7.9% reported engaging in at least 1 extreme unhealthy weight control behavior (eg, vomited). At *EAT-II*, of the male participants who strongly agreed with weighing themselves often, 47.5% reported engaging in at least 1 less extreme unhealthy weight control behavior and 6.4% reported engaging in at least 1 extreme unhealthy weight control behavior. At *EAT-III*, these values were 42.8% and 6.9%, respectively.

### Objective 3: Contemporaneous Change in Self-Weighing and Outcome Variables Over 10 Years

To further investigate the relationship between change in self-weighing and change in outcome variables, beta coefficients and odds ratios from random coefficient models are presented (Table 4). In female participants, no significant relationships were found between change in self-weighing and change in weight status variables. The researchers discovered significant relationships between change in self-weighing and change



**Figure 2.** Percentage of male participants strongly disagreeing, disagreeing, agreeing, and strongly agreeing with the statement *I weigh myself often* in 1999, 2005, and 2010. Note: Only those with complete data are included. Data are weighted for nonresponse. *EAT-I*, *EAT-II*, and *EAT-III* indicate three waves of *Eating and Activity in Teens and Young Adults*.

in psychological variables. A 1-unit increase in the response to *I weigh myself often* was significantly ( $P \leq .001$ ) associated with an almost 1-unit ( $-0.97$ ) decrease in body satisfaction, an increase in weight concern (0.55) and depression (0.41), and a decrease in self-esteem ( $-0.34$ ). These findings indicate that on average, a female who changed her response to *I weigh myself often* from *agree* at *EAT-I* to *strongly agree* at *EAT-II* would have reported a corresponding 0.97-point decrease in body satisfaction, 0.34-point decrease in self-esteem, 0.55-point increase in weight concern, and a 0.41-point increase in depression over the 5-year interval. Corresponding effect sizes ranged from 0.09 to 0.21 in magnitude, indicating small effects.<sup>24</sup> If endorsement of self-weighing changed by 1 unit, the corresponding change in probability of engaging in less extreme or extreme unhealthy weight control behaviors was not significant.

In male participants, no significant relationships were found between change in self-weighing and change in weight status variables or psycho-

logical variables, except for weight concern. A 1-unit increase in response to *I weigh myself often* corresponded to a significant ( $P \leq .001$ ) change of about a half-unit (0.53) increase in weight concern. This indicates that a male increasing endorsement of self-weighing between *EAT-I* and *EAT-II*, for example, would have a 0.53 increase in weight concern over this 5-year period. The effect size for this association, 0.24, was small.<sup>24</sup> As in females, a change in the frequency of self-weighing was not significantly associated with a change in the probability of engaging in unhealthy weight control behaviors.

## DISCUSSION

This study examined the percentage of adolescents endorsing self-weighing and relationships between self-weighing and weight status, psychological, and behavioral variables in a longitudinal cohort during the transition from adolescence to young adulthood. In female participants, significant positive correlations were

found at each time point between self-weighing and weight concern and self-esteem. In male participants, significant positive correlations were found at each time point between self-weighing and weight concern. Contemporaneous change analyses revealed that increases in self-weighing were significantly related to decreases in body satisfaction and self-esteem in female participants (thus showing a negative correlation), increases in weight concern and depression in female participants, and increases in weight concern in male participants.

The first aim of this article was to describe the prevalence of self-weighing during the transition from adolescence to young adulthood. The researchers did not observe a marked trend over time in the percentage of adolescents or young adults expressing agreement with the statement *I weigh myself often*. That said, the percentage of both female participants and male participants selecting *strongly disagree* increased between times 2 and 3, whereas the percentage selecting *disagree* decreased. Participants were aged about 15–25 years throughout this 10-year period.

The second aim was to examine cross-sectional associations between self-weighing and various measures. In female participants, cross-sectional relationships were found between endorsing more frequent self-weighing and higher discrepancy between desired and ideal weight (significant at *EAT-II*), lower body satisfaction (significant at *EAT-I* and *EAT-III*), greater weight concern (significant at all time points), greater depressive symptomatology (significant at *EAT-I*), and lower self-esteem (significant at all time points). Other researchers<sup>11,13</sup> have also found these constructs to be related to self-weighing. The only consistent relationship across gender was between self-weighing and weight concern. Similarly, Klos and colleagues<sup>9</sup> found a cross-sectional relationship between self-weighing and the weight concern subscale of the Eating Disorder Examination questionnaire in both female participants and male participants; however, this relationship was no longer significant when controlling for BMI.

