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Preventing Weight Gain in First Year College Students: An Online Intervention to Prevent the “Freshman Fifteen”

Rachel W. Gow, Ph.D.^a, Sara E. Trace, M.S.^a, and Suzanne E. Mazzeo, Ph.D.^a

^aVirginia Commonwealth University, 806 W. Franklin St., PO Box 842018, Richmond, VA 23284-2018, Phone: 804-827-1708, Fax: (804) 828-2237

Abstract

The transition to college has been identified as a critical period for increases in overweight status. Overweight college students are at-risk of becoming obese adults, and, thus prevention efforts targeting college age individuals are key to reducing adult obesity rates. The current study evaluated an Internet intervention with first year college students ($N = 170$) randomly assigned to one of four treatment conditions: 1) no treatment, 2) 6-week online intervention 3) 6-week weight and caloric feedback only (via email), and 4) 6-week combined feedback and online intervention. The combined intervention group had lower BMIs at post-testing than the other three groups. This study demonstrated the effectiveness and feasibility of an online intervention to prevent weight gain among college students.

Keywords

college freshman; weight gain; obesity prevention

1. Introduction

In the last decade, obesity rates increased rapidly among individuals ages 18 to 29, from 7.1% in 1991 to 12.1% in 1999 (Mokdad et al., 1999), and more recent data suggest this trend is on an increasing trajectory (Mokdad et al., 2003). For many young adults, the transition to college occurs within this age range. A small number of studies have recently begun to investigate the validity of the “freshman fifteen,” a colloquialism referring to weight gain occurring during the transition from high school to college.

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Corresponding Author: Suzanne E. Mazzeo, Ph.D., semazzeo@vcu.edu.

Contributors

Authors Gow and Mazzeo designed this study and wrote the protocol. Authors Gow and Trace conducted literature searches and provided summaries of previous research studies. Author Gow conducted the statistical analysis and wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

This study was based on a doctoral dissertation completed by Rachel W. Gow at the Virginia Commonwealth University, conducted under the direction of Suzanne E. Mazzeo.

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Conflict of Interest

The authors have no conflicts of interest.

Although results across studies are somewhat inconsistent, multiple investigations have suggested that the transition to college can be a time of significant and rapid weight gain (e.g., Anderson, Shapiro, & Lundgren, 2003; Holm-Denoma, Joiner, & Vohs, 2008; Levitsky, Halbmaier, & Mrdjenovic, 2004). The average weight gain in the first semester of college ranged from 3.5 (Holm-Denoma et al., 2008) to 7.8 pounds (Lloyd-Richardson, Bailey, Fava, & Wing, 2006). These findings are alarming because a relatively small weight gain can place an individual's Body Mass Index (BMI) in the overweight range (Levitsky et al., 2004). Indeed, in one study, the percentage of individuals classified as overweight increased from 21% to 32% in the first semester of college (Anderson et al., 2003). Because overweight and obesity are associated with several negative health and psychosocial outcomes (e.g., Calle, Thun, Petrelli, Rodriguez, & Heath, 1999; Neumark-Sztainer & Haines, 2004), it is important to develop prevention programs for college students as they enter this high-risk transition period.

1.1 Weight Gain Prevention among College Students

Few obesity prevention programs have specifically targeted college students. Interventions that have been successful in preventing weight gain have involved face-to-face psychoeducation (Stice, Orjada, & Tristan, 2006), psychoeducation plus behavioral techniques (Hivert, Langlois, Berard, Cuerrier, & Carpentier, 2007), or daily e-mail feedback to participants about changes in weight and caloric intake based on students' self-reports (Levitsky, Garay, Nausbaum, Neighbors, & DellaValle, 2006). Each of these programs is described in greater detail in the following section.

