Published in final edited form as:

Prev Med. 2018 August ; 113: 80–90. doi:10.1016/j.ypmed.2018.04.027.

Personal, behavioral, and environmental predictors of healthy weight maintenance during the transition to adulthood

Nicole Larson, PhD, MPH, RDN¹, Ying Chen, MD, MS, MA², Melanie Wall, PhD², Megan R. Winkler, PhD, RNC-NIC, CPNP-PC¹, Andrea B. Goldschmidt, PhD³, and Dianne Neumark-Sztainer, PhD, MPH, RD¹

¹Division of Epidemiology and Community Health, School of Public Health, University of Minnesota, 1300 South Second Street, Suite 300, Minneapolis, MN 55454

²Division of Biostatistics in the Department of Psychiatry, Department of Biostatistics in the Mailman School of Public Health, Columbia University, 1051 Riverside Drive, New York, NY 10032

³Department of Psychiatry and Human Behavior, Alpert Medical School of Brown University, The Miriam Hospital/Weight Control and Diabetes Research Center, 196 Richmond Street, Providence, RI, 02903

Abstract

There is a high prevalence of overweight among U.S. young adults and the intergenerational implications of excess weight gain at this life stage are great. We used Project EAT (Eating and Activity in Teens and Young Adults) study data to identify personal, behavioral, and environmental factors that predicted healthy weight maintenance during the transition from adolescence to adulthood and as individuals progressed from the third to fourth decade of life. The sample included 1,120 young adults who were secondary school students in Minneapolis-St. Paul at Time 1 (1998–1999) and responded at follow-ups in 2008–2009 and 2015–2016. Results showed individual factors and multiple environmental factors contribute to maintenance. The most consistent findings suggest that having higher body satisfaction and avoiding unhealthy weight control behaviors (e.g., skipping meals) and dieting are protective against excess weight gain for women and men. For example, the odds ratio associated with a one standard deviation increase in the probability of using an extreme weight control behavior from adolescence and adulthood was 0.67 (CI: 0.54, 0.84) among women and 0.34 (CI: 0.12, 0.96) among men indicating decreased odds of maintaining a healthy weight. Social support for healthy eating and physical activity were protective whereas close relationships with individuals who were dieting (e.g., parents, significant others) reduced the likelihood of maintaining a healthy weight. Primary prevention strategies should continue beyond adolescence and involve peer social support to encourage young people at a healthy weight to be satisfied with their shape/size and avoid restrictive weight control behaviors.

Corresponding author: Nicole Larson, PhD, MPH, RDN, Senior Research Associate, phone: 612-625-5881, fax: 612-626-7103, larsonn@umn.edu.

CONFLICT OF INTEREST

The authors have no conflict of interest to report.

Keywords

weight status; overweight; obesity; adolescence; young adulthood; eating behavior; physical activity

INTRODUCTION

Young adulthood is a high-risk period for undesired weight gain and transitioning to a potentially unhealthy body mass index (BMI) (Gordon-Larsen et al., 2010; Kimokoti et al., 2013). Although some individuals with a BMI at or above 25 kg/m² are metabolically healthy, there are a number of associated health risks as BMI increases above this defined value. Being at an unhealthy BMI and, in particular the presence of obesity (BMI ≥ 30 kg/m²), during young adulthood may negatively impact reproductive outcomes as well as long-term risk for type 2 diabetes and cardiovascular disease (Adane et al., 2017; Attard et al., 2013; Cheng et al., 2016; Lloyd-Jones et al., 2007; Nodine and Hastings-Tolsma, 2012; Truesdale et al., 2006). Limiting excess weight gain and supporting healthy weight maintenance are important population-level health targets for young adults (Buscemi et al., 2017).

Additional research addressing the complex influences on young adults' weight-related behaviors is needed to strengthen multi-contextual weight gain prevention strategies. Few developmentally-tailored interventions for young adults have demonstrated effectiveness (Cheng et al., 2016; Laska et al., 2012) and most existing studies addressing influences on weight maintenance focus on what is needed to prevent weight regain after weight loss versus the potentially different supports needed for ongoing maintenance of a healthy weight (Annesi and Marenco, 2017; Harris et al., 1994; Kraschnewski et al., 2010; Kruger et al., 2008; Nikolaou et al., 2015; Turk et al., 2012; Weiss et al., 2007; Wing and Hill, 2001; Wing and Phelan, 2005). Given that many environmental characteristics have the potential to influence weight maintenance, the development of more effective primary prevention guidelines will require consideration of multiple contexts.

The current study extends the evidence base and aligns with calls for research to inform prevention efforts by focusing on the identification of potentially modifiable personal, behavioral, and environmental factors that predict healthy weight maintenance during the transition from adolescence to adulthood, and factors specifically of relevance during the understudied transition from the third to fourth decade of life (National Institutes of Health, 2015; National Institutes of Health Obesity Research Task Force, 2011; Story et al., 2008). As few longitudinal studies of weight-related health extend from adolescence to beyond the third decade (Larson et al., 2011b; Winpenny et al., 2017), this study used data collected over more than fifteen years of follow up and examined early adulthood separately as a unique stage. Also, based on prior research that has identified sex-specific correlates of weight status (Arabshahi et al., 2017; Morgan et al., 2012; Quick et al., 2013), this study separately examined associations among women and men.

Social cognitive theory (SCT) and an ecological framework were used in combination to guide the study (Figure 1) given their complementary strengths; the depth of SCT is useful

for illuminating individual-level (personal and behavioral) factors and the breadth of an ecological framework aids in illuminating environmental (physical and social) factors that determine weight-related outcomes in multiple contexts (Kelder et al., 2015; Sallis and Owen, 2015). Further, the attention to dynamic interactions between individuals and their environments as central constructs of both models (i.e., reciprocal determinism) is useful for guiding the interpretation of results and their translation to comprehensive interventions (Kelder et al., 2015; Sallis and Owen, 2015). The potential predictors shown in Figure 1 were included based on their relevance to the guiding health behavior models, the existing literature that more broadly addresses correlates of weight status, and the availability of representative measures within the longitudinal data that were used for the current study (Bandura, 1986; Haines et al., 2007; Kelder et al., 2015; Neumark-Sztainer et al., 2007; Quick et al., 2013; Sallis and Owen, 2015).

METHODS

Study Design and Population

Data were drawn from the population-based, Project EAT (Eating and Activity in Teens and Young Adults) longitudinal study of weight-related health. A total of 1,664 young adults responded at each of the three time points included in the current analysis. For the original assessment (Time 1) in 1998–1999, 4,746 adolescents enrolled at 31 public secondary schools in Minneapolis-St. Paul, Minnesota completed surveys and had their height and weight measured in school classrooms (Neumark-Sztainer et al., 2002a; Neumark-Sztainer et al., 2002b). A follow-up assessment was conducted online and by mail in 2008–2009 (Time 3) as participants progressed through adolescence and emerging adulthood (Larson et al., 2011a; Neumark-Sztainer et al., 2006b; Neumark-Sztainer et al., 2011). The Time 4 assessment was designed to follow up again in 2015–2016 as participants progressed through young adulthood and entered their fourth decade of life (mean age of 31.0 ± 1.6 years).

Invitations to complete the Time 4 online or paper survey were mailed to all original participants who had responded to at least one previous follow-up assessment; however, given the focus on adulthood and prior findings that few young people returned to a healthy weight if they were overweight at a young age (Goldschmidt et al., 2018), Time 2 (2003–2004) data were not included. Time 4 data collection yielded a response from 66.1% of the 2,770 original participants who could be contacted. The University of Minnesota's Institutional Review Board Human Subjects Committee approved all protocols and participants provided informed consent.

Survey Measures

Personal, behavioral, and environmental factors.—For each factor in the analysis and shown in Figure 1, Table 1 provides the survey item wording, available psychometric properties, and a coding scheme description. Time 1 survey development was guided by SCT; however, not all key constructs of SCT (e.g., exposure to food advertising, televised modeling of eating behaviors) were represented in the survey to avoid excessive participant burden and some constructs were excluded from the current analysis due to a strong

likelihood of confounding (e.g., weight-related teasing). Survey development at Time 3 and Time 4 was additionally guided by an ecological perspective in alignment with the expanding literature (Larson et al., 2011b). For follow-up surveys, new items were accordingly added to assess characteristics of physical and social environments (Brug et al., 2006; Huang and Glass, 2008; Larson et al., 2011b; Sallis et al., 2009), minor alterations were made to Time 1 items in order to ensure developmental appropriateness, and some Time 1 items were dropped due to poor construct performance in related analyses (Haines et al., 2007; Neumark-Sztainer et al., 2007). For most measures, scale psychometric properties were examined in the full Time 4 sample and test-retest reliability was determined in a subgroup of 103 participants who completed the survey twice. Selected measures were also examined as part of a Health Risk Behavior score in order to allow for examining the combined potential influence of behaviors on the likelihood of weight maintenance. The score represents a sum of points (0/1) assigned for not meeting eating, activity, and other weight-related health recommendations at Time 1 (range: 0–8, standard deviation=1.4) and Time 3 (range: 0–9, standard deviation=1.7).

