Published in final edited form as:
*J Am Diet Assoc*. 2008 October ; 108(10): 1708–1715. doi:10.1016/j.jada.2008.07.007.

# Weight Gain Prevention: Identifying Theory-Based Targets for Health Behavior Change in Young Adults

**Kathryn A. Strong, MS**[1], **Serena L. Parks, BS**[1], **Eileen Anderson, EdD**[2], **Richard Winett, PhD**[2], and **Brenda M. Davy, PhD, RD**[1]

[1]*Department of Human Nutrition, Foods and Exercise, Virginia Tech, Blacksburg, VA 24061, Ph: 540.231.6784, Fax: 540.231.3916*

[2]*Department of Psychology, Center for Research in Health Behavior, Virginia Tech, Blacksburg, VA 24061*

## Abstract

Young adults attending college are more vulnerable to weight gain than the general population. We sought to identify health behavior change targets related to weight management in college students. Based on the social cognitive theory model for health behavior change, we investigated the health-related lifestyle behaviors and physiological characteristics of this population. Forty-three college students (18.3±0.1 years) completed a series of quantitative assessments (body weight and composition, cardiorespiratory fitness, diet and activity habits) and structured qualitative assessments (structured interview or focus group). Participants were predominantly normal-weight (mean BMI=22.2±0.4 kg/m$^2$) and fit ($VO_2$max = 50.5±1.5 ml/kg/min). However, healthy eating and physical activity were not considered high priorities, despite having ample free time, high exercise self-efficacy, positive outcome expectations for exercise, and a desire to exercise more. Participants reported that regularly engaging in exercise was difficult. This may have been due to poor planning/ time management, satisfaction with body image, lack of accountability and feelings of laziness. Dietary patterns generally met recommendations but were low in fruits, vegetables and whole grains. Social support for exercise and healthy dietary habits were important factors associated with health behaviors. Students reported a decline in exercise and dietary habits relative to high school, which may contribute to college weight gain. Our results suggest that this population may not have adequate self-regulatory skills, such as planning and self-monitoring, to maintain healthy behaviors in the college environment. Dietitians working with young adults attending college may use these findings to guide the behavioral therapy component of their weight management medical nutrition therapy goals and outcomes.

### Keywords

Weight gain prevention; college weight gain; young adults; behavior change; diet; physical activity; exercise; social cognitive theory

Corresponding Author: Brenda M. Davy, PhD, RD, 221 Wallace Hall (0430).

## INTRODUCTION

The increasing prevalence of obesity has led to public health initiatives for preventive action (1–3). Trends in adults indicate that obesity develops through gradual weight gain during early adulthood (4,5), with most obese individuals becoming so before age 35 (4). Between 1991–1998, the greatest increases in the prevalence of obesity were among young adults (18–29 years) and those with higher education levels (6). Hill et al. (7) estimated that the average American adult gains weight at a rate of ~2 lbs (~0.9 kg) per year. However, young adults attending college appear to gain weight more rapidly than the general population, with a mean weight gain of ~4–9 lbs during their first year at college (8–10), without evidence of compensatory weight loss in later years (9). Perpetual weight gain yielding an increase of >2 $kg/m^2$ over 15 years places young adults at markedly increased cardiovascular disease risk compared to those with a stable or decreased body mass index (BMI) (11). These effects persist independently of baseline BMI, suggesting that weight stability in early adulthood may be an important factor in chronic disease risk reduction for both normal and overweight individuals.

The college environment, which many young adults will experience (12,13), is one which may be conducive to overconsumption due to factors such as readily available energy-dense foods. Academic pressures may lead to increased time studying and computer usage while devaluing exercise and organized sports participation. Since previous work has demonstrated that college students are particularly vulnerable to weight gain, preventing weight gain in this population may have important implications for long-term weight management.

Investigations of weight gain prevention have examined selected constructs within a behavior change theory (10,14–16) or implemented interventions based on components of behavior change (17,18). However, the relative influence of theoretical factors underlying health behaviors and health behavior change among young adults attending college remain elusive. This is relevant to dietetics practice, as behavioral therapy is recognized as an important component of medical nutrition therapy for adult weight management (19).

Our objective was to identify potential targets to improve health behaviors in young adults attending college through an empirical investigation of lifestyle factors related to body weight, based on the social cognitive model for health behavior change (20). We investigated modifiable lifestyle factors that could mediate college weight gain, and identified psychosocial correlates of health behaviors including self-regulation, social support, self-efficacy, and outcome expectations (20).