Stice et al.'s (2006) psychoeducational intervention involved a semester long college course on eating disorders and obesity. Intervention participants gained significantly less weight than control participants who gained an average of 4.5 kg at six-month follow-up. Further, there was a reduction in eating disorder symptoms, thin-ideal internalization, body dissatisfaction, and dieting in the intervention participants. Hivert et al. (2007) targeted weight gain, physical activity, and caloric intake among first year students in a randomized controlled trial of an educational and behavioral intervention. The intervention group lost weight (.2 kg) while the control group's weight increased (1.2 kg) in the first year of the study. Another series of studies which targeted first-year college students (Levitsky et al., 2006) demonstrated the effectiveness of participant weight monitoring and researcher feedback via the Internet in preventing weight gain. Over two studies the control groups gained significantly more weight ($M = 3.1$ kg and $M = 2.0$ kg) than the treatment groups ($M = 0.1$ kg and $M = -0.82$ kg).

Although these studies yielded positive results, several important limitations should be noted. First, Stice's psychoeducational intervention (Stice et al., 2006) did not target first year students, a group at elevated risk of weight gain during the transition to college. This time period might be a particularly fruitful one for prevention efforts. Additionally, instead of a randomized control group, a matched group of another class was used. Random assignment of participants to conditions is ideal to ensure that comparison groups are equivalent on potential confounding variables at baseline (Shadish, 2002). In addition, the psychoeducation program (Stice et al., 2006) was only accessible to students who had the time, interest, and resources needed to attend such a course. Further, it is unlikely that most universities could offer such a course because of restricted resources (e.g., time, faculty availability, costs), which limits potential for widespread dissemination of the program. Additionally, factors typically associated with weight maintenance (and particularly relevant to college students) such as healthy body image, eating and exercise behaviors were not addressed by Levitsky et al.'s (2006) study. Further, the results of this study may not generalize to other university settings given the small, predominantly White sample, and the relatively high average socio-economic status of students at this university.

The feasibility and efficacy of Internet interventions have been demonstrated across a wide range of physical and mental health conditions, including smoking cessation, chronic pain management, and cardiac rehabilitation (Bennett & Glasgow, 2009). Overall, Internet interventions are underutilized given the high percentage of Americans with Internet access; however, higher rates of utilization were noted among college-educated individuals (Bennett & Glasgow, 2009). Thus, Internet interventions might be particularly well-received within a college population. In fact, several studies have demonstrated the feasibility of various Internet-based interventions targeting eating disorders among college students (Lowe et al., 2006; Zabinski et al., 2001). However, only one Internet-based study has attempted to prevent weight gain in first year college students (Levitsky et al., 2006). This study suggests that low intensity Internet-based approaches may be feasible and effective for the college population (Levitsky et al., 2006).

To date, no study has compared interactive psychoeducation and Internet feedback (weight and caloric) interventions or examined the combination of these methods. Therefore, the current study investigated the effectiveness of an Internet-based weight-gain prevention program in first semester college students that combined participant monitoring, feedback, and education on healthy lifestyle behaviors and body image. In contrast to previous work that emphasized feedback regarding weight and caloric intake only or psychoeducation/behavioral intervention alone, this study had multiple intervention arms which facilitated comparisons of different treatment types. These arms were: 1) weight and caloric feedback occurring within the context of a comprehensive, six-week Internet intervention addressing healthy eating, increased physical activity, media literacy and positive body image (i.e., the combined group), 2) weight and caloric feedback alone, 3) the Internet intervention alone, and 4) the no treatment control group.

The primary study outcome was Body Mass Index (BMI); secondary outcomes were eating and weight related attitudes and behaviors. We hypothesized that, relative to participants in the no treatment control condition, participants in the feedback, Internet intervention, and combined feedback and Internet intervention groups would have lower BMIs at post-testing. Participants in the combined group were expected to have lower BMIs and higher rates of health-promoting behavior such as higher fruit and vegetable intake, lower fat intake, and more physical activity than those in the Internet intervention, feedback, and control groups at post-testing. Further, the Internet intervention and the combined intervention group participants were expected to report less disordered eating behaviors and body image dissatisfaction than the feedback only and control groups at post-testing.

2. Method

A four-arm randomized pretest-posttest control group design with three month follow-up was used to determine the effect of the intervention on participants' BMI and other related study measures among first year students (Campbell & Stanley, 1963). This study aimed to include at least 44 participants/arm, which was expected to yield power ≥ 0.80 , based on $\alpha \leq 0.05$ and assuming a medium effect size (i.e., $f = 0.25$; Cohen, 1977).