Weight status.—Self-reported height and weight were used to calculate BMI at each time point. At Time 1, both measured and self-reported height and weight were collected and high correlations were found between measured and self-reported BMI in the entire sample of male ($r=0.88$) and female ($r=0.85$) adolescents (Himes et al., 2005). Measurements were also completed at Time 3 for a subsample and very high correlations with self-reported BMI were observed among males ($r=0.95$) and females ($r=0.98$) (Sirard et al., 2013). Healthy weight status was defined using the screening guidelines (Barlow and the Expert Committee, 2007; National Institutes of Health, 1998): (1) a BMI below the 85th percentile for sex and age at Time 1 (Barlow and the Expert Committee, 2007; Kuczmarski et al., 2000) and (2) a BMI less than 25 kg/m² at Time 3 and Time 4 (Jensen et al., 2014; National Institutes of Health, 1998).

Statistical Analysis

All analyses were conducted with the Statistical Analysis System (SAS, version 9.4, 2013, SAS Institute, Cary, NC, USA). No explicit control for multiple comparisons was performed, but 95% confidence intervals for all associations are presented with the inclusion of at least two significant figures and interpretation focused on patterns in the observed associations. As attrition from the original school-based sample did not occur at random, in all analyses, the data were also weighted using the response propensity method (Little, 1986). The weighting method resulted in estimates more generalizable to the population of young people in the Minneapolis-St. Paul metropolitan area in 1998–1999. Additionally, all variables were standardized to allow for relative comparisons of strength between observed associations and examined for missingness; it was determined that missingness was less than 15% for all but 6% of the variables and no variables had more than 25% of the data missing.

Analyses were first conducted to exclude individuals who did not have self-reported or measured height and weight data available at one or more time point, women who reported being pregnant when they reported their weight at either Time 3 or Time 4 ($n=130$), and adults with a BMI under 18.5 kg/m² ($n=19$) at Time 4. A sample of 602 women and 518

men who were not overweight at Time 1 were then identified and their characteristics were examined in comparison to the overall sample that participated at Time 1, Time 3, and Time 4. The comparison was conducted for all Time 1 characteristics included in the analyses described here and did not detect any significant differences between the overall sample and the subsample who were not overweight as adolescents. All further analyses focused only on the individuals who were not overweight as adolescents in order to allow for identifying predictors of healthy weight maintenance during the transition to adulthood and were sex-stratified a priori based on existing evidence (Arabshahi et al., 2017; Morgan et al., 2012; Quick et al., 2013). Ethnic/racial backgrounds identified by the weighted sample of 1,120 participants were 50.2% white, 16.9% African American, 19.8% Asian, 5.2% Hispanic, 2.7% Native American, and 5.2% mixed or other ethnicity/race.

Predictors of healthy weight maintenance from adolescence to young adulthood (defined by a non-overweight BMI at Time 1, Time 3, and Time 4) were identified using sex-stratified logistic regression models that included each of the personal, behavioral, and environmental factors and controlled for Time 1 BMI, age, ethnicity/race, and parental socioeconomic status. For each factor of interest, two separate logistic regressions were fit: one including only the Time 1 value for the factor and the other including both the Time 1 value and change over time (Time 4 – Time 1) in the value of the factor. Odds ratios from models including only the Time 1 value for a factor represent the overall increased prospective odds of maintaining a healthy weight associated with a one standard deviation difference in the Time 1 factor, regardless of how the factor changed over time. For the models that additionally included change in the factor over time, the odds ratio for change represents the increased odds of maintaining a healthy weight associated with a one standard deviation change in the factor when comparing individuals who were identical on the factors at Time 1. Table 2 reports the odds ratio from the first model corresponding to the Time 1 value of the factor and the odds ratio from the second model corresponding to the change in the value of the factor (where the Time 1 value is controlled).

Among the subsample of 400 women and 295 men that were not overweight at Time 1 nor Time 3, predictors of healthy weight maintenance in early adulthood were similarly identified using sex-stratified logistic regression models that included each of the personal, behavioral, and environmental factors and controlled for Time1 BMI, age, ethnicity/race, and parental socioeconomic status. For each factor of interest, two separate regressions were fit: one including only the Time 3 value for the factor and the other including both the Time 3 value and 5-year change (Time 4 – Time 3) in the value of the factor. Table 3 reports the odds ratio from the first model corresponding to the Time 3 value and the odds ratio from the second model corresponding to the 5-year change in the factor value (where the Time 3 value is controlled).

To potentially identify independent effects of any one factor, additional models were fit (see Additional Files 1-2) including all personal, behavioral, physical, and social environmental factors simultaneously with the exception of three variables for which missingness was greater than 15%. As described above, for each set of models used to identify predictors of weight maintenance during the transition from adolescence to adulthood and during early adulthood, one model was fit that included all potential Time 1 (or Time 3) predictors and a

second model was fit that also included the respective change over time. The concordance statistic (C-index) summarizing overall predictability of the models was calculated.

RESULTS

Factors Associated with Healthy Weight Maintenance from Adolescence to Adulthood

Factors of relevance for women and men.—Among the 1,120 young people who were not overweight in adolescence, several factors were associated with the odds of being at a healthy weight in adulthood (Table 2). Maintaining high body satisfaction or increasing satisfaction was identified as protective whereas initiating at least one unhealthy or extreme weight control behavior, starting to diet at least one time per year, the onset of binge eating behavior, higher exposure to parental dieting as an adolescent, and experiencing an increase over time in exposure to the dieting behavior of a friend or significant other were associated with lower odds of maintaining a healthy weight for both women and men. Standardized odds ratios indicated that measures of body satisfaction and weight control behaviors were among the strongest predictors. For example, the odds ratio of maintaining a healthy weight in women is 0.67 (CI: 0.54, 0.84) (indicating decreased odds of maintenance) for a one standard deviation increase in the probability of using an extreme weight control behavior from adolescence to adulthood and 0.34 (CI: 0.12, 0.96) among men.

Factors of sex-specific relevance.—The models of maintaining healthy weight status over the transition from adolescence to adulthood also identified factors that were associated with odds of being at a healthy weight among only women (e.g., outcome expectations associated with adolescent food choices) or among only men (e.g., increasing the frequency of breakfast eating during the transition to adulthood). A one standard deviation increase in the health risk behavior score in adolescence, was also related to a decreased odds of maintaining a healthy weight with an odds ratio of 0.74 (CI: 0.6, 0.91) among women.

Overall contribution to factors to explaining healthy weight maintenance.—Models including all of the factors examined here were found to have strong predictive ability to identify the non-overweight adolescents who were also at a healthy weight in adulthood (Additional File 1). Models including change in all factors over time along with measures of all factors in adolescence had C-index values of 0.93 for women and 0.88 for men.

Factors Associated with Healthy Weight Maintenance in Young Adulthood

Factors of relevance for women and men.—Among the 695 young people who were not overweight in adolescence or early adulthood (Time 1 or Time 3), the results further identified several factors associated with higher odds of being at a healthy weight in adulthood (Table 3). Having and maintaining high body satisfaction over time was identified as protective whereas initiating at least one unhealthy weight control behavior, starting to diet at least one time per year, higher exposure to the dieting behavior of a friend or significant other as an early adult, and experiencing an increase over time in exposure to the dieting behavior of a friend or significant other were associated with lower odds of healthy weight maintenance for both women and men.

Factors of sex-specific relevance.—The models of maintaining healthy weight status in adulthood also identified factors that were associated with odds of being at a healthy weight among only women (e.g., residing a shorter distance from a gym/fitness facility in early adulthood) or among only men (e.g., experiencing an increase in exposure to coworkers that care about healthy eating and activity). A one standard deviation increase in the health risk behavior score, was also related to a decreased odds of maintenance (OR: 0.67, CI: 0.51, 0.89) among women. It is further notable that an increase in financial strain was associated with lower odds of maintaining a healthy weight in adulthood among women versus a higher odds of maintaining a healthy weight among men.

Overall contribution to factors to explaining healthy weight maintenance.—Models including all of the factors examined here were found to have strong predictive ability to identify the non-overweight early adults who maintained a healthy weight in adulthood (Additional File 2). Models including change in all factors over time along with measures of all factors in early adulthood had C-index values of 0.94 for women and 0.86 for men.

DISCUSSION

The results of this study linking body dissatisfaction, binge eating, and use of unhealthy weight control behaviors to weight gain build on prior studies among the Project EAT cohort and other samples of young people (Arabshahi et al., 2017; Haines et al., 2010; Haines et al., 2007; Loth et al., 2015; Morgan et al., 2012; Neumark-Sztainer et al., 2012; Tanofsky-Kraff et al., 2006). Although it is possible the observed associations could in part reflect reverse causation, the results align with evidence from prior studies that, in general, lower body satisfaction does not serve as a motivator for engaging in healthy weight-related behaviors (Neumark-Sztainer et al., 2004; Neumark-Sztainer et al., 2006a). Young people might engage in unhealthy weight control behaviors in response to becoming overweight, but research also more broadly suggests that young people who do not feel good about their bodies are less likely to engage in behaviors that help them to manage their weight and maintain good overall health (Neumark-Sztainer et al., 2004; Neumark-Sztainer et al., 2006a). Dieting and the use of unhealthy weight control behaviors may further promote cycles of short-term weight loss followed by gaining back more weight than was previously lost (Dulloo et al., 2015; Dulloo and Montani, 2015). Results of the current study add to this evidence in examining weight-related behaviors over a period of more than 15 years and focusing on healthy weight maintenance irrespective of small shifts in BMI. The cognitions and behaviors that predict whether young people maintain their BMI within a healthy range as they navigate various life events of early adulthood (e.g., marriage, pregnancy) and regardless of small shifts in either direction over time are important to identify and address. Based on the results described here, strategies and messages designed to help young people maintain a healthy weight should promote recognition of unrealistic ideals for body shape and size, encourage self-acceptance of diverse body shapes, and discourage restrictive weight control behaviors.