## METHODS

Participants were 1$^{st}$ and 2$^{nd}$ year college students, living on-campus, and ≥ 18 years of age. Students majoring in Human Nutrition, Foods and Exercise (i.e. Dietetics, Exercise and Health Promotion) were excluded, as their health habits may not be representative of the general college population. Eligible participants did not have depression, eating disorders, or major chronic diseases. The Centers for Epidemiological Studies Depression Scale (CES-D) (21) and the Eating Attitudes Test (EAT-26) (22) were used to assess symptoms of depression and disordered eating, respectively. Participants with scores ≥35 on the CES-D and ≥20 on the EAT-26 were excluded. Females were not pregnant during the course of the study. Participants were recruited via campus advertisements, but were kept naïve as to the exact purpose of the study in order to reduce the likelihood of attracting only those with significant health interests. Of those recruited (n=63), four were ineligible based on CES-D or EAT-26 scores and 16 were not able to complete all study procedures. The final sample included 43 individuals. For each participant, completion of all study procedures took place over a 3–4 week period, after which time they were compensated $20. Participants provided informed consent prior to their participation in the investigation; the protocol and consent form were approved by the Institutional Review Board at Virginia Tech.

## Procedures

All participants completed a series of questionnaires and laboratory-based measurements. Questionnaires included the Health Beliefs Survey (23) which assessed SCT determinants of eating behaviors; assessments of theory-based determinants for physical activity (PA) behaviors (24); the Three-Factor Eating Questionnaire (TFEQ) (25); and a questionnaire to prioritize activities of college students(interview participants only=30). Laboratory measurements included assessment of body weight and composition, waist circumference, resting blood pressure, and cardiorespiratory fitness. Height was measured using a wall-mounted stadiometer, and body weight was measured using a digital scale (Scale-tronix, White Plains, NY). Waist circumference was measured to the nearest 0.5 cm at the umbilicus (Gulick tape measure, Country Technology, Inc.). Blood pressure was measured using an automated Dinamap XL vital signs monitor (model 9300, Johnson & Johnson Medical, Tampa, FL) using recommended measurement procedures (26). Maximal oxygen consumption ($VO_2$ max) was used to assess cardiorespiratory fitness, which was determined during graded treadmill running to exhaustion using indirect calorimetry (TrueMax 2400, ParvoMedics, Salt Lake City, UT). $VO_2$max (ml/kg/min) measurements were used to determine age- and sex-specific American College of Sports Medicine (ACSM) $VO_2$max percentile ranking (27). Body composition was measured using dual energy X-ray absorptiometry (DEXA) (GE Lunar Prodigy Advance, Madison, WI). Habitual PA was measured with 7-day activity logs of time spent engaged in PA and verified 7-day pedometer (Accusplit Eagle 120XL, San Jose, CA) step counts. Activity logs also included minutes spent watching television and playing video games, minutes spent on the computer, bed time (time of day), wake time (time of day), minutes spent napping, and types of PA with intensity ratings. When reporting our findings, we have used the term *PA* when referring broadly to activities which involve muscle movement such as walking around campus, and the term *exercise* when referring to specific structured activities which improve cardiorespiratory fitness such as running, team sports, or gym-based physical activities. To determine habitual dietary intake, food intake records were obtained for four consecutive days including one weekend day and three weekdays; records were analyzed using NDS-R software (University of Minnesota, Minneapolis, MN) with food groups servings determined according to the Dietary Guidelines for Americans (28). Two 4-day records averaging <1200 kcal/day were excluded due to suspected underreporting (29).

Participants then took part in either an elicitation interview or a focus group. A series of 30 elicitation interviews (one interview with each of 30 students; 1–2 hours per student) followed by two focus groups (n=13; 1.5 hours per group) were conducted. All interactions were conducted by one investigator (*KS*), with a second investigator (*BD, SP*) present to observe and take notes. Upon participant authorization, the sessions were recorded and written transcripts were generated.

Semi-structured interviews elicited information about students' daily routine, dietary and PA habits. Participants responded to questions about their usual activities and experiences related to psychosocial correlates of health behavior change, for example: "do you keep track of how much PA you do?". Psychosocial correlates included self-efficacy, self-regulation, social support, and outcome expectations for diet and PA behaviors.

Conducting 30 elicitation interviews allowed the investigators to reach a point of "response saturation" (i.e., no new revealing information from participants, informational redundancy). Following the completion of the elicitation interviews and determination of themes in each topic area, two focus groups for peer validation and discussion of major interview findings (n=8 and n=5 participants, respectively) were conducted with students who did not participate in an interview (30). The focus group sample size was determined according to recommended guidelines (30,31). These groups were used to provide insight into the authenticity and credibility of the interview findings (30).

### Data Analysis

Elicitation interviews were analyzed to identify themes (30). “Major themes” were defined as responses given by ≥50% of participants, and “minor themes” were defined as responses given by 25–49% of participants. Individual responses were tabulated by reviewing interview transcripts and written notes; discrepancies were clarified with audio recordings. Similar responses were grouped, and response frequencies were calculated to detect major and minor themes. The tabulations and groupings were independently reviewed by two researchers. Findings were organized according to SCT components (32): behaviors, environmental factors, and personal factors including self-regulation, social support, self-efficacy, and outcome expectations. Content from focus groups were analyzed using published guidelines (31). The investigators independently analyzed the focus group discussions and then met to confirm findings.

Statistical analysis was conducted using SPSS statistical analysis software (SPSS v.12.0 for Windows). Analyses included descriptive statistics (means, standard error, and frequencies) and Pearson’s correlations. Sex differences were determined using Independent Samples t-tests. The alpha level was set *a priori* at $P<0.05$. Data are expressed as mean ± SEM.