This article's third aim was to investigate contemporaneous changes in self-weighing and changes in

**Table 2.** Cross-Sectional Pearson Correlations Between Response to *I Weigh Myself Often* (Strongly Disagree [SD], Disagree [D], Agree [A], or Strongly Agree [SA]) and Continuous Variables

Variables	EAT-I				EAT-II				EAT-III				
<b>Females</b>													
Weight status variables													
Weight	-0.01				0.07				0.10				
<i>I weigh myself often</i>	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA	
Mean	129.0	125.7	128.9	125.5	137.4	139.0	146.1	139.3	149.9	148.7	160.9	156.8	
BMI, kg/m <sup>2</sup>	-0.02				0.07				0.09				
	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA	
	22.5	22.2	22.5	21.9	23.4	23.7	24.9	23.7	25.6	25.7	27.3	26.6	
Psychological variables													
Weight disparity (%)	-0.01				-0.14*				-0.09				
	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA	
	91.6	92.7	91.2	92.0	93.5	92.3	88.5	90.1	89.2	88.7	86.7	86.6	
Body satisfaction	-0.17*				-0.24				-0.17*				
	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA	
	33.9	32.1	30.9	27.9	34.3	32.3	28.4	28.0	31.8	28.1	28.5	26.8	
Weight concern	0.30*				0.34*				0.34*				
	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA	
	6.6	7.5	8.3	9.3	6.5	7.5	8.6	9.1	6.9	8.1	8.3	9.7	
Depression	0.14*				0.10				0.11				
	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA	
	17.7	18.2	19.2	19.6	19.2	19.2	19.9	21.1	18.8	19.3	19.0	21.5	
Self-esteem	-0.18*				-0.19*				-0.15*				
	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA	
	17.9	17.6	16.9	15.4	18.5	18.2	17.0	16.6	18.6	17.6	17.8	16.9	
<b>Males</b>													
Weight status variables													
Weight	0.07				0.06				0.13				
<i>I weigh myself often</i>	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA	
Mean	140.9	148.7	144.0	157.9	167.9	173.1	177.8	163.6	178.5	198.3	189.4	192.2	
BMI, kg/m <sup>2</sup>	-0.02				0.08				0.12				
	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA	
	21.8	22.7	22.6	23.8	23.9	24.7	25.4	23.7	25.5	28.7	26.8	26.9	
Psychological variables													
Weight disparity (%)	0.02				0.00				-0.06				
	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA	
	99.5	98.7	103.6	93.9	99.7	98.1	98.6	102.6	97.2	90.8	96.0	95.7	
Body satisfaction	-0.07				-0.11				-0.11				
	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA	
	38.0	36.6	36.3	36.4	37.3	35.1	35.6	31.5	36.4	32.3	33.8	35.5	
Weight concern	0.24*				0.27*				0.28*				
	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA	
	5.0	5.9	6.0	7.8	4.8	6.3	6.5	6.9	5.3	6.8	6.7	7.2	
Depression	0.05				0.08				-0.02				
	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA	
	15.9	16.0	16.2	17.5	17.1	17.4	17.1	21.0	17.3	17.6	17.0	17.1	
Self-esteem	-0.11				-0.06				-0.02				
	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA	
	19.6	18.8	18.4	18.6	19.5	18.5	19.3	17.8	19.1	18.1	18.8	19.5	

BMI indicates body mass index; EAT-I, EAT-II, and EAT-III, three waves of *Eating and Activity in Teens and Young Adults*.

\*Correlation significant at  $P < .001$ .

Note: Models are weighted for nonresponse but not otherwise adjusted for covariates. Numbers differ based on variables. Means appear below the correlation at each time point. Weight disparity % = self-assessed ideal weight divided by actual weight, multiplied by 100. Body satisfaction: *Body Shape Satisfaction Scale* minus scores ranging from 5 (dissatisfied) to 50 (satisfied). Weight concern: assessed with items *I think a lot about being thinner* and *I am worried about gaining weight*: scores range from 3 (low weight concern) to 12 (high weight concern). Depression: Six items from Kandel and Davies Depressive Mood scale<sup>22</sup>; scores range from 10 (low depressive symptoms) to 50 (high depressive symptoms). Self-esteem: Six items from the Rosenberg Self-esteem scale<sup>23</sup>; scores range from 6 (low) to 24 (high).