Findings of the current study also extend previous research regarding the relevance of parental practices and more broadly social environments for weight-related health. Several

studies have linked the weight-related behaviors of young people to parental practices and the results described here are in alignment with existing evidence that the behaviors parents model are more consistently associated with child outcomes than parental attempts to encourage healthy eating or physical activity (Bauer et al., 2011; Vaughn et al., 2016; Yee et al., 2017). Further, there is a growing literature that similarly suggests young people are more likely to eat healthy foods, engage in physical activity, and avoid unhealthy weight control behaviors when peers and significant others support and model these behaviors (Berge et al., 2012; Berge et al., 2015; Bruening et al., 2012; Sirard et al., 2013). However, few existing studies have demonstrated these various forms of social support may be related to healthy weight maintenance across such an extended period of the life course. The results described here uniquely build on what is known on the relevance of coworkers' attitudes and behaviors based on mostly cross-sectional research designs (Lemon et al., 2009; Tabak et al., 2015; Tamers et al., 2015; Watts et al., 2016; Winston et al., 2015). In particular, we were unable to identify other population-based, longitudinal research addressing linkages between coworker support for healthy lifestyle behaviors and weight-related outcomes of young adults.

A number of strengths and limitations are important to note in drawing conclusions. Strengths included the large and population-based sample, prospective design, and multi-contextual assessment. Limitations included attrition and the reliance on self-report of height, weight, and other characteristics. Sampling weights were used to correct for attrition; however, it is possible that some bias remained after accounting for the finding that young people who completed the baseline and follow-up surveys were more likely to identify as female, white, and having higher educational attainment. In order to minimize respondent burden, not all potentially relevant attitudes could be assessed and many of the self-report measures were brief with some having poor test-retest reliability; accordingly, measurement error may have weakened our ability to detect associations. There is also a risk that reverse causation could explain some of the results observed because of the time gaps between surveys.

In summary, the results of this study strengthened the evidence base available to inform strategies for the primary prevention of excess weight gain. Results emphasized the particular relevance of efforts to help young people maintain a positive body image, raise awareness regarding the potential harms of restrictive weight control behaviors, and shift social norms to provide stronger support for engaging in healthy eating and physical activity. Further, the results suggest it will be important for health promotion guidelines and interventions to address multiple contexts (home/family, peer/partner, work) in order to most effectively help young people maintain a healthy weight. Future studies should evaluate the impact of interventions designed to support young people at a healthy weight in maintaining a positive body image and avoiding restrictive weight control behaviors. Observational studies could additionally build on the current results in combination with the existing literature by examining how predictive factors may interact and vary according to demographic factors, identifying mechanisms that underlie sex differences, utilizing objective measures to identify other potentially influential neighborhood factors, and carrying out more in-depth exploration of how young adults' significant others, friends, and coworkers can best support them in making healthy eating choices and being physically

activity (Lippert, 2016). Although our findings regarding a sex difference in the association between financial strain and weight status aligns with national surveillance data and prior research, there remains a need for additional research to further investigate potential underlying reasons that have been proposed (e.g., social norms for women) (Hernandez and Pressler, 2014; Hruschka, 2012; Ogden et al., 2017). More qualitative research in regards to social support may be particularly useful to guide the development of future peer-led interventions and improve understanding of how various forms of social support may interact with the role of other contextual factors. Likewise, additional qualitative studies could be useful to build on what is known regarding the relevance of parenting practices for adolescents' weight-related behavior (Bauer et al., 2011; Vaughn et al., 2016; Yee et al., 2017) and identify potential strategies that parents can use as their sons and daughters transition to adulthood.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

ACKNOWLEDGEMENTS

This study was supported by Grant Number R01HL116892 (PI: *Blinded for peer review*) from the National Heart, Lung, and Blood Institute. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Heart, Lung, and Blood Institute or the National Institutes of Health.

References

- Adane A, Tooth L, Mishra G, 2017 Pre-pregnancy weight change and incidence of gestational diabetes mellitus: A finding from a prospective cohort study. *Diabetes Res Clin Pract* 124, 72–80. [PubMed: 28110238]
- Annesi J, Marengo N, 2017 Psychosocial changes as correlates of weight regain vs. continued loss within 2-year trials of a self-regulation-focused community-based intervention. *Clin Obes* 7, 22–33. [PubMed: 28079977]
- Arabshahi S, Lahmann P, Hughes M, Williams G, van der Pols JC, 2017 Dietary behaviours, weight loss attempts and change in waist circumference: 15-year longitudinal study in Australian adults. *Asia Pac J Clin Nutr* 26, 657–664. [PubMed: 28582816]
- Attard S, Herring A, Howard A, Gordon-Larsen P, 2013 Longitudinal trajectories of BMI and cardiovascular disease risk: the national longitudinal study of adolescent health. *Obesity* 11, 2180–2188.
- Bandura A, 1986 *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall, Englewood Cliffs, NJ.
- Barlow S, the Expert Committee, 2007 Expert Committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: Summary report. *Pediatrics* 120, S164–192. [PubMed: 18055651]
- Bauer K, Berge J, Neumark-Sztainer D, 2011 The importance of families to adolescents' physical activity and dietary intake. *Adolesc Med State Art Rev* 22, 601–613. [PubMed: 22423466]
- Berge J, MacLehose R, Eisenberg M, Laska M, Neumark-Sztainer D, 2012 How significant is the 'significant other'? Associations between significant others' health behaviors and attitudes and young adults' health outcomes. *Int J Behav Nutr Phys Act* 9, 35. [PubMed: 22469471]
- Berge J, MacLehose R, Loth K, Eisenberg M, Fulkerson J, Neumark-Sztainer D, 2015 Parent-adolescent conversations about eating, physical activity and weight: prevalence across sociodemographic characteristics and associations with adolescent weight and weight-related behaviors. *J. Behav. Med* 38, 122–135. [PubMed: 24997555]

- Birnbaum A, Lytle L, Murray D, Story M, Perry C, Boutelle K, 2002 Survey development for assessing correlates of young adolescents' eating. *Am J Health Behav* 26, 284–295. [PubMed: 12081361]
- Bruening M, Eisenberg M, MacLehose R, Nannery M, Story M, Neumark-Sztainer D, 2012 Relationship between adolescents' and their friends' eating behaviors: breakfast, fruit, vegetable, whole-grain, and dairy intake. *J Acad Nutr Diet* 112, 1608–1613. [PubMed: 23017570]
- Brug J, van Lenthe FJ, Kremers S, 2006 Revisiting Kurt Lewin: How to gain insight into environmental correlates of obesogenic behaviors. *Am J Prev Med* 31, 525–529. [PubMed: 17169715]
- Buscemi S, Chiarello P, Buscemi C, Corleo D, Massenti M, Barile A, Rosafio G, Maniaci V, Settapani V, Cosentino L, Giordano C, 2017 Characterization of metabolically healthy obese people and metabolically unhealthy normal-weight people in a general population cohort of the ABCD study. *J Diabetes Res* 9294038.
- Cheng H, Medlow S, Steinbeck K, 2016 The health consequences of obesity in young adulthood. *Curr Obes Rep* 5, 30–37. [PubMed: 26830309]
- Cusatis D, Shannon B, 1996 Influences on adolescent eating behavior. *J Adolesc Health* 18, 27–34. [PubMed: 8750425]
- Dulloo A, Jacquet J, Montani J, Schutz Y, 2015 How dieting makes the lean fatter: from a perspective of body composition autoregulation through adipostats and proteinstats awaiting discovery. *Obes Rev* 16, 25–35. [PubMed: 25614201]
- Dulloo A, Montani J, 2015 Pathways from dieting to weight regain, to obesity and to the metabolic syndrome: an overview. *Obes Rev* 16, 1–6.
- Feskanich D, Rimm E, Giovannucci E, Colditz G, Stampfer M, Litin L, Willett W, 1993 Reproducibility and validity of food intake measurements from a semiquantitative food frequency questionnaire. *J Am Diet Assoc* 93, 790–796. [PubMed: 8320406]
- Godin G, Shephard R, 1985 A simple method to assess exercise behavior in the community. *Can. J. Appl. Sport Sci* 10, 141–146. [PubMed: 4053261]
- Goldschmidt A, Wall M, Choo T, Evans E, Jelalian E, Larson N, Neumark-Sztainer D, 2018 Fifteen-year weight and disordered eating patterns among community-based adolescents. *Am J Prev Med* 54, e21–e29. [PubMed: 29132950]
- Gordon-Larsen P, The N, Adair L, 2010 Longitudinal trends in obesity in the United States from adolescence to the third decade of life. *Obesity* 18, 1801–1804. [PubMed: 20035278]
- Haines J, Kleinman K, Rifas-Shiman S, Field A, Austin S, 2010 Examination of shared risk and protective factors for overweight and disordered eating among adolescents. *Arch Pediatr Adolesc Med* 164, 336–343. [PubMed: 20368486]
- Haines J, Neumark-Sztainer D, Wall M, Story M, 2007 Personal, behavioral, and socioenvironmental risk and protective factors for adolescent overweight. *Obesity* 15, 2748–2760. [PubMed: 18070766]
- Harris J, French S, Jeffery R, McGovern P, Wing R, 1994 Dietary and physical activity correlates of long-term weight loss. *Obes Res* 2, 307–313. [PubMed: 16358394]
- Hernandez D, Pressler E, 2014 Accumulation of childhood poverty on young adult overweight or obese status; race/ethnicity and gender disparities. *J Epidemiol Community Health* 68, 478–484. [PubMed: 24391207]
- Himes JH, Hannan P, Wall M, Neumark-Sztainer D, 2005 Factors associated with errors in self-reports of stature, weight, and body mass index in Minnesota adolescents. *Ann Epidemiol* 15, 272–278. [PubMed: 15780774]
- Hruschka D, 2012 Do economic constraints on food choice make people fat? A critical review of two hypotheses for the poverty-obesity paradox. *Am J Hum Biol* 24, 277–285. [PubMed: 22345082]
- Huang T, Glass T, 2008 Transforming research strategies for understanding and preventing obesity. *JAMA* 300, 1811–1813. [PubMed: 18854544]
- Jensen M, Ryan D, Apovian C, et al., American College of Cardiology/American Heart Association Task Force on Practice Guidelines, Obesity Society, 2014 2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: a report of the American College of Cardiology/