## RESULTS AND DISCUSSION

### Participant Characteristics

The sample population was predominately white (36 Caucasians, 4 African Americans, 3 Asians), freshmen (74% of sample), and of normal BMI ( BMI=22.2±0.4 kg/m$^2$). However, 16% were classified as overweight (BMI≥25 kg/m$^2$) which is lower than that reported in other studies of college students (8,10,33). Results of laboratory-based assessments in our sample are provided in Table 1. Mean resting blood pressure (BP) in this sample was within a normal range (systolic BP, 121.8±1.5 mmHg; diastolic BP, 63.1±872 mmHg), however systolic BP was significantly higher in males than females (Table 1). Body fatness was significantly higher in females than in males; while there are no established recommendations for optimal body composition values, the mean values in this sample correspond to ~50$^{th}$ and 10–20$^{th}$ percentile in population-based data for young adult men and women, respectively (34). Previous work has determined that freshman women gain an average of 0.73 lbs/month, which represented a rate of weight gain that was 36 times faster than age-matched women not attending college (35); thus weight gain prevention interventions should target college women, and include activities that improve fitness, lean body mass and muscular strength (36).

### Dietary Behaviors

Males consumed significantly more energy than females (2236±112 vs. 1711±90 kcal/day, respectively; P=0.001), but there were no sex differences in percent of energy consumed from macronutrients with carbohydrate, fat and protein comprising ~ 50%, 35%, and 15% of total energy, respectively. Energy from alcohol contributed 0.6±0.5% of total energy intake; no sex differences in alcohol intake were found. Average daily intake of fruit (1.0±0.2 cup equivalents), vegetables (1.5±0.1 cup equivalents), and whole grains (1.4±0.2 oz equivalents) were not significantly different between males and females and were well below recommendations (28,37). Total fiber intake in our sample was approximately half of recommended levels (15±6 g/day and 13±5 g/day in males and females, respectively) (38), while mean sodium intake (males: 3953±260mg/day; females: 2855±177mg/day) exceeded recommendations (39). Although somewhat lower than intakes reported by West et al. (15), energy from added sugar consumption among our participants (~321 kcal/day; 80.3±6.1 g/day) was almost twice the energy excess of 174 kcal/day that Levitsky et al. (40) observed in their study of college weight gain.

## Physical Activity Behaviors

In general, participants had a high level of cardiorespiratory fitness ($VO_2max$ = 50.5±1.5 ml/kg/min), with 73% of the sample greater than the ACSM sex- and age-specific $VO_2max$ $70^{th}$ percentile (34). In the pooled sample, participants reported a mean of 35±5 minutes of moderate- and high-intensity PA per day (examples: weight lifting, running, organized sports) while mean daily steps taken were 11,412±657, which slightly exceeds PA recommendations (28) for reducing chronic disease risk based upon the finding that 10,000 steps may be comparable to about 30 min moderate intensity PA (41,42). However, minutes engaged in moderate- to high-intensity PA was below the recommended level of 60 minutes on most days of the week to prevent weight gain (28). Previous work has attributed college weight gain largely to decreases in PA, particularly among freshman females (14,43), and has reported a decline in regular PA participation from ~65% in high school students to ~30% in the general population (44,45). In this sample, no sex differences were noted in daily minutes of moderate- and high intensity PA or in daily step counts (Table 1).

With respect to sleeping and sedentary activities, students slept 8.0 hours/night (±10 min), with an average bedtime of 1:16 am (±9 min), and wake time of 9:13 am (±8 min). Students took ~1 (0.9±0.2) nap per week with a mean duration of ~50 minutes each, spent 150±18 minutes/day watching television and playing video games, and 162±12 minutes/day on the computer. Therefore, students spend a significant amount of time (~5 hours/day) engaged in sedentary activities.

## Associations of Theoretical Determinants with Laboratory-Based Measurements

Questionnaire scores (Mean, SEM, ranges) for SCT determinants of health behaviors are provided in Table 2. Students seldomly (score of 2=”seldom”) use dietary strategies to regulate their calorie and fat intake or plan/track their food intake, but occasionally (score of 3=”occasionally”) use dietary strategies to eat more fiber, fruits and vegetables. Quantitative measures of habitual dietary intake and PA were significantly correlated ($P<0.05$) with respective SCT determinants of eating and PA behaviors. Specifically, the dietary strategy of *regulating calories and fat* was significantly correlated with total energy intake (kcal), percent energy from added sugar, and fiber (g/1000 kcal), fruit and vegetable servings, and sodium intake (r=−0.42, r=−0.37, r=0.46, r=0.37, r=−.317, respectively). A second dietary strategy, *planning and tracking*, *was* associated with a lower energy intake (r=−0.41), increased fruit and vegetable consumption (r=0.35), less energy from added sugars (r=−0.33), and increased fiber consumption (r=0.58). The final dietary strategy investigated, *regulating fiber*, *fruits and vegetables* was positively associated with fruit/vegetable and whole grain consumption, less energy from added sugars, and increased intake of fiber (r=0.48, r=0.34, r=−0.45, r=0.67, respectively). Thus, students who utilize dietary strategies to consume healthy diets also report consuming diets lower in fat, added sugars and sodium, and higher intake of fiber, fruits and vegetables.