**Table 3.** Percentage of Female and Male Participants Choosing Response Category for *I Weigh Myself Often* (Strongly Disagree [SD], Disagree [D], Agree [A], or Strongly Agree [SA]) Who Reported Engaging in Less Extreme and Extreme UWCBs

	EAT-I				EAT-II				EAT-III			
<b>Behavioral variables</b>												
Females												
Less extreme UWCB												
<i>I weigh myself often</i>	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA
Prevalence	43.3	54.1	66.3	80.9	43.6	60.7	71.1	81.3	54.9	62.0	66.9	74.8
Extreme UWCB												
	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA
	11.5	6.9	13.4	20.8	12.1	17.2	26.5	39.7	14.7	15.3	25.7	39.1
Males												
Less extreme UWCB												
<i>I weigh myself often</i>	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA
Prevalence	27.7	30.3	34.2	44.5	17.7	35.9	43.7	47.5	24.3	40.2	38.0	42.8
Extreme UWCB												
	SD	D	A	SA	SD	D	A	SA	SD	D	A	SA
	3.7	1.3	2.7	7.9	5.9	8.0	6.6	6.4	1.7	10.1	8.0	6.9

EAT-I, EAT-II, and EAT-III indicate three waves of *Eating and Activity in Teens and Young Adults*; UWCB, unhealthy weight control behaviors.

Note: Models are weighted for nonresponse but not otherwise adjusted for covariates. Numbers differ based on variables.

weight status, psychological, and behavioral outcomes over 10 years. An increase in endorsement of frequent self-weighing was associated with a decrease in self-esteem and body satisfaction, an increase in weight concern and depression in female participants, and an increase in weight concern in male participants. Corroborating these findings, studies using different nonclinical samples of adolescents and young adults have found a relationship between self-weighing and lower self-esteem,<sup>6</sup> body satisfaction/weight concern,<sup>9</sup> and higher depression<sup>6</sup> and disordered eating score.<sup>25</sup> However, others have not found evidence for these relationships.<sup>26,27</sup> In the previously mentioned longitudinal study assessing self-weighing at EAT-I and change in outcomes between EAT-I and EAT-II,<sup>16</sup> greater self-weighing at EAT-I significantly predicted larger increases in BMI 5 years later in the younger cohort of female adolescents and predicted more binge eating and unhealthy weight control behaviors in both the younger and older cohort of female adolescents 5 years later. The most likely reason for an association between self-weighing and BMI not being replicated here is that in the 2006 study, greater self-weighing frequency predicted greater changes

in BMI in the younger cohort of females who were in middle school at EAT-I (results for the older cohort were not statistically significant), and for the current analyses, cohorts were combined because there was no reason to believe self-weighing frequency changed differently by cohort. It is possible that engaging at self-weighing at a younger age (during middle school) contributes to larger BMI gains compared with self-weighing in the teenage years (during high school). In addition, the 2006 study controlled for covariates and the current article did not, to allow for the true prevalence of the outcomes assessed. Concerning unhealthy weight control behaviors, the current study found increasing odds of unhealthy weight control behaviors with greater endorsement of self-weighing; however, owing to the stringent significance level ( $P \leq 01$ ) set to control for multiple comparisons, the result was not significant. The findings presented here are in alignment with previous *Project EAT* studies, although statistical significance being met may vary as a result of sample size, strength of relationship, or a priori  $P$ .

The current study builds on previous analyses from *Project EAT* in which associations were examined be-

tween self-weighing and various measures.<sup>11-13</sup> Specifically, the current study uses measures of self-weighing collected at 3 separate time points at 5-year intervals. In addition to describing cross-sectional relationships between self-weighing and outcomes at each of 3 *Project EAT* time points, assessing self-weighing at multiple time points allowed for an examination of contemporaneous changes in self-weighing and measures of well-being. Examining change in self-weighing and change in outcomes provides stronger evidence of possible causalities than cross-sectional relationships.