American Heart Association Task Force on Practice Guidelines and The Obesity Society. *Circulation* 129, S102–S138. [PubMed: 24222017]

- Kandel D, Davies M, 1982 Epidemiology of depressive mood in adolescents. *Arch. Gen. Psychiatry* 39, 1205–1212. [PubMed: 7125850]
- Kelder S, Hoelscher D, Perry C, 2015 How individuals, environments, and health behaviors interact, in: Glanz K, Rimer B, Viswanath K (Eds.), *Health behavior: theory, research, and practice*, 5th ed. Jossey-Bass Public Health, San Francisco, CA, pp. 159–182.
- Kimokoti R, Newby P, Gona P, Zhu L, McKeon-O'Malley C, Pablo Guzman J, D'Agostino R, Millen B, 2013 Patterns of weight change and progression to overweight and obesity differ in men and women: implications for research and interventions. *Public Health Nutr* 16, 1463–1475. [PubMed: 22939318]
- Kraschnewski J, Boan J, Esposito J, Sherwood N, Lehman E, Kephart D, Sciamanna C, 2010 Long-term weight loss maintenance in the United States. *Int J Obes* 34, 1644–1654.
- Kruger J, Blanck H, Gillespie C, 2008 Dietary practices, dining out behavior, and physical activity correlates of weight loss maintenance. *Prev Chronic Dis* 5.
- Kuczmarski R, Ogden C, Grummer-Strawn L, Flegal K, Guo S, Wei R, Mei Z, Curtin L, Roche A, Johnson C, 2000 CDC growth charts: United States. *Adv Data* 314, 1–27.
- Larson N, Neumark-Sztainer D, Harwood E, Eisenberg M, Wall M, Hannan P, 2011a Do young adults participate in surveys that 'go green'? Response rates to a web and mailed survey of weight-related health behaviors. *Int J Child Health Hum Dev* 4, 225–237. [PubMed: 23173062]
- Larson N, Neumark-Sztainer D, Story M, van den Berg P, Hannan P, 2011b Identifying correlates of young adults' weight behavior: survey development. *Am J Health Behav* 35, 712–725. [PubMed: 22251762]
- Laska M, Pelletier J, Larson N, Story M, 2012 Interventions for weight gain prevention during the transition to young adulthood: a review of the literature. *J Adolesc Health* 50, 324–333. [PubMed: 22443834]
- Lemon S, Zapka J, Li W, Estabrook B, Magner R, Rosal M, 2009 Perceptions of worksite support and employee obesity, activity, and diet. *Am J Health Behav* 33, 299–308. [PubMed: 19063651]
- Lippert A, 2016 Stuck in unhealthy places: how entering, exiting, and remaining in poor and nonpoor neighborhoods is associated with obesity during the transition to adulthood. *J. Health Soc. Behav* 57, 1–21. [PubMed: 26957132]
- Little R, 1986 Survey nonresponse adjustments for estimates of means. *Int Stat Rev* 54, 139–157.
- Lloyd-Jones D, Liu K, Colangelo L, Yan L, Klein L, Loria C, Lewis C, Savage P, 2007 Consistently stable or decreased body mass index in young adulthood and longitudinal changes in metabolic syndrome components: the Coronary Artery Risk Development in Young Adults Study. *Circulation* 115, 1004–1011. [PubMed: 17283263]
- Loth K, Watts A, van den Berg P, Neumark-Sztainer D, 2015 Does body satisfaction help or harm overweight teens? A 10-year longitudinal study of the relationship between body satisfaction and body mass index. *J Adolesc Health* 57, 559–561. [PubMed: 26385064]
- Morgan A, Keiley M, Ryan A, Radomski J, Gropper S, Connell L, Simmons K, Ulrich P, 2012 Eating regulation styles, appearance schemas, and body satisfaction predict changes in body fat for emerging adults. *J Youth Adolesc* 41, 1127–1141. [PubMed: 22447394]
- Motl RW, Dishman RK, Trost SG, Saunders RP, Dowda M, Felton G, Ward DS, Pate RR, 2000 Factorial validity and invariance of questionnaires measuring socialcognitive determinants of physical activity among adolescent girls. *Prev Med* 31, 584–594. [PubMed: 11071840]
- National Institutes of Health, 1998 Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults--the evidence report [published correction appears in *Obes Res*. 1998;6(6):464]. *Obes Res* 6, 51S–209S. [PubMed: 9813653]
- National Institutes of Health, 2015 NIH-wide strategic plan, fiscal years 2016–2020: turning discovery into health. National Institutes of Health, U.S. Department of Health and Human Services.
- National Institutes of Health Obesity Research Task Force, 2011 Strategic plan for NIH obesity research. National Institutes of Health, U.S. Department of Health and Human Services.

- Neumark-Sztainer D, Croll J, Story M, Hannan PJ, French SA, Perry C, 2002a Ethnic/racial differences in weight-related concerns and behaviors among adolescent girls and boys: findings from Project EAT. *J Psychosom Res* 53, 963–974. [PubMed: 12445586]
- Neumark-Sztainer D, Goeden C, Story M, Wall M, 2004 Associations between body satisfaction and physical activity in adolescents: Implications for programs aimed at preventing a broad spectrum of weight-related disorders. *Eating Disorders* 12, 125–137. [PubMed: 16864312]
- Neumark-Sztainer D, Paxton S, Hannan P, Haines J, Story M, 2006a Does body satisfaction matter? Five-year longitudinal associations between body satisfaction and health behaviors in adolescent females and males. *J Adolesc Health* 39, 244–251. [PubMed: 16857537]
- Neumark-Sztainer D, Story M, Hannan P, Moe J, 2002b Overweight status and eating patterns among adolescents: Where do youth stand in comparison to the Healthy People 2010 Objectives? *Am J Pub Health* 92, 844–851. [PubMed: 11988458]
- Neumark-Sztainer D, Wall M, Guo J, Story M, Haines J, Eisenberg M, 2006b Obesity, disordered eating, and eating disorders in a longitudinal study of adolescents: how do dieters fare 5 years later? *J Am Diet Assoc* 106, 559–568. [PubMed: 16567152]
- Neumark-Sztainer D, Wall M, Haines J, Story M, Sherwood N, van den Berg PA, 2007 Shared risk and protective factors for overweight and disordered eating in adolescents. *Am J Prev Med* 33, 359–369. [PubMed: 17950400]
- Neumark-Sztainer D, Wall M, Larson N, Eisenberg M, Loth K, 2011 Dieting and disordered eating behaviors from adolescence to young adulthood: Findings from a 10-year longitudinal study. *J Am Diet Assoc* 111, 1004–1011. [PubMed: 21703378]
- Neumark-Sztainer D, Wall M, Story M, Standish A, 2012 Dieting and unhealthy weight control behaviors during adolescence: associations with 10-year changes in body mass index. *J Adolesc Health* 50, 80–86. [PubMed: 22188838]
- Nikolaou C, Hankey C, Lean M, 2015 Weight changes in young adults: a mixed-methods study. *Int J Obes* 39, 508–513.
- Nodine P, Hastings-Tolsma M, 2012 Maternal obesity: improving pregnancy outcomes. *Am J Matern Child Nurs* 37, 110–115.
- Ogden C, Fakhouri T, Carroll M, Hales C, Fryar C, Li X, Freedman D, 2017 Prevalence of obesity among adults, by household income and education - United States, 2011–2014. *Morb Mortal Wkly Rep* 66, 1369–1373.
- Pasch K, Laska M, Lytle L, Moe S, 2010 Adolescent sleep, risk behaviors, and depressive symptoms: are they linked? *Am J Health Behav* 34, 237–248. [PubMed: 19814603]
- Pingitore R, Spring B, Garfield D, 1997 Gender differences in body satisfaction. *Obesity Res* 5, 402–409.
- Quick V, Wall M, Larson N, Haines J, Neumark-Sztainer D, 2013 Personal, behavioral and socio-environmental predictors of overweight incidence in young adults: 10-yr longitudinal findings. *Int J Behav Nutr Phys Act* 10, 37. [PubMed: 23531253]
- Rimm E, Giovannucci E, Stampfer M, Colditz G, Litin L, Willett W, 1992 Reproducibility and validity of an expanded self-administered semiquantitative food frequency questionnaire among male health professionals. *Am J Epidemiol* 135, 1114–1126; discussion 1127–1136. [PubMed: 1632423]
- Rockett H, Breitenbach M, Frazier A, Witschi J, Wolf A, Field A, Colditz G, 1997 Validation of a youth/adolescent food frequency questionnaire. *Prev Med* 26, 808–816. [PubMed: 9388792]
- Rockett H, Wolf A, Colditz G, 1995 Development and reproducibility of a food frequency questionnaire to assess diets of older children and adolescents. *J Am Diet Assoc* 95, 336–340. [PubMed: 7860946]
- Sallis J, Owen N, 2015 Ecological models of health behavior, in: Kelder S, Hoelscher D, Perry C (Eds.), *Health behavior theory, research, and practice*. Jossey-Bass Public Health, San Francisco, CA, pp. 43–64.
- Sallis J, Story M, Lou D, 2009 Study designs and analytic strategies for environmental and policy research on obesity, physical activity, and diet: recommendations from a meeting of experts. *Am J Prev Med* 36, S72–S77. [PubMed: 19147064]