With respect to dietary social support (Table 2), mean scores were neutral (1=”strongly disagree”, 5=”strongly agree”) as to whether or not their friends and families provided social support for managing their intake of fat, fiber, fruits and vegetables. However, *social support for fiber, fruit, and vegetables* was correlated with fiber intake (g) (r=.425, p=0.006), whole grain servings (r=0.35, P=0.03) and micronutrients including folate, calcium, iron, and potassium (data not shown). Dietary efficacy for *decreasing fat* and *reducing Sugar* was higher (0=”certain I cannot”, 100=”certain I can”) than dietary efficacy for *planning and tracking* and *increasing fiber, fruits and vegetables,* suggesting that this segment of the population may benefit from learning and practicing behavioral skills related to planning and regulating intake of healthful foods. Dietary efficacy for *increasing fiber, fruits and vegetables* was associated (all $P<0.05$) with fruit and vegetable intake (r=0.40), whole grain intake (r=0.35), intake of added sugars (r=−0.37), and fiber intake (r=0.51). Dietary efficacy for *planning and tracking* was associated with whole grain intake (r=0.32), intake of added sugars (r=−0.35), and fiber intake (r=0.37)(all $P<0.05$). Thus, students who report high dietary self-efficacy for positive dietary habits appear more likely to consume healthier diets. Given that students had high ratings for positive and low ratings for negative dietary outcome expectations (Table 2; rating of 1=”strongly disagree”, 5=”strongly agree”), they appear to recognize the benefits of healthy dietary habits. Although the dietary intake data are self-reported, which is an important limitation to acknowledge, these findings suggest that behavioral change strategies believed to be effective in improving dietary behaviors in other segments of the population (23) may also be effective intervention strategies for those counseling young adults.

In general, mean scores for PA SCT constructs (goal-setting and planning, social support, self-efficacy) were higher than those reported for dietary constructs. Scores on these constructs were correlated (all $P<0.05$) with objective measures of activity patterns as follows: Daily step counts were correlated with *self-regulation for exercise goals* (r=0.45), *self-regulation for exercise plans* (r=0.53), *social support from friends* (r=0.41), *self-efficacy* (r=0.43), and *outcome expectations* (r=0.45); while *social support from friends* was negatively correlated with sedentary activities such as minutes watching television and playing video games (r= −0.31) and minutes using a computer (r=−0.46). Time spent (minutes) in moderate- and high-intensity PA was correlated with *self-regulation for exercise plans, self-efficacy* and *outcome expectations* (r=0.45, 0.49, 0.33, respectively). ACSM $VO_2$max percentile was significantly correlated with *self regulation for exercise goals* (r=0.54) and *self-efficacy* (r=0.52). These associations of theoretical constructs with reported measures of diet and PA, which suggests that interventions aimed at teaching young adults self-regulatory behaviors, increasing self-efficacy and positive outcome expectations, increasing social and environmental support for PA and healthy eating may lead to improvements in health behaviors within this segment of our population.

## College Lifestyle: Behaviors, Personal Factors, and Environmental Factors

The elicitation interviews revealed several themes pertaining to participants’ behaviors, personal factors, and environmental factors; major (M) and minor (m) themes are designated following each phrase in parentheses. The transition from high school to the college environment resulted in considerable lifestyle changes. In high school, students had fewer responsibilities (M). In college they play fewer organized sports (m), exercise less, and eat more (M). They also now sleep more, wake up later (M), and stay up later (m). Students ranked daily priorities in order of greatest to least importance as follows: going to classes, studying, hanging out with friends, sleeping, exercising, dating or meeting partners, eating healthy foods, work, having an ideal body, surfing the internet, and going to a great party.

**Dietary Behaviors—**Students generally skip breakfast (m) or have something they can prepare in their dorm room, eat quickly, or carry to class (e.g., cereal, granola bar)(M). Lunch generally consists of sandwiches, salads, or wraps, but also fast-food type meals which are available on-campus (M). For dinner, students have entrées like pasta, meat and potatoes, salad, burgers, and sandwiches (M). Most students snack on chips or crackers and sweets that they keep in their dorm rooms (M). Snack foods primarily come from an off-campus grocer, and rarely vending machines (M). Students generally drink water (M), juice (m), or sweetened beverages (M). When short on time (generally ≥1–3 times per week), students tended to eat something quickly, which is usually fast foods (M).

About two thirds of participants consumed alcoholic beverages (M). They drink 1–2 nights per week or more (m), consume at least 5–6 alcoholic beverages per night when they drink (M); usually beer and/or hard liquor (M). While drinking alcoholic beverages, students often eat pizza, fast-food (M) or party snacks such as chips or sweets (m).