Strengths of this study include a large sample size, which allowed for adequate power to detect relationships, and weighting to adjust for nonresponse in a sample followed for a decade, which enhanced the generalizability of the final sample. The primary limitation of this study concerns the operationalization of the independent variable. Asking participants about the degree to which they agree with the statement *I weigh myself often* on a 4-point Likert response scale may not equate to a measure asking participants to rate self-weighing in terms of frequency per unit of time, as used in other studies (eg, Quick et al<sup>11</sup>). However, as mentioned, a

**Table 4.** Longitudinal Contemporaneous Change Beta Coefficients or Odds Ratios Corresponding to a 1-Unit Change in Response to *I Weigh Myself Often* (Strongly Disagree to Strongly Agree) Over 10 Years

Continuous outcomes	Females (n = 1,058)				Males (n = 810)			
	$\beta$	SD	ES	P	$\beta$	SD	ES	P
Weight status variables								
Weight	-.15	28.47	-0.01	.70	-.08	35.99	0.00	.88
Body mass index	-.08	4.64	-0.02	.28	-.07	4.46	-0.02	.32
Cognitive variables								
Weight disparity (%)	.39	12.36	0.03	.19	.18	15.47	0.01	.38
Body satisfaction	<b>-.97</b>	9.16	<b>-0.11</b>	<b>&lt; .001</b>	-.29	8.52	-0.03	.20
Weight concern	<b>.55</b>	2.60	<b>0.21</b>	<b>&lt; .001</b>	<b>.53</b>	2.21	<b>0.24</b>	<b>&lt; .001</b>
Psychological variables								
Depression	<b>.41</b>	4.41	<b>0.09</b>	<b>&lt; .001</b>	.08	4.39	0.02	.52
Self-esteem	<b>-.34</b>	3.43	<b>-0.10</b>	<b>&lt; .001</b>	-.12	3.38	-0.04	.16
Dichotomous outcomes								
	OR	Females (n = 1,058)			Males (n = 810)			P
		% Mean	% Change	P	OR	% Mean	% Change	P
Behavioral variables								
Less extreme UWCB	1.15	60.2	~3.3	.05	1.22	32.2	~4.5	.03
Extreme UWCB	1.21	17.1	~2.8	.01	1.16	5.2	~0.8	.31

ES indicates effect size (change as a fraction of SD); OR, odds ratio of probability of behavior for 1-step change within an individual in reporting agreement (*strongly disagree*, *disagree*, *agree*, or *strongly agree*) with the statement *I weigh myself often*; UWCB, unhealthy weight control behavior.

Statistically significant beta coefficients ( $P \leq .001$ ) are shown in bold type. Weight disparity % = self-assessed ideal weight divided by actual weight, multiplied by 100. Body satisfaction: Body Shape Satisfaction scale minus scores range from 5 (dissatisfied) to 50 (satisfied). Weight concern: assessed with items *I think a lot about being thinner* and *I am worried about gaining weight*: scores range from 3 (low weight concern) to 12 (high weight concern). Depression: Six items from Kandel and Davies Depressive Mood scale; scores range from 10 (low depressive symptoms) to 50 (high depressive symptoms). Self-esteem: Six items from the Rosenberg Self-esteem scale; scores range from 6 (low) to 24 (high).

Note: For less extreme and extreme UWCB, table entries are from the logistic model. Models are weighted for nonresponse.

small study comparing the assessment of self-weighing used in the current article with a more objective assessment yielded a moderate correlation. It is possible that over this 10-year period, cultural shifts in body image and the media had an impact on the outcome variables assessed in this cohort. A meta-analysis found the media's conception of thinness to be inversely related to self-esteem and positively associated with worsening depression, with small but significant effect sizes.<sup>28</sup> However, researchers have found little difference between Caucasian and Chinese students and no difference in BMI of African or Caucasian models, which brings into question the role of the media in body image and associated constructs.<sup>29,30</sup> Despite these limitations, the strong external validity of this study makes it an important contribution to the literature and directs attention to key psychological factors: self-esteem, depression, and body satisfaction. Future studies could address limita-

tions of internal validity by using more detailed measures of weighing frequency.

This study builds on the extant literature examining links between self-weighing and adverse outcomes. In 1 study, female participants self-reported that the number on the scale affected their mood.<sup>31</sup> Mercurio and Rima<sup>32</sup> suggested that Objectification Theory might help to link self-weighing and body dissatisfaction conceptually and posited that this relationship was mediated by body surveillance. They found empirical support for this idea. Objectification Theory asserts that a focus on one's physical attributes and the importance of this self-evaluation imposed by society breeds self-consciousness, and unduly focusing on appearance and imagining others' evaluation of physical looks makes self-monitoring this appearance important.<sup>33</sup> Future research examining interrelationships between self-weighing and weight status, psychological, and behavioral outcomes over time are warranted, espe-