- Sallis JF, Buono MJ, Roby JJ, Micalo FG, Nelson JA, 1993 Seven-day recall and other physical activity self-reports in children and adolescents. *Med Sci Sports Exerc* 25, 99–108. [PubMed: 8423762]
- Sirard J, Bruening M, Wall M, Eisenberg M, Kim S, Neumark-Sztainer D, 2013 Physical activity and screen time in adolescents and their friends. *Am J Prev Med* 44, 48–55. [PubMed: 23253649]
- Sirard J, Hannan P, Cutler G, Neumark-Sztainer D, 2013 Evaluation of 2 self-report measures of physical activity with accelerometry in young adults. *J Phys Act Health* 10, 85–96. [PubMed: 22241145]
- Story M, Kaphingst K, Robinson-O'Brien R, Glanz K, 2008 Creating healthy food and eating environments: policy and environmental approaches. *Annu Rev Public Health* 29, 253–272. [PubMed: 18031223]
- Tabak R, Hipp J, Marx C, Brownson R, 2015 Workplace social and organizational environments and healthy-weight behaviors. *PLoS One* 10, e0125424. [PubMed: 25919659]
- Tamers S, Thompson B, Cheadle A, Zheng Y, Bishop S, Beresford S, 2015 Promoting changes in obesogenic behaviors: does coworker social support play a role? *Am J Health Promot* 29, 311–313. [PubMed: 24670072]
- Tanofsky-Kraff M, Cohen M, Yanovski S, Cox C, Theim K, Keil M, Reynolds J, Yanovski J, 2006 A prospective study of psychological predictors of body fat gain among children at high risk for adult obesity. *Pediatrics* 117, 1203–1209. [PubMed: 16585316]
- Truesdale K, Stevens J, Lewis C, Schreiner P, Loria C, Cai J, 2006 Changes in risk factors for cardiovascular disease by baseline weight status in young adults who maintain or gain weight over 15 years: the CARDIA study. *Int J Obes* 30, 1397–1407.
- Turk M, Sereika S, Yang K, Ewing L, Hravnak M, Burke L, 2012 Psychosocial correlates of weight maintenance among black & white adults. *Am J Health Behav* 36, 395–407. [PubMed: 22370440]
- Vaughn A, Ward D, Fisher J, Faith M, Hughes S, Kremers S, Musher-Eizenman D, O'Connor T, Patrick H, Power T, 2016 Fundamental constructs in food parenting practices: a content map to guide future research. *Nutr Rev* 74, 98–117. [PubMed: 26724487]
- Watts A, Laska M, Larson N, Neumark-Sztainer D, 2016 Millennials at work: workplace environments of young adults and associations with weight-related health. *J Epidemiol Community Health* 70, 65–71. [PubMed: 26265679]
- Weiss E, Galuska D, Kettel Khan L, Gillespie C, Serdula M, 2007 Weight regain in US adults who experienced substantial weight loss, 1999–2002. *Am J Prev Med* 33, 34–40. [PubMed: 17572309]
- Wing R, Hill J, 2001 Successful weight loss maintenance. *Annu Rev Nutr* 21, 323–341. [PubMed: 11375440]
- Wing R, Phelan S, 2005 Long-term weight loss maintenance. *Am J Clin Nutr* 82, 222S–225S. [PubMed: 16002825]
- Winpenny E, Penney T, Corder K, White M, van Sluijs EMF, 2017 Change in diet in the period from adolescence to early adulthood: a systematic scoping review of longitudinal studies. *Int J Behav Nutr Phys Act* 14, 60. [PubMed: 28472992]
- Winston G, Phillips E, Wethington E, Devine C, Wells M, Peterson J, Hippolyte J, Ramos R, Martinez G, Eldridge J, Charlson M, 2015 Social network characteristics associated with weight loss among black and hispanic adults. *Obesity* 23, 1570–1576. [PubMed: 26179578]
- Yee A, Lwin M, Ho S, 2017 The influence of parental practices on child promotive and preventive food consumption behaviors: a systematic review and meta-analysis. *Int J Behav Nutr Phys Act* 14, 47. [PubMed: 28399881]

Figure 1.

Theoretical framework for identifying personal, behavioral, and environmental influences on healthy weight maintenance from adolescence to adulthood*

*Data was available to examine the relevance of a predictive factor as assessed at Time 1 in adolescence (T1), Time 3 in early adulthood (T3), or both life stages. Associations of change over time in predictive factors from T1 or T3 to Time 4 in adulthood (T4) with the likelihood of healthy weight maintenance to T4 were also examined when possible. Factors included in the framework were selected based on alignment with constructs of social cognitive theory (personal factors, behavioral factors) and a broader ecological framework (physical and social environmental factors); however, not all major constructs of these models could be represented by the Project EAT data. The double-sided arrows within the figure are intended to reflect reciprocal determinism and the dynamic interactions between individuals (personal factors), their behaviors, and their environments.

Table 1

Description of personal, behavioral, and environmental measures

	Assessment time point	Survey items or description ^a
Personal Factors		
Committed relationship status	3, 4	<i>What is your relationship status?</i> A value of 1 was coded if respondents indicated they had a domestic partner, were married, or in a committed dating relationship or engage and other responses were coded as 0. Test-retest agreement=99%.
Parental status	3, 4	<i>How many children do you have (including step-children or adopted children)?</i> The number of children was coded. Test-retest $r=0.98$
Educational attainment	3, 4	<i>What is the highest level of education that you have completed?</i> Response ranging from middle school or junior high (coded 1) to a graduate or professional degree (coded 7). Test-retest agreement=97%
Financial strain	3, 4	<i>How difficult is it for you to live on your total household income right now?</i> Responses ranging from <i>not at all difficult</i> (coded 1) to <i>extremely difficult or impossible</i> (coded 4). Test-retest $r=0.83$.
Depressive symptoms	1, 3–4	Six-item scale assessing depressive mood (e.g., <i>During the past 12 months, how often have you been bothered or troubled by feeling too tired to do things?</i>) (Kandel and Davies: 1982). The three response categories were <i>not at all</i> (coded 1), <i>somewhat</i> (coded 2), and <i>very much</i> (coded 3). Items were summed such that higher values indicated poorer mood. Cronbach's $\alpha=0.85$, test-retest $r=0.77$.
Body satisfaction	1, 3–4	Body satisfaction scale, including 10 items assessing satisfaction with different body part; (height, weight, body shape, waist, hips, thighs, stomach, face, body build, shoulders) (Pingiore et al., 1997). Five response categories ranging from <i>very dissatisfied</i> (coded 1) to <i>very satisfied</i> (coded 5). Items were summed such that higher values indicated higher satisfaction. Cronbach's $\alpha=0.92$, range 10–50; test-retest $r=0.82$.
Self-efficacy for physical activity	3	Four statements adapted from the self-efficacy scale developed by Motl and colleagues (Motl et al., 2000). Participants were asked to indicate their agreement with each of four statements such as <i>I can be physically active during my free time on most days even if it is very hot or cold outside</i> . The four response options for each statement, ranging from <i>disagree a lot</i> (coded 1) to <i>agree a lot</i> (coded 4), were summed to form a scale with the range 4–16. Cronbach's $\alpha=0.80$; test-retest $r=0.74$.
Self-efficacy for healthy eating	1	Assessment was based on nine statements regarding how sure adolescents were they could eat healthy food in various situations (Cusatis and Shannon, 1996). Participants were asked to rate their confidence for each statement such as <i>If you wanted to, how sure are you that you could eat healthy foods when you are stressed out</i> . The five response options for each statement, ranging from <i>not at all sure</i> (coded 1) to <i>very sure</i> (coded 5), were summed to form a scale with the range 9–54. Cronbach's $\alpha=0.87$.
Outcome expectations for food choices	1	Participants were asked to indicate their agreement with each of five items regarding the extent to which dietary intake can affect health, appearance, and performance (e.g., <i>The types of food I eat affect my weight</i>) (Birbaum et al., 2002). The four response options for each statement, ranging from <i>strongly disagree</i> (coded 1) to <i>strongly agree</i> (coded 4), were summed to form a scale with the range 5–20. Cronbach's $\alpha=0.80$.
Concern for health	1	<i>How much do you care about... (1) eating healthy foods? and (2) being healthy?</i> Four responses ranging from <i>not at all</i> (coded 1) to <i>very much</i> (coded 4). <i>How strongly do you agree with the following statements?</i> Three statements (e.g., <i>Teenagers don't need to be concerned about their eating habits</i>). Four responses ranging from <i>strongly disagree</i> (coded 4) to <i>strongly agree</i> (coded 1). Items were summed such that higher values indicated greater concern for health. Time 1 Cronbach's $\alpha=0.69$; range 5–20.
Behavioral Factors		
Prepare food at home		<i>During the past month, how often have you prepared a meal that included vegetables?</i> Six response options ranging from <i>never</i> (coded 1) to <i>most days of the week</i> (coded 6). Test-retest $r=0.84$.
Eating behaviors		For each item on the adult food frequency questionnaire (FFQ), there was nine response categories ranging from <i>never, or less than once per month to 6+ per day</i> . Similar questions and response categories were included on the Time 1 youth FFQ. Validity