Participants believe a “healthy meal or diet” includes fruits, vegetables, or salads; meat, chicken, or protein; grains, breads, or pasta (M); foods low in fat or not fried; and foods low in sugar or carbohydrates (m). These beliefs are consistent with what their parents, particularly their mother, taught them at home (M). Most students thought they ate too few fruits (M) and vegetables (m). Among those who ate dessert daily or more, almost all were female; they reported that they were eating too much dessert (m).

**Physical Activity Behaviors—**Most students participate in aerobic fitness activities, pick-up games (M), organized sports, and strength training (m) about two to three times per week (M). Compared to high school, many students report that they exercise less in college (M). Their workouts are less intense, less structured, and consist of voluntary activities rather than activities required for organized sports (M). However, students walk more in college than they did in high school (m).

**Diet- and Physical Activity-Related SCT Constructs—**Findings related to dietary and PA SCT constructs are presented in detail with selected illustrative quotes in an online supplementary table (Table 3); major and minor themes are identified within the table. Key constructs related to health behaviors are summarized in the following section.

**Self Regulation:** Self-regulatory behaviors relevant to body weight management include self-monitoring of body weight, tracking of exercise/PA, and planning and monitoring of meals/dietary intake. Students reported weighing themselves <1–2 times per month. They expressed concern about a reduction in their PA level in the transition from high school to college, yet most had not implemented changes to their PA habits nor did they formally record/track their exercise (i.e. miles run, minutes exercised). Students reported that they want to eat regular, balanced meals, however they did not plan meals and snacks in advance. They did not monitor or track their consumption of energy or fat, and only looked at *Nutrition Facts* labels out of curiosity or boredom; these Facts generally did not influence their decisions to consume foods.

**Social Support:** Having social support from friends encouraged students to be physically active, and they reported that exercising with friends is socially rewarding. With respect to social support for dietary habits, students do not believe that their families currently influence their food choices but that their friends do influence their food choices, as they generally eat ≥2 meals per day with friends.

The influence of an individual’s social network on risk of obesity has been recognized (46). Importantly, obesity risk was increased more among those with obese friends (57% increased risk), as compared to those with obese siblings or spouses (40% and 37%, respectively). This influence is even higher among same-sex friends (71% increased risk). Our findings may be consistent with these observations, in that social support from friends was positively correlated with daily step counts and negatively correlated with time spent in sedentary activity; social support from friends was also positively correlated with healthy dietary behaviors such as fruit, vegetable, and fiber intake. Socializing was considered a higher daily priority than exercising or eating healthfully, thus interventions which include social groups may be more effective in promoting positive health behavior change as compared to those targeting only individuals. Furthermore, including sources of environmental support in SCT-based diet and PA interventions significantly improves long-term health behaviors (23). For this population, increasing environmental support could include on-campus posters (dining halls, dormitories, academic buildings) promoting benefits of a healthy diet and PA which were recognized within this age group (i.e. stress reduction, increasing energy level, psychological and social benefits); training dormitory resident advisors as peer-advocates for positive health behaviors; and using technology (podcasts, Internet sites, e-mail, web-based social networking) to guide the development of improved diet and PA behaviors.

A multi-level approach, which includes both individual and environmental support, may facilitate healthy eating and regular PA to become a social norm (i.e. perception of what others think and do with respect to healthy eating and exercise (47)). If young adults perceive healthy dietary patterns and being active as normative behaviors, the personal value and daily priority of positive health habits increase. Previous work has reported that social support and social norms, two components of the social environment, are independently associated with college student’s participation in strenuous leisure time PA (47). However, interventions must target changing both social support and social norms related to health behaviors, as messages aimed solely at changing perceived campus norms may be less influential than perceived norms within student’s social network (48).

**Self-Efficacy:** Students were fairly confident (rated as 7 on a scale of 1–10) that they could work out more if they needed to. Almost all believe they know how to improve their fitness level (M) and that they have enough time to do so. Students are interested in learning about eating healthfully and believe they are capable of improving their diets (rated 8 on a scale of 1–10). However, the major incentive for improving their diets would be the onset of a diet-related disease or illness.

**Outcome Expectations:** Being physically active is important to college students, and many report that they would like to exercise more. They believe that the positive outcomes of being active are improved health and functioning, improved psychological health, being in better shape or more competitive at sports, as well as social benefits. Students stated that they would work out more if they experienced body dissatisfaction (e.g., weight gain, clothes not fitting). When they eat healthy foods, most students state that they “feel better”, both physically and psychologically, and are energized. Other reported benefits of eating well include weight loss/ better weight management. Perceived negative outcomes of consuming an unhealthy diet are feeling tired, sluggish, or uncomfortable. Dietitians may reinforce these perceived benefits of dietary habits when counseling young adults as opposed to addressing outcome expectations such as disease risk reduction, which may be more meaningful to older adults.