2.1 Participants

Participants ($N = 170$) were first year students recruited from Introduction to Psychology courses at a large southeastern public university. Recruitment occurred at the beginning of the fall semester through brief classroom announcements and fliers. Participants had to be healthy first year college students aged 22 years or younger to be eligible for this study. Healthy participants were defined as those without a chronic medical or psychiatric condition including, but not limited to, cardiovascular disease, schizophrenia, anorexia nervosa or bulimia nervosa. Two participants were excluded after completing baseline measures because they were not first

year students; none were excluded based on any health or psychiatric problem. Following baseline assessments, 159 participants, male ($n = 41$) and female ($n = 118$), chose to participate in the intervention phase of the study. The following ethnicities were represented in the current sample: 53.8% ($n = 85$) White; 22.2% ($n = 35$) African American; 10.8% ($n = 17$) Asian; 2.5% ($n = 4$) Hispanic; and 10.8% ($n = 17$) "Other." The mean age of participants was 18.10. Participants described their living situations as in the dormitory with roommates (60.8%); alone in a dormitory (4.4%); off-campus with family (21.5%); apartment with roommates (10.8%); and other (2.5%).

BMI was calculated as weight (kg)/height (m)² (World Health Organization, 1995). For adults, BMI is categorized into the following weight statuses: underweight (≤ 18.5), normal weight (18.5 - 24.9), overweight (25.0 - 29.9), and obese (≥ 30.0). The mean BMI was 24.38 (SD = 5.05) with a range from underweight (BMI = 17.52) to severely obese (BMI = 41.01).

2.2 Procedure

Participants completed baseline assessments and then, following review of screening criteria (discussed above), eligible individuals were randomly assigned to the Internet intervention arm ($n = 40$), feedback intervention arm ($n = 39$), combined intervention arm ($n = 40$), or the control group ($n = 40$). A software program was used to randomly assign participants to groups and to select randomly which group would have the lower number of participants. Post-test measures were completed within one week of the end of the 6-week intervention and follow-up measures were completed three months after completion of the intervention.

2.2.1 Research setting—Height and weight measures were collected in person by the principal investigator and trained research assistants. Surveys were administered to participants through a secure website called Sona Systems© and the interventions were administered through a secure website, Blackboard© (an Internet classroom tool used in many university settings); both sites are maintained by VCU. Blackboard© was also used to track participant access of intervention materials.

2.2.2 No treatment control group—Participants in the no treatment control group completed baseline, post, and three-month follow up questionnaires and anthropometric measures. They did not receive an intervention.

2.2.3 Feedback intervention group—Participants in the feedback group were asked to weigh themselves in a VCU gym and report their weight to the principal investigator once each week via Blackboard©. Each week a graph representing individualized change in weight was emailed to participants' private email accounts with a corresponding statement of equivalent caloric change. The difference in weekly weights was converted to calories using the standard conversion of 3500 kcal/lb.

2.2.4 Internet intervention group—This Internet intervention was based on a face-to-face group focused on healthy eating and exercise that was developed and pilot tested with parents of overweight or obese children (Mazzeo et al., 2008). This original intervention was grounded in Social Cognitive Theory (SCT, Bandura, 1986). With this intervention as a guide, the current study focused on developing and implementing an intensive, six-session, Internet intervention. The basic concepts of the previous intervention were retained; however, the material was modified to address the unique attitudes and behaviors often associated with the transition period to college. More specifically, parenting strategies related to promoting healthy eating and exercise in younger children were removed and factors in the college environment that have been shown to contribute to student weight gain were added (e.g., access to all-you-can eat commercially prepared foods, snacking, media advertising, and inactivity). The following

topics were covered: the significance of overweight and obesity, the role of the “toxic” college environment, nutrition, increasing physical activity, decreasing sedentary behavior, mindfulness of hunger and satiety cues, healthy body image, media literacy, and motivation.