Assessment time point	Survey items or description ^a
	and reliability of FFQ measures have previously been reported (Feskanich et al., 1993; Rimm et al., 1992; Rockett et al., 1997; Rockett et al., 1995).
Fruit (servings/day)	1-4 Fruit intake (excluding juice) was estimated by summing 9 items reported on the Time 1 FFQ and reported consumption of 11 items on the FFQ completed at Times 3 and 4.
Vegetables (servings/day)	1-4 Vegetable intake (excluding potatoes) was estimated by summing 19 items reported on the Time 1 FFQ and reports for 26 items on the FFQ completed at Times 3 and 4.
Water (times/day)	3, 4 Estimated based on reported consumption of <i>water: bottled, sparkling, or tap (8 oz cup)</i> on the FFQ completed at Times 3 and 4.
Sugary drinks (servings/day)	1, 3, 4 Sugary drink intake was estimated by summing the reported consumption of carbonated beverages with sugar and fruit drinks on the Time 1 FFQ and reported consumption of carbonated beverages (with and without caffeine) and other sugared beverages (including fruit drinks, sports drinks, and ice teas) on the FFQ completed at Times 3 and 4.
Alcoholic drinks (drinks/day)	1, 3, 4 Estimated based on reported consumption of three items (beer; wine or wine coolers; liquor like vodka or rum) on the Time 1 FFQ and reported consumption of five items (regular beer; light beer; red wine; white wine; liquor) on the FFQ at Times 3 and 4.
Energy-dense snacks (servings/day)	Energy-dense snack (e.g., potato chips, cookies, ice cream) intake was estimated by summing the reported consumption of 21 items on the Time 1 FFQ and reported consumption of 13 items on the FFQ completed at Times 3 and 4.
Fast food (times/week)	1-4 <i>In the past week, how often did you eat something from a fast food restaurant (like McDonald's, Burger King, Hardee's etc)?</i> Six responses ranging from never (coded 0) to more than 7 times (coded 10). Test-retest $r=0.54$.
Breakfast (times/week)	1-4 <i>During the past week, how many days did you eat breakfast?</i> Five responses ranging from never (coded 0) to every day (coded 7). Test-retest $r=0.82$.
Weight control behaviors Unhealthy (any past year use)	1-4 <i>Have you done any of the following things in order to lose weight or keep from gaining weight during the past year?</i> Five yes/no response items (<i>fasted, ate very little food, used food substitute, skipped meals, smoked more cigarettes</i>). Scores were dichotomized to none or 1 method (coded 0 or 1). Test-retest agreement=85%.
Extreme (any past year use)	1-4 <i>Have you done any of the following things in order to lose weight or keep from gaining weight during the past year?</i> Four yes/no response items (e.g., <i>took diet pills, made myself vomit, used laxatives, used diuretics</i>). Scores were dichotomized to none or 1 method (coded 0 or 1). Test-retest agreement=96%.
Dieting (ever in past year)	1-4 <i>How often have you gone on a diet during the last year?</i> By "diet" we mean changing the way you eat so you can lose weight. Responses were dichotomized to represent nondieters (coded 0 if responded never) and dieters (coded 1 for responses ranging from 1-4 times to I am always dieting). Test-retest agreement=89%.
Healthy (any past year use)	1-4 <i>How often have you done each of the following things in order to lose weight or keep from gaining weight during the past year?</i> Behaviors assessed at Time 3 and Time 4 were: <i>exercise, ate more fruits and vegetables, ate less high-fat foods, ate less sweets, drank less soda pop (not including diet pop), and 6) watched my portion sizes (serving sizes)</i> . Responses were dichotomized and combined such that those reporting the use of one or more healthy behavior sometimes or on a regular basis were coded as using healthy weight control behaviors and those indicating never or rarely for each behavior were coded as nonusers. Test-retest agreement=96%. For Time 1, only yes/no response options were provided and only the behaviors <i>exercise, ate more fruits and vegetables, ate less high-fat foods, and ate less sweets</i> were listed.
Binge eating (ever in past year)	1, 3-4 <i>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)?</i> and <i>"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?"</i> Respondents who answered affirmatively to both of these questions were classified as engaging in binge eating (coded 1) and others as not having binged (coded 0). Test-retest agreement=94%.
Physical activity (hours/week)	1, 3, 4 Assessed using questions that were adapted from the widely used Godin Leisure-Time Exercise Questionnaire (Godin and Shephard, 1985; Sallis et al., 1993) by including developmentally appropriate examples of activities at each time point and asking about total hours versus the number of times they spent more than 15 minutes in activities. Survey items individually assessed hours of strenuous and moderate activity in a typical week. Response options were <i>none, less than % hour, % hour to 2 hours, 2 % to 4 hours, 4 % to 6 hours, and 6 or more hours</i> . Each response was assigned a midpoint value and responses were then summed to compute total weekly hours. Test-retest reliability for adapted tool $r=0.82$.

Survey items or description ^a			Assessment time point
Adequate sleep (% yes)	Participants were asked when they usually go to bed and get out of bed separately for weekdays and weekend days. Average weekday and weekend day sleep duration were calculated from the times provided. Overall average daily sleep duration was calculated as (weekday duration *5/7) + (weekend day duration*2/7). Getting adequate sleep (coded 0/1) was defined by sleeping for a daily average of 7–9 hours according to the <i>Healthy People 2020</i> objectives. Items were drawn from a previously validated questionnaire (Pasch et al., 2010). Test-retest agreement=79%	3, 4	
Physical Environment Factors			
Home healthy food availability	<i>How often are the following true?</i> Three statements (e.g., <i>Fruits and vegetables are available in my home</i>). Four responses ranging from <i>never to always</i> . Cronbach's $\alpha = 0.62$; range 3–12; test-retest $r = 0.84$.	1, 3, 4	
Home unhealthy food availability	<i>How often are the following true?</i> Three statements (e.g., <i>Potato chips or other salty snacks are available in my home</i>). Four responses ranging from <i>never to always</i> . Cronbach's $\alpha = 0.69$; range 3–12; test-retest $r = 0.77$.	1, 3, 4	
Distance to supermarket	Perceived walking distance to <i>supermarket/mid-size grocery store</i> . Responses ranging from <i>1–5 minutes</i> (coded 1) to <i>31+ minutes</i> (coded 5). Test-retest $r = 0.71$.	3	
Distance to convenience store	Perceived walking distance to <i>convenience/small grocery store</i> . Responses ranging from <i>1–5 minutes</i> (coded 1) to <i>31+ minutes</i> (coded 5). Test-retest $r = 0.72$.	3	
Distance to fast food restaurant	Perceived walking distance to <i>fast food restaurant</i> . Responses ranging from <i>1–5 minutes</i> (coded 1) to <i>31+ minutes</i> (coded 5). Test-retest $r = 0.76$.	3	
Distance to gym/fitness facility	Perceived walking distance to <i>gym or fitness facility</i> . Responses ranging from <i>1–5 minutes</i> (coded 1) to <i>31+ minutes</i> (coded 5). Test-retest $r = 0.70$.	3	
Distance to park/path	Perceived shortest walking distance to <i>park and walking or bike path</i> . Five responses ranging from <i>1–5 minutes</i> (coded 1) to <i>31+ minutes</i> (coded 5). Test-retest $r(\text{park}) = 0.67$, $r(\text{path}) = 0.60$.	3	
Perceived neighborhood safety	<i>Please choose the answer that best applies to you and the neighborhood where you lived for the majority of the past year. 1) The crime rate in my neighborhood makes it unsafe to go on walks during the day; 2) The crime rate in my neighborhood makes it unsafe to go on walks at night</i> . Cronbach's $\alpha = 0.77$; range=2–8; test-retest $r = 0.71$.	3	
Social Environment Factor			
Perceived parental overweight	<i>Which of the following best describes your biological mother's weight?</i> The same question was also used to assess father's weight. Five response options ranging from <i>very underweight to very overweight</i> were provided. Test-retest for mother $r = 0.83$ and for father $r = 0.83$. Coded 1 if the response for mother or father was <i>overweight</i> or <i>very overweight</i> .	1	
Household meal frequency	<i>During the past seven days, how many times did all, or most, of your family living in your house eat a meal together?</i> Six responses ranging from <i>never</i> (coded 1) to <i>more than 7 times</i> (coded 6). Participants were asked specifically about family members eating together when they were an adolescent and about household members eating together when they were an adult. Test-retest $r = 0.64$.	1, 3, 4	
Parent dieting	<i>My mother diets to lose weight or keep from gaining weight</i> . The same question was used to assess paternal dieting. Four responses ranging from <i>not at all</i> (coded 1) to <i>very much</i> (coded 4) for each item. An average value was assigned to represent responses for mother (test-retest $r = 0.61$) and father (test-retest $r = 0.60$) in cases when the adolescent responded about two parents.	1	
Parent support for healthy eating and physical activity	<i>My mother cares about eating healthy food. My mother encourages me to eat healthy food</i> . The same two questions were used to assess paternal support. Four responses ranging from <i>not at all</i> (coded 1) to <i>very much</i> (coded 4) for each item. Responses to the two questions were summed after an average value was assigned to represent responses for mother and father in cases when the adolescent responded about two parents. Cronbach's $\alpha = 0.73$; range=2–8; Item test-retest $r = 0.60$ – 0.70 .	1	
Parent support for and physical activity	<i>My mother cares about staying fit and exercising. My mother encourages me to be physically active</i> . The same two questions were used to assess paternal support. Four responses ranging from <i>not at all</i> (coded 1) to <i>very much</i> (coded 4) for each item. Responses to the two questions were summed after an average value was assigned to represent responses for mother and father in cases when the adolescent responded about two parents. Cronbach's $\alpha = 0.76$; range=2–8; Item test-retest $r = 0.66$ – 0.70 .	1	