**Common Barriers – Time, Financial, Accessibility:** Students report having effective time management skills, although some acknowledge their skills could be improved. When busy, students eliminate planned exercise from their schedule. Students reported that working out is not difficult when part of a routine, but becomes a challenge with other responsibilities, lack of accountability, and feelings of laziness. Students regularly have ≥5 hours of free time each weekday, and almost all weekends are “free”. In their free time, students socialize, watch television, surf the Internet or play video games, and play sports, exercise, or perform other physical activities. Thus, students have ample time to exercise. With regard to barriers for healthy eating, the only food option on campus after 8pm is a fast food facility. As most dining halls are “a la carte” style and organized in a way that does not facilitate “balanced” meals (i.e. food station-type lines), students often must wait in long lines to obtain dietary variety (fruits, salads, etc). Thus, time can be a barrier to healthy eating for students eating in dining halls.

Students have acceptable access to quality gym facilities, and the use of meal plans prevents food cost from being a barrier to healthy eating. Students perceived their college environment is one that makes unhealthy foods more available than healthy foods. Many students had a refrigerator and microwave in their dorm rooms, but do not keep fresh fruits and vegetables in their dorms as they tend to spoil. Thus, exercise facilities and healthy foods are available on campus, but there are barriers to accessing healthy foods due to students having to visit multiple dining hall “stations”; storing healthy, perishable food in dorm rooms is not perceived as a feasible way for them to address this barrier. These findings could be used by dietitians to develop “student shopping lists” which include nutritious shelf-stable convenience items as well as to recommend produce and amounts for dorm-room storage, as well as weekly planning guides which include scheduled exercise, weekly exercise and dietary goals, and grocery store shopping trips.

## CONCLUSIONS

Social cognitive theory-based interventions can significantly increase fruit, vegetable and fiber consumption, PA, and prevent long-term weight gain (23). However, to be effective, interventions must address mediators of weight gain relevant to the targeted population. Among young adults, declining PA participation and high levels of sedentary activity likely contribute to college weight gain. Before college, healthy meals and regular exercise were part of a regular routine, but these positive health behaviors appear to decline in the transition from high school to college. Weight gain prevention interventions aimed at this population should instill skills in goal setting, planning, and self-monitoring, while incorporating social and environmental support to facilitate adherence and the long-term adoption of healthy behaviors. Additionally, dietitians working with young adults attending college may use these findings to guide the behavioral therapy component of their weight management medical nutrition therapy goals and outcomes (19).

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## Acknowledgements

**FUNDING DISCLOSURE**

This work was supported by NIH grant K01 DK075424-02.

## References

1. Kumanyika SK, Obarzanek E. Pathways to obesity prevention: report of a National Institutes of Health workshop. Obes Res 2003;11:1263–1274. [PubMed: 14569052]
2. The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obestiy, 2001. Office of the Surgeon General: U.S. Department of Health and Human Services, Public Health Service; 2001.
3. Towards prevention of obesity: research directions. Obes Res 1994;2:571–584. [PubMed: 16355518]
4. McTigue KM, Garrett JM, Popkin BM. The natural history of the development of obesity in a cohort of young U.S. adults between 1981 and 1998. Ann Intern Med 2002;136:857–864. [PubMed: 12069559]
5. Sheehan TJ, DuBrava S, DeChello LM, Fang Z. Rates of weight change for black and white Americans over a twenty year period. Int J Obes Relat Metab Disord 2003;27:498–504. [PubMed: 12664083]
6. Mokdad AH, Serdula MK, Dietz WH, Bowman BA, Marks JS, Koplan JP. The spread of the obesity epidemic in the United States, 1991–1998. Jama 1999;282:1519–1522. [PubMed: 10546690]
7. Hill JO, Wyatt HR, Reed GW, Peters JC. Obesity and the environment: where do we go from here? Science 2003;299:853–855. [PubMed: 12574618]
8. Anderson DA, Shapiro JR, Lundgren JD. The freshman year of college as a critical period for weight gain: an initial evaluation. Eat Behav 2003;4:363–367. [PubMed: 15000962]