The weekly sessions were delivered via Blackboard®. Participatory activities were incorporated throughout, including self-assessments, group discussions via the Blackboard® discussion board and experiential activities (e.g., mindful eating). Sessions were designed to last approximately 45 minutes each and focused on environmental, personal, and behavioral factors involved in maintaining a healthy weight. Participants were given homework assignments that encouraged implementation of the new skills (Stewart, Carter, Drinkwater, Hainsworth, & Fairburn, 2001). Also, online asynchronous discussion groups were facilitated by the principal investigator, a trained clinician, who monitored for signs of clinical distress related to the intervention; no distress was reported or observed throughout the intervention. Treatment adherence was assessed through a Blackboard® tool allowing instructors to view participants’ access of materials on the Internet site. Participation credit was provided if materials were viewed. No minimal viewing time was set because materials could be downloaded, and, thus time spent actually using them could not be not accurately measured.

2.2.5 Combined feedback and Internet intervention group—The combined feedback and Internet intervention group received the six week online intervention and weight and caloric feedback as described previously.

2.2.6 Participant compensation—All participants received research credit for completion of assessments and each week of participation in the intervention. Additionally, participants were entered into a raffle each week of the intervention for one of ten \$7.50 gift cards to the university bookstore. Participants who completed post-testing and/or three month follow-up measures had the chance to win one of two \$50 gift cards from a local department store at each time point.

2.3 Measures

2.3.01 International Physical Activity Questionnaire, Short, Last 7 Days, Self-administered Format (IPAQ)—The IPAQ asks participants to recall their physical activities in the last seven days. The IPAQ yields a total physical activity score, as well as four subscale scores: walking activity, moderate physical activity, vigorous physical activity, and sedentary activity. It has acceptable validity and reliability (Craig et al., 2003).

2.3.02 Binge Eating Scale (BES)—The BES is a 16 item self-report measure of binge eating symptomatology. This measure discriminates effectively among individuals with no, moderate, and severe binge eating behaviors (Gormally, Black, Daston, & Rardin, 1982). The BES yields internally consistent scores (Cronbach’s $\alpha = .85$; Gormally et al., 1982). In the current study, internally consistent scores were observed at baseline (Cronbach’s $\alpha = .86$).

2.3.03 Block Food Screener (BFS)—The BFS (Block, Gillespie, Rosenbaum, & Jenson, 2000) is a 27 item screener used to assess dietary intake and has been found to be an accurate tool for measuring dietary intake in adult populations when compared to multiple day food intake records (Block et al., 2000). In the current study, scores were calculated for fiber, fat, and fruit and vegetable intake.

2.3.04 Body Rating Scale (BRS)—The BRS includes nine schematic figures of adolescent females and males ranging from “1” representing the most underweight figure to “9” representing the most overweight figure. The measure’s validity has been demonstrated and adequate two-week test-retest reliability reported (Thompson & Altabe, 1990). Body

dissatisfaction (BD) scores are derived by subtracting the ideal body size rating from the current body size rating (Stunkard, Sorenson, & Schulsinger, 1983). Positive scores indicate that current body size is greater than ideal body size; negative scores indicate smaller current than ideal body size.

2.3.05 Three Factor Eating Questionnaire (TFEQ)—The TFEQ is a 51-item, self-report questionnaire with three subscales: cognitive restraint, disinhibition, and susceptibility to hunger (Stunkard & Messick, 1988). The developers found support for the content, construct, and criterion-related validity of the TFEQ, and all subscales yielded internally consistent scores (Cronbach's $\alpha = .93$, Stunkard & Messick, 1988). A more recent study reported reliability scores for each subscale: cognitive restraint (.84), disinhibition (.78), and hunger (.80; Karlsson, Persson, Sjostrom, & Sullivan, 2000). The current study also found support for the internal consistency of the subscales: restraint (Cronbach's $\alpha = .82$), disinhibition (Cronbach's $\alpha = .76$), and hunger (Cronbach's $\alpha = .84$).

2.3.06 Eating Behaviors Questionnaire (EBQ)—This measure is a shortened version of a questionnaire developed by Levitsky et al. (2004) for their study of weight gain in first year students. This version included questions about eating frequency, quantity and type of food consumed, as well as the number of people with whom one consumes meals.