cially those using a more objective assessment of self-weighing frequency. Because of the suggestion of changes in self-weighing frequency and adverse changes in body dissatisfaction, weight concern, depressive symptoms, and self-esteem, caution is advised in recommending this behavior to adolescents and young adults. At the same time, self-weighing is a frequently used behavior among young adults,<sup>31</sup> it has been found to be associated with improvements in binge eating and depression as part of weight loss treatment,<sup>27</sup> and it can serve as inexpensive objective feedback about weight control in a population with high rates of overweight/obesity,<sup>34</sup> which can also be associated with adverse psychological outcomes.<sup>35</sup> Future experimental research in healthy young adult participants should be designed carefully to exclude participants for whom self-weighing might not be advisable (eg, female individuals with low body satisfaction, self-esteem, or high depressive symptoms) and to monitor and address weight status,

psychological, and behavioral outcomes. This would allow for evidence of potential causality, direction of that causality, and further information about those for whom specifically self-weighing behavior is or is not beneficial.

## IMPLICATION FOR RESEARCH AND PRACTICE

Because self-weighing is a behavior that carries relatively little social stigmatization, adolescents or young adults may feel more comfortable reporting to their primary care provider information about how often they weigh themselves, compared with discussing how depressed they feel or responding to questions about self-esteem. Because results from the current study suggest that self-weighing and changes in self-weighing frequency are associated with adverse psychological changes, especially in female participants, it may be advisable for clinicians to ask about self-weighing at office visits, noting change over time, as a proxy for investigating other, more concerning changes in well-being.