9. Lewis CE, Jacobs DR Jr, McCreath H, et al. Weight gain continues in the 1990s: 10-year trends in weight and overweight from the CARDIA study. Coronary Artery Risk Development in Young Adults. Am J Epidemiol 2000;151:1172–1181. [PubMed: 10905529]
10. Racette SB, Deusinger SS, Strube MJ, Highstein GR, Deusinger RH. Weight changes, exercise, and dietary patterns during freshman and sophomore years of college. J Am Coll Health 2005;53:245–251. [PubMed: 15900988]
11. Lloyd-Jones DM, Liu K, Colangelo LA, et al. 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 2007;115:1004–1011. [PubMed: 17283263]
12. National Center for Education Statistics. Percent of population enrolled in secondary and postsecondary institutions, by age group and country. [Accessed October 9, 2007]. http://nces.ed.gov/programs/digest/d04/tables/dt04_396.asp. Published 2004
13. National Center for Education Statistics. Total fall enrollment in degree-granting institutions by sex and student attendance status: Selected years, 1970–2004. [Accessed October 9, 2007]. http://nces.ed.gov/fastfacts/display.asp. Published 2006
14. Butler SM, Black DR, Blue CL, Gretebeck RJ. Change in diet, physical activity, and body weight in female college freshman. Am J Health Behav 2004;28:24–32. [PubMed: 14977156]
15. West DS, Bursac Z, Quimby D, et al. Self-reported sugar-sweetened beverage intake among college students. Obesity (Silver Spring) 2006;14:1825–1831. [PubMed: 17062813]
16. Jeffery RW, French SA. Preventing weight gain in adults: design, methods and one year results from the Pound of Prevention study. Int J Obes Relat Metab Disord 1997;21:457–464. [PubMed: 9192229]
17. Levine MD, Klem ML, Kalarchian MA, et al. Weight gain prevention among women. Obesity (Silver Spring) 2007;15:1267–1277. [PubMed: 17495203]
18. Calfas KJ, Sallis JF, Nichols JF, et al. Project GRAD: two-year outcomes of a randomized controlled physical activity intervention among young adults. Graduate Ready for Activity Daily. Am J Prev Med 2000;18:28–37. [PubMed: 10808980]
19. American Dietetic Association Adult Weight Management Toolkit. Chicago, IL: American Dietetic Association; 2007.
20. Bandura, A. Self-efficacy : the exercise of control. New York: W.H. Freeman; 1997.
21. Radloff L. The CES-D scale: a self-report depression scale for research in the general population. Applied Psych Meas 1977;1:385–401.
22. Garner DM, Olmsted MP, Bohr Y, Garfinkel PE. The eating attitudes test: psychometric features and clinical correlates. Psychol Med 1982;12:871–878. [PubMed: 6961471]
23. Winett RA, Anderson ES, Wojcik JR, Winett SG, Bowden T. Guide to health: nutrition and physical activity outcomes of a group-randomized trial of an Internet-based intervention in churches. Ann Behav Med 2007;33:245–255.
24. Rovniak LS, Anderson ES, Winett RA, Stephens RS. Social cognitive determinants of physical activity in young adults: a prospective structural equation analysis. Ann Behav Med 2002;24:149–156. [PubMed: 12054320]
25. Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. J Psychosom Res 1985;29:71–83. [PubMed: 3981480]
26. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. National High Blood Pressure Education Program. Bethesda: U.S Department of Health and Human Services; 2003.
27. Whaley, MH.; Brubaker, PH.; Otto, RM.; Armstrong, LE. ACSM's guidelines for exercise testing and prescription. 7th ed.. Philadelphia, Pa.: Lippincott Williams & Wilkins; 2006.
28. Dietary Guidelines for Americans, 2005. 6th Edition. U.S. Department of Health and Human Services and U.S. Department of Agriculture: U.S. Government Printing Office; 2005 [Accessed October 9, 2007]. http://www.health.gov/dietaryguidelines/default.htm
29. Johnson, R.; Hankin, J. Dietary assessment and validation. In: Monsen, ER., editor. Research : successful approaches. 2nd ed.. Chicago: American Dietetic Association; 2003. p. 237
30. Bogdan, R.; Biklen, S. Qualitative Research for Education: An Introduction to Theory and Methods. 4th ed.. Boston: Allyn and Bacon; 2003.

31. Krueger, R. Focus groups: a practical guide for applied research. Newbury Park: Sage; 1988.
32. Bandura, A. Social foundations of thought and action : a social cognitive theory. Englewood Cliffs, N.J.: Prentice-Hall; 1986.
33. Rose N, Hosig K, Davy B, Serrano E, Davis L. Whole-grain intake is associated with body mass index in college students. J Nutr Educ Behav 2007;39:90–94. [PubMed: 17346657]
34. ACSM's Guidelines for Exercise Testing and Prescription. 7th Edition ed. American College of Sports Medicine; 2005.
35. Hovell MF, Mewborn CR, Randle Y, Fowler-Johnson S. Risk of excess weight gain in university women: a three-year community controlled analysis. Addict Behav 1985;10:15–28. [PubMed: 4003134]
36. Haskell WL, Lee IM, Pate RR, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Med Sci Sports Exerc 2007;39:1423–1434. [PubMed: 17762377]
37. United States Department of Agriculture. My Pyramid website. [Accessed March 21, 2008]. http://mypramid.gov
38. Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids. Washington, DC: The National Academies Press; 2002.
39. Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate. Washington, DC: The National Academies Press; 2004.
40. Levitsky DA, Halbmaier CA, Mrdjenovic G. The freshman weight gain: a model for the study of the epidemic of obesity. Int J Obes Relat Metab Disord 2004;28:1435–1442. [PubMed: 15365585]
41. Welk GJ, Differding JA, Thompson RW, Blair SN, Dziura J, Hart P. The utility of the Digi-walker step counter to assess daily physical activity patterns. Med Sci Sports Exerc 2000;32:S481–S488. [PubMed: 10993418]
42. Wilde BE, Sidman CL, Corbin CB. A 10,000-step count as a physical activity target for sedentary women. Res Q Exerc Sport 2001;72:411–414. [PubMed: 11770790]
43. Hajhosseini L, Holmes T, Mohamadi P, Goudarzi V, McProud L, Hollenbeck CB. Changes in body weight, body composition and resting metabolic rate (RMR) in first-year university freshmen students. J Am Coll Nutr 2006;25:123–127. [PubMed: 16582028]
44. Kann L, Warren CW, Harris WA, et al. Youth Risk Behavior Surveillance--United States, 1995. MMWR CDC Surveill Summ 1996;45:1–84. [PubMed: 8841032]
45. The Healthy People 2010 Database, Data 2010. Focus Area 22-Physical Activity and Fitness. October 2007 edition. [Accessed October 9, 2007]. http://wonder.cdc.gov/scripts/broker.exe
46. Christakis NA, Fowler JH. The spread of obesity in a large social network over 32 years. N Engl J Med 2007;357:370–379. [PubMed: 17652652]
47. Okun MA, Ruehlman L, Karoly P, Lutz R, Fairholme C, Schaub R. Social support and social norms: do both contribute to predicting leisure-time exercise? Am J Health Behav 2003;27:493–507. [PubMed: 14521246]
48. Polonec LD, Major AM, Atwood LE. Evaluating the believability and effectiveness of the social norms message "most students drink 0 to 4 drinks when they party". Health Commun 2006;20:23–34. [PubMed: 16813486]