Assessment time point		Survey items or description ^a
Significant other or peer dieting	1, 3–4	<i>Many of my friends diet to lose weight or keep from gaining weight. My significant other diets to lose weight or keep from gaining weight</i> (test-retest $r=0.74$). <i>My significant other encourages me to diet to control my weight</i> (test-retest $r=0.74$). Responses ranging from <i>not at all</i> (coded 1) to <i>very much</i> (coded 4).
Significant other or peer support for healthy eating	1, 3–4	<i>Many of my friends care about eating healthy food</i> (test-retest $r=0.58$). <i>My significant other cares about eating healthy food</i> (test-retest $r=0.77$). Responses ranging from <i>not at all</i> (coded 1) to <i>very much</i> (coded 4) were averaged at time points when the participant responded to multiple questions.
Significant other or peer support for physical activity	1, 3–4	<i>Many of my friends care about staying fit and exercising</i> (test-retest $r=0.50$). Four responses ranging from <i>not at all</i> (coded 1) to <i>very much</i> (coded 4). <i>How strongly do you agree with the following statements? Three statements (e.g., My significant other and I like to do active things together.)</i> . Four responses ranging from <i>strongly disagree</i> (coded 1) to <i>strongly agree</i> (coded 4). Cronbach's $\alpha=0.82$, range=2–8; test-retest $r=0.86$.
Coworkers care about healthy eating and activity	3, 4	<i>Many of my coworkers care about eating healthy food. Many of my coworkers think it is important to be physically active.</i> Four responses ranging from <i>strongly disagree</i> (coded 1) to <i>strongly agree</i> (coded 4). Responses were summed such that higher scores represent greater concern for healthy weight-related behavior (range=2–8). Test-retest r (food)=0.65, test-retest r (active)=0.69.

^aFor most measures, scale psychometric properties were examined in the full Time 4 sample and estimates of item test-retest reliability were determined in a subgroup of 103 participants who completed the Time 4 survey twice within a period of one to four weeks. Psychometric properties were also examined at Time 1 ($n=161$ adolescents) and Time 3 ($n=66$ young adults) in separate samples of young people, and these data are provided when Time 4 psychometrics were not available.

Table 2

Associations of personal, behavioral, and environmental factors with maintaining a healthy weight status from adolescence to adulthood among women (n=602) and men (n=518) recruited in Minneapolis-St. Paul, MN.^{a,b,c}

	Women		Men	
	Factor in adolescence OR (95% CI) ^d	Change in factor from adolescence to adulthood OR (95% CI) ^d	Factor in adolescence OR (95% CI) ^d	Change in factor from adolescence to adulthood OR (95% CI) ^d
Personal Factors				
Concern for health	1.16 (0.94, 1.42)	N/A	0.86 (0.71, 1.03)	N/A
Self-efficacy for healthy eating	1.13 (0.92, 1.39)	N/A	1.01 (0.83, 1.22)	N/A
Outcome expectations for food choices	1.38 (1.12, 1.71)	N/A	0.99 (0.83, 1.19)	N/A
Depressive symptoms	0.89 (0.72, 1.08)	0.70 (0.55, 0.89)	0.88 (0.71, 1.10)	0.97 (0.75, 1.26)
Body satisfaction	1.04 (0.84, 1.29)	6.84 (4.64, 10.09)	0.86 (0.7, 1.05)	2.27 (1.69, 3.04)
Behavioral Factors				
Health risk behavior score ^e	0.74 (0.6, 0.91)	N/A	0.92 (0.72, 1.17)	N/A
Eating behaviors				
Fruit (servings/day) ^f	1.24 (0.98, 1.56)	0.97 (0.77, 1.23)	0.93 (0.75, 1.16)	1.00 (0.75, 1.33)
Vegetables (servings/day) ^f	1.34 (1.04, 1.72)	1.27 (0.90, 1.80)	0.86 (0.69, 1.09)	1.25 (0.85, 1.84)
Sugary drinks (servings/day) ^f	0.73 (0.58, 0.91)	0.57 (0.38, 0.86)	0.80 (0.64, 1.00)	0.82 (0.60, 1.12)
Alcohol intake (servings/day) ^f	0.84 (0.66, 1.07)	1.10 (0.84, 1.45)	1.12 (0.92, 1.38)	0.79 (0.63, 0.99)
Energy-dense snacks (servings/day) ^f	0.80 (0.59, 1.09)	0.83 (0.25, 2.71)	1.15 (0.91, 1.44)	0.55 (0.14, 2.17)
Fast food (times/week)	0.86 (0.71, 1.05)	0.54 (0.4, 0.72)	0.89 (0.74, 1.08)	0.84 (0.69, 1.02)
Breakfast (times/week)	1.08 (0.88, 1.33)	1.06 (0.8, 1.38)	1.06 (0.87, 1.29)	1.35 (1.03, 1.76)
Weight control behaviors				
Unhealthy (any past year use)	1.03 (0.86, 1.23)	0.52 (0.41, 0.66)	1.03 (0.77, 1.38)	0.55 (0.40, 0.76)
Extreme (any past year use)	0.97 (0.82, 1.14)	0.67 (0.54, 0.84)	1.36 (0.92, 2.02)	0.34 (0.12, 0.96)
Dieting (ever in past year)	1.07 (0.90, 1.26)	0.53 (0.41, 0.67)	0.84 (0.63, 1.13)	0.48 (0.35, 0.67)
Healthy (any past year use)	0.95 (0.74, 1.20)	1.05 (0.80, 1.38)	0.86 (0.71, 1.03)	0.54 (0.42, 0.70)
Binge eating (ever in past year)	1.02 (0.87, 1.18)	0.65 (0.52, 0.8)	0.83 (0.59, 1.16)	0.63 (0.43, 0.91)

	<u>Women</u>		<u>Men</u>	
	Factor in adolescence	Change in factor from adolescence to adulthood	Factor in adolescence	Change in factor from adolescence to adulthood
	OR (95% CI) ^d	OR (95% CI) ^d	OR (95% CI) ^d	OR (95% CI) ^d
Physical activity (hours/week)	0.87 (0.7, 1.07)	1.35 (0.98, 1.87)	1.16 (0.95, 1.42)	1.28 (0.98, 1.68)
Physical Environment Factors				
Home healthy food availability	1.04 (0.85, 1.26)	2.1 (1.22, 3.61)	0.93 (0.75, 1.16)	0.69 (0.41, 1.15)
Home unhealthy food availability	0.86 (0.71, 1.05)	0.9 (0.69, 1.16)	1.09 (0.88, 1.35)	0.88 (0.66, 1.16)
Social Environment Factors				
Perceived parental overweight	1.06 (0.86, 1.32)	N/A	0.88 (0.71, 1.08)	N/A
Household meal frequency	0.99 (0.81, 1.21)	1.04 (0.69, 1.56)	0.77 (0.63, 0.94)	0.99 (0.66, 1.50)
Parent dieting	0.75 (0.62, 0.91)	N/A	0.78 (0.64, 0.96)	N/A
Parent support for healthy eating	0.89 (0.73, 1.09)	N/A	0.82 (0.68, 0.99)	N/A
Parent support for physical activity	1.01 (0.84, 1.23)	N/A	0.91 (0.75, 1.11)	N/A
Significant other or peer dieting	1.12 (0.91, 1.38)	0.42 (0.28, 0.61)	0.82 (0.68, 0.98)	0.42 (0.27, 0.65)
Significant other or peer support for healthy eating	1.17 (0.94, 1.46)	1.61 (1.16, 2.24)	0.95 (0.8, 1.12)	1.15 (0.76, 1.73)
Significant other or peer support for physical activity	1.01 (0.82, 1.24)	1.8 (1.26, 2.57)	0.81 (0.68, 0.97)	1.13 (0.74, 1.71)

^aWomen who were pregnant at the time they reported their adult weight (Time 3 or 4) and adults who were underweight at Time 4 (n=19 with BMI <18.5) were excluded.

^bN/A denotes survey data was not available to allow for examination of an association.

^cAssociations between each individual factor and healthy weight status (body mass index <25.0) in adulthood were tested separately, weighted for nonresponse, and adjusted for baseline body mass index, age, ethnicity/race, and parental socioeconomic status.

^dAll odds ratios were calculated using standardized data to represent the personal, behavioral, and environmental factors of interest. The odd ratios shown thus represent the odds associated with a one standard deviation change in the factor when the units are continuous or the increased probability of the factor being present when dichotomous.

^eThe health risk behavior score represents a sum of points (0/1) assigned for not meeting fruit intake recommendations (women: 1.5–2 cups/day, men: 2–2.5 cups/day), not meeting vegetable intake recommendations (women: 2.5–3 cups/day, men: 3–4 cups/day), consuming more one or more sugary drink per day, consuming two or more alcoholic drinks per day, not eating breakfast daily, eating fast food at least once per week, ever binge eating, use of any unhealthy weight control behaviors, not meeting physical activity recommendations (less than 150 minutes/week of moderate-to-vigorous activity), and smoking cigarettes daily.