## REFERENCES

- Singh AS, Mulder C, Twisk JWR, van Mechelen W, Chinapaw MJM. Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obes Rev Off J Int Assoc Study Obes.* 2008;9:474-488.
- Neumark-Sztainer D, Story M, Hannan PJ, Perry CL, Irving LM. Weight-related concerns and behaviors among overweight and nonoverweight adolescents: implications for preventing weight-related disorders. *Arch Pediatr Adolesc Med.* 2002;156.
- Van Wormer JJ, French SA, Pereira MA, Welsh EM. The impact of regular self-weighing on weight management: a systematic literature review. *Int J Behav Nutr Phys Act.* 2008;5:54. <http://dx.doi.org/10.1186/1479-5868-5-54>.
- Pacanowski CR, Linde JA, Neumark-Sztainer D. Fear of fatness: links between eating disorders and obesity. *Curr Obes Rep.* 2015;4. In press.
- Strimas R, Dionne MM. Differential effects of self-weighing in restrained and unrestrained eaters. *Personal Individ Differ.* 2010;49:1011-1014.
- Ogden J, Whyman C. The effect of repeated weighing on psychological state. *Eur Eat Disord Rev.* 1997;5:121-130.
- Boutelle KN, Libbey H, Neumark-Sztainer D, Story M. Weight control strategies of overweight adolescents who successfully lost weight. *J Am Diet Assoc.* 2009;109:2029-2035.
- Alm ME, Neumark-Sztainer D, Story M, Boutelle KN. Self-weighing and weight control behaviors among adolescents with a history of overweight. *J Adolesc Health.* 2009;44:424-430.
- Klos LA, Esser VE, Kessler MM. To weigh or not to weigh: the relationship between self-weighing behavior and body image among adults. *Body Image.* 2012;9:551-554.
- Friend S, Bauer KW, Madden TC, Neumark-Sztainer D. Self-weighing among adolescents: associations with body mass index, body satisfaction, weight control behaviors, and binge eating. *J Acad Nutr Diet.* 2012;112:99-103.
- Quick V, Larson N, Eisenberg ME, Hannan PJ, Neumark-Sztainer D. Self-weighing behaviors in young adults: tipping the scale toward unhealthy eating behaviors? *J Adolesc Health.* 2012;51:468-474.
- Neumark-Sztainer D, van den Berg P, Hannan PJ, Story M. Self-weighing in adolescents: helpful or harmful? Longitudinal associations with body weight changes and disordered eating. *J Adolesc Health.* 2006;39:811-818.
- Quick V, Loth K, MacLehose R, Linde JA, Neumark-Sztainer D. Prevalence of adolescents' self-weighing behaviors and associations with weight-related behaviors and psychological well-being. *J Adolesc Health.* 2013;52:738-744.
- Neumark-Sztainer D, Story M, Hannan PJ, Croll J. Overweight status and eating patterns among adolescents: where do youths stand in comparison with the healthy people 2010 objectives? *Am J Public Health.* 2002;92:844-851.
- Neumark-Sztainer D, Croll J, Story M, Hannan PJ, French SA, Perry C. Ethnic/racial differences in weight-related concerns and behaviors among adolescent girls and boys: findings from Project EAT. *J Psychosom Res.* 2002;53:963-974.
- Neumark-Sztainer D, Wall M, Eisenberg ME, Story M, Hannan PJ. Overweight status and weight control behaviors in adolescents: longitudinal and secular trends from 1999 to 2004. *Prev Med.* 2006;43:52-59.
- Neumark-Sztainer D, Wall M, Guo J, Story M, Haines J, Eisenberg M. Obesity, disordered eating, and eating disorders in a longitudinal study of adolescents: how do dieters fare 5 years later? *J Am Diet Assoc.* 2006;106:559-568.
- Little RJ. Survey nonresponse adjustments for estimates of means. *Int Stat Rev.* 1986;54:139-157.
- Neumark-Sztainer D, Wall MM, Larson N, et al. Secular trends in weight status and weight-related attitudes and behaviors in adolescents from 1999 to 2010. *Prev Med.* 2012;54:77-81.
- Quick V, Larson N, Neumark-Sztainer D, Wall M, Haines J. Personal, behavioral and socio-environmental predictors of overweight incidence in young adults: 10-yr longitudinal findings. *Int J Behav Nutr Phys Act.* 2013;10:37. <http://dx.doi.org/10.1186/1479-5868-10-37>.
- Pingitore R, Spring B, Garfield D. Gender differences in body satisfaction. *Obes Res.* 1997;5:402-409.
- Kandel DB, Davies M. Epidemiology of depressive mood in adolescents: an empirical study. *Arch Gen Psychiatry.* 1982;39:1205-1212.
- Rosenberg M. Society and the adolescent self-image. Princeton, NJ: Princeton University Press; 1965.
- Cohen J. *Statistical Power Analysis for the Behavioral Sciences.* 2nd ed. Hillsdale, NJ: Routledge; 1988.
- Walsh DJ, Charlton BG. The association between the development of weighing technology, possession and use of weighing scales, and self-reported severity of disordered eating. *Ir J Med Sci.* 2014;183:471-475.
- Gow RW, Trace SE, Mazzeo SE. Preventing weight gain in first year college students: an online intervention to prevent the "freshman fifteen." *Eat Behav.* 2010;11:33-39.
- Gokee-Larose J, Gorin A, Wing R. Behavioral self-regulation for weight loss in young adults: a randomized controlled trial. *Int J Behav Nutr Phys Act.* 2009;6:10.
- Hausenblas HA, Campbell A, Menzel JE, Doughty J, Levine M, Thompson JK. Media effects of experimental presentation of the ideal physique on eating disorder symptoms:

- a meta-analysis of laboratory studies. *Clin Psychol Rev.* 2013;33:168-181.
29. Baillie LE, Copeland AL. Disordered eating and body image in Chinese and Caucasian students in the United States. *Eat Behav.* 2013;14:314-319.
30. Coetzee V, Perrett DI. African and Caucasian body ideals in South Africa and the United States. *Eat Behav.* 2011;12:72-74.
31. Mintz LB, Awad GH, Stinson RD, et al. Weighing and body monitoring among college women: the scale number as an emotional barometer. *J Coll Stud Psychother.* 2013;27:78-91.
32. Mercurio A, Rima B. Watching my weight: self-weighing, body surveillance, and body dissatisfaction. *Sex Roles.* 2011;65:47-55.
33. Fredrickson BL, Roberts TA. Objectification theory. *Psychol Women Q.* 1997;21:173-206.
34. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA.* 2014;311:806-814.
35. Luppino FS, de Wit LM, Bouvy PF, et al. Overweight, obesity, and depression: a systematic review and meta-analysis of longitudinal studies. *Arch Gen Psychiatry.* 2010;67:220-229.

## Monthly Virtual Collections at JNEB

Each month Shirley Camp, our New Resources editor, selects JNEB articles for a themed collection on a topic of interest to our readers. Recent topics have included survey validation, SNAP-Ed, nutrition and technology, heart health, farmers markets, and bone health. While the articles are from JNEB and are always available from the archive, each virtual collection is active for 2 months—check <http://www.jneb.org> often to see our newest virtual collections.