**Table 1**

Health-related characteristics of male and female college students

| | Male (n=22) Mean±SEM[a] | Female (n=21) Mean±SEM | *P* |
|---|---|---|---|
| Age, years | 18.6±0.1 | 18.1±0.1 | 0.008* |
| Height, cm | 177.2±0.8 | 164.0±1.4 | <0.001* |
| Weight, kg | 71.0±1.8 | 60.2±1.3 | <0.001* |
| Body Mass Index (BMI), $kg/m^2$ | 22.5±0.6 | 21.9±0.6 | 0.525 |
| Waist Circumference (WC), cm | 79.0±1.3 | 76.7±1.2 | 0.206 |
| Body Fat, % | 15.0±1.2 | 29.9±1.3 | <0.001* |
| Systolic Blood Pressure, mmHg | 124.2±2.2 | 117.1±1.7 | 0.016* |
| Diastolic Blood Pressure, mmHg | 62.3±1.3 | 63.4±1.2 | 0.741 |
| $VO_2$max, ml/kg/min | 55.4±1.5 | 44.8±2.0 | <0.001* |
| Dietary Cognitive Restraint | 6.23±1.0 | 7.67±1.0 | 0.310 |
| Disinhibition | 3.68±0.4 | 4.81±0.5 | 0.080 |
| Feelings of Hunger | 4.36±0.9 | 5.05±0.3 | 0.450 |
| Reported Moderate and High-Intensity Activity, min/wk | 239±41 | 318±82 | 0.394 |
| Average Step Count, steps/day | 10,318±622 | 10,280±644 | 0.966 |

[a]SEM=standard error of the mean.

*Significant difference, males vs. females, *P*<0.05.

**Table 2**

Social cognitive determinants of eating and physical activity behaviors

| | Mean score±SEM[a] | Range |
|---|---|---|
| Dietary Strategies:[b] | | |
| Regulating calories and fat[c] | 2.4±0.2 | 1.0–4.6 |
| Planning and tracking[c] | 2.1±0.1 | 1.0–4.4 |
| Regulating fiber, fruit and vegetables[c] | 3.6±0.1 | 1.7–5.0 |
| Dietary Social Support:[b] | | |
| Fat Support[c] | 2.8±0.1 | 1.3–4.3 |
| Fiber, fruit, and vegetable support[c] | 2.8±0.1 | 1.7–4.7 |
| Dietary Self-Regulatory Efficacy:[b] | | |
| Planning and tracking[d] | 73.4±2.9 | 16.7–100.0 |
| Decreasing fat[d] | 76.1±3.0 | 10.0–100.0 |
| Increasing fiber, fruit, and vegetables[d] | 71.7±3.0 | 23.9–98.3 |
| Reducing sugar[d] | 75.1±2.7 | 21.7–100.0 |
| Dietary Outcome Expectations:[b] | | |
| Positive expectations[c] | 4.2±0.1 | 2.2–5.0 |
| Negative expectations[c] | 2.4±0.1 | 1.0–4.3 |
| Physical Activity:[e] | | |
| Self-regulation for exercise goals[c] | 2.9±0.1 | 1.0–4.9 |
| Self-regulation for exercise plans[c] | 2.8±0.1 | 1.3–4.4 |
| Social support from friends[c] | 2.7±0.2 | 1.0–5.0 |
| Self-efficacy[c] | 3.5±0.1 | 1.3–4.9 |
| Outcome expectations[f] | 5.8±0.1 | 4.1–7.0 |

[a]SEM=standard error of the mean.

[b]Reference (38).

[c]Scored on a scale of 1–5.

[d]Scored on a scale of 0–100.

[e]Reference (42).

[f]Scored on a scale of 1–7.