^fModels additionally included adjustment for underreporting of food and drink consumption. Adjustment was made using a continuous ratio of energy intake to estimated energy requirement. Energy intake was based on the 2007 Willett semi-quantitative food frequency questionnaire at Time 3 and Time 4, and the youth form of this questionnaire at Time 1. The estimated energy requirement was estimated using sex- and age- specific equations. Height and weight measurements along with self-reported age and physical activity were inputs to these equations. Self-reported hours of light, moderate, and vigorous physical activity were used to estimate weekly Metabolic Equivalent of Task expenditure and assign each participant a multiplier according to the Dietary Reference Intake definitions.

Table 3

Five-year associations of personal, behavioral, and environmental factors with maintaining a healthy weight status in adulthood among women (n=400) and men (n=295) recruited in Minneapolis-St. Paul, MN.^{a,b,c}

	Women		Men	
	Factor in early adulthood	5-year change in factor OR (95% CI) ^d	Factor in early adulthood	5-year change in factor OR (95% CI) ^d
Personal Factors				
Committed relationship status	0.81 (0.62, 1.05)	0.98 (0.62, 1.52)	1.21 (0.88, 1.66)	0.71 (0.46, 1.08)
Parental status (number of children)	0.72 (0.56, 0.91)	0.72 (0.55, 0.96)	1.12 (0.84, 1.49)	1.32 (0.96, 1.81)
Educational attainment	1.49 (1.13, 1.97)	1.48 (1.10, 1.98)	1.08 (0.83, 1.40)	0.86 (0.66, 1.11)
Financial strain	0.85 (0.66, 1.09)	0.69 (0.50, 0.95)	1.04 (0.79, 1.37)	1.54 (1.09, 2.16)
Depressive symptoms	0.86 (0.64, 1.15)	0.74 (0.55, 1.00)	0.98 (0.74, 1.30)	1.30 (0.96, 1.77)
Body satisfaction	1.78 (1.28, 2.47)	2.98 (2.06, 4.31)	0.67 (0.49, 0.92)	1.79 (1.31, 2.45)
Self-efficacy for physical activity	1.11 (0.85, 1.43)	N/A	1.31 (1.02, 1.69)	N/A
Behavioral Factors				
Health risk behavior score ^e	0.67 (0.51, 0.89)	N/A	1.03 (0.73, 1.44)	N/A
Prepare food at home	1.39 (1.06, 1.83)	0.89 (0.60, 1.31)	0.93 (0.72, 1.20)	0.86 (0.59, 1.27)
Eating behaviors				
Fruit (servings/day) ^f	1.28 (0.96, 1.70)	1.03 (0.73, 1.47)	1.01 (0.64, 1.60)	0.86 (0.59, 1.27)
Vegetables (servings/day)	1.09 (0.82, 1.46)	1.06 (0.76, 1.47)	0.86 (0.61, 1.21)	1.17 (0.74, 1.83)
Water (times/day)	1.20 (0.90, 1.59)	0.71 (0.47, 1.08)	0.92 (0.70, 1.20)	0.90 (0.64, 1.26)
Sugary drinks (servings/day) ^f	0.85 (0.62, 1.16)	0.63 (0.37, 1.10)	1.33 (0.86, 2.05)	0.82 (0.50, 1.30)
Alcohol intake (servings/day) ^f	0.95 (0.68, 1.34)	1.01 (0.66, 1.54)	1.13 (0.85, 1.50)	0.69 (0.47, 1.01)
Energy-dense snacks (servings/day) ^f	1.17 (0.77, 1.77)	0.96 (0.64, 1.45)	1.33 (0.90, 0.96)	0.75 (0.48, 1.19)
Fast food (times/week)	0.84 (0.61, 1.15)	0.74 (0.55, 0.99)	1.09 (0.88, 1.35)	1.02 (0.79, 1.30)
Breakfast (times/week)	1.27 (0.97, 1.66)	0.84 (0.61, 1.15)	1.14 (0.86, 1.52)	1.24 (0.90, 1.70)
Weight control behaviors				
Unhealthy (any past year use)	0.72 (0.57, 0.91)	0.72 (0.52, 0.99)	0.89 (0.63, 1.27)	0.47 (0.30, 0.74)
Extreme (any past year use)	0.96 (0.76, 1.23)	0.66 (0.47, 0.92)	0.91 (0.67, 1.24)	0.53 (0.16, 1.73)

	Women		Men	
	Factor in early adulthood	OR (95% CI) ^d	Factor in early adulthood	OR (95% CI) ^d
	5-year change in factor	OR (95% CI) ^d	5-year change in factor	OR (95% CI) ^d
Dieting (ever in past year)	0.87 (0.69, 1.09)	0.61 (0.45, 0.83)	1.04 (0.72, 1.51)	0.47 (0.31, 0.70)
Healthy (any past year use)	0.88 (0.66, 1.17)	0.82 (0.55, 1.22)	0.93 (0.71, 1.22)	0.41 (0.29, 0.58)
Binge eating (ever in past year)	0.85 (0.68, 1.06)	0.77 (0.57, 1.03)	1.06 (0.65, 1.71)	0.78 (0.48, 1.26)
Physical activity (hours/week)	0.84 (0.63, 1.13)	0.97 (0.69, 1.36)	1.12 (0.87, 1.43)	1.25 (0.94, 1.67)
Adequate sleep (% for 7–9 hours/day)	0.94 (0.72, 1.23)	0.91 (0.64, 1.29)	1.42 (1.09, 1.85)	1.06 (0.74, 1.50)
Physical Environment Factors				
Home healthy food availability	1.08 (0.82, 1.42)	1.25 (0.85, 1.83)	1.20 (0.92, 1.56)	0.72 (0.51, 1.03)
Home unhealthy food availability	0.96 (0.74, 1.25)	1.12 (0.78, 1.63)	1.47 (1.12, 1.92)	0.77 (0.51, 1.17)
Neighborhood resources				
Supermarket distance	0.82 (0.63, 1.07)	N/A	0.97 (0.72, 1.30)	N/A
Convenience store distance	0.87 (0.65, 1.15)	N/A	0.83 (0.62, 1.11)	N/A
Fast food restaurant distance	0.95 (0.73, 1.24)	N/A	0.95 (0.72, 1.25)	N/A
Gym/fitness facility distance	0.76 (0.58, 0.99)	N/A	1.02 (0.77, 1.37)	N/A
Park/trail distance	0.94 (0.73, 1.21)	N/A	0.89 (0.67, 1.19)	N/A
Perceived neighborhood safety	1.27 (0.98, 1.65)	N/A	1.06 (0.80, 1.42)	N/A
Social Environment Factors				
Household meal frequency	0.93 (0.72, 1.20)	0.56 (0.31, 1.01)	1.20 (0.89, 1.63)	1.41 (0.80, 2.50)
Significant other or peer dieting	0.57 (0.40, 0.80)	0.57 (0.37, 0.88)	0.66 (0.45, 0.97)	0.47 (0.27, 0.80)
Significant other or peer support for healthy eating	0.99 (0.72, 1.35)	1.31 (0.89, 1.92)	1.18 (0.80, 1.74)	0.62 (0.36, 1.06)
Significant other or peer support for physical activity	1.08 (0.79, 1.48)	1.20 (0.81, 1.78)	1.05 (0.70, 1.57)	1.5 (0.93, 2.41)
Coworkers care about healthy eating and activity	1.15 (0.83, 1.58)	1.61 (0.99, 2.62)	0.99 (0.75, 1.30)	2.13 (1.28, 3.56)

^a Women who were pregnant at the time they reported their adult weight (Time 3 or 4; n=130) and adults who were underweight at Time 4 (n=19 with BMI <18.5) were excluded.

^b N/A denotes survey data was not available to allow for examination of an association.

^c Associations between each individual factor and healthy weight status (body mass index < 25.0) in adulthood were tested separately, weighted for nonresponse, and adjusted for baseline body mass index, age, ethnicity/race, and parental socioeconomic status.

^d All odds ratios were calculated using standardized data to represent the personal, behavioral, and environmental factors of interest. The odds ratios shown thus represent the odds associated with a one standard deviation change in the factor when the units are continuous or the increased probability of the factor being present when dichotomous.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

The health risk behavior score represents a sum of points (0/1) assigned for not meeting fruit intake recommendations (women: 1.5–2 cups/day, men: 2–2.5 cups/day), not meeting vegetable intake recommendations (women: 2.5–3 cups/day, men: 3–4 cups/day), consuming more one or more sugary drink per day, consuming two or more alcoholic drinks per day, not eating breakfast daily, eating fast food at least once per week, ever binge eating, use of any unhealthy weight control behaviors, not meeting physical activity recommendations (less than 150 minutes/week of moderate-to-vigorous activity), not sleeping 7–9 hours per day, and smoking cigarettes daily.

Models additionally included adjustment for underreporting of food and drink consumption. Adjustment was made using a continuous ratio of energy intake to estimated energy requirement. Energy intake was based on the 2007 Willett semi-quantitative food frequency questionnaire. The estimated energy requirement was estimated using sex- and age-specific equations. Height and weight measurements along with self-reported age and physical activity were inputs to these equations. Self-reported hours of light, moderate, and vigorous physical activity were used to estimate weekly Metabolic Equivalent of Task expenditure and assign each participant a multiplier according to the Dietary Reference Intake definitions.