2.3.07 Eating Disorder Inventory (EDI)—The EDI is a 64-item self-report measure with eight subscales (Garner, Olmsted, & Polivy, 1983). Response options range from 1 = *always* to 6 = *never*. Only the body dissatisfaction (EDI-BD) and drive for thinness subscales (EDI-DFT) were used in this study. The EDI-BD and EDI-DFT yielded internally consistent scores (Cronbach's $\alpha = .91$ and $.90$, respectively) in the current study. Garner et al. (1983) reported adequate criterion-related, convergent, and discriminant validity for EDI subscales.

2.3.08 Eating Disorder Screening Questions—Eating disorder symptomatology was assessed (to screen out individuals with eating disorders) using a questionnaire adapted from a Mid-Atlantic Twin Registry survey (Bulik, Sullivan, Wade, & Kendler, 2002). Questions correspond to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision's (American Psychiatric Association, 2000) criteria for eating disorder symptoms.

2.3.09 Smoking items—Three items assessing cigarette use were administered to assess smoking frequency. These items were taken from the Bridge to Better Health Survey, which has been used in previous studies of health risk behaviors in adolescents (Fries et al., 2001). Items assess whether participants have ever tried smoking, and smoking frequency within the last month (number of days and number of cigarettes per day).

2.3.10 Demographic Questionnaire—This questionnaire asked participants to report their age, year in school, ethnicity, gender, current living situation, history of chronic health and psychiatric problems (for screening purposes).

2.3.11 Anthropometric Measures—Height was measured to the nearest 1/8 inch using a stadiometer. Weight was measured to the nearest 1/4 lb. using a medical balance beam scale. These data were used to calculate BMI.

3. Data Analysis

Analyses of variance (ANOVAs) were conducted at baseline to assess for any significant differences among the four groups (three intervention, one control). The specific hypotheses of this study were evaluated using analyses of covariance (ANCOVAs), controlling for the influence of pre-test scores on each measure. In these analyses, time of assessment was the

within-subjects variable, and group (feedback only, Internet intervention only, combined intervention, or control) was the between-subjects variable. Outcomes were participants' scores at post-testing and three-month follow-up.

3.1 Intent-to-Treat Analysis

Analyses were conducted using an intent-to-treat (ITT) approach. This approach analyzes all the data based on participants' assigned group, regardless of whether they actually complete the intervention or not (Hulley et al., 2001). Thus, participants' most recent data were used as their post-intervention scores. ITT protects against threats to validity from attrition (Spilker, 1991). Chi-square analyses were conducted to determine whether attrition rates differed by treatment condition.

4. Results

4.1 Analyses of Attrition

Nine participants (5.3%) completed baseline height and weight assessments without subsequently completing questionnaires or participating in the intervention phase. After the remaining participants were assigned to an intervention group, nine participants did not participate in any of the weekly sessions. Baseline scores for participants who completed the post-intervention assessment and those who chose not to participate in the intervention were compared via independent samples *t*-tests. Results indicated that individuals who participated in the intervention ($M = 30.22$, $SD = 11.82$; $t(10.76) = -2.54$, $p < .05$) had significantly greater EDI body dissatisfaction scores than individuals who only completed baseline measures ($M = 23.56$, $SD = 7.30$).

In addition, independent samples *t*-tests assessed differences between individuals who attended four or more intervention sessions (i.e., "completers"; $n = 126$) and those who dropped out (i.e., attended three or less sessions; $n = 33$). This cutoff was selected because four sessions represents a majority; thus, individuals who had attended this proportion of the intervention could be considered to have a clinically significant "dose" of their assigned treatment). A significant difference was found between drop outs ($M = .92$, $SD = 1.47$; $t(154) = -2.32$, $p < .05$) and completers ($M = 1.68$, $SD = 1.69$) on the BFS; drop outs reported less fruit and vegetable consumption. No significant differences were observed on any of the other measures ($p > .05$).

To compare baseline scores for the four intervention groups, one-way analyses of variance (ANOVAs) were performed. No significant differences were found among groups on any measures.

The influence of gender and ethnicity on attrition was examined using chi-square analyses. These analyses compared individuals who completed ($n = 109$) and those who did not complete post-intervention measures ($n = 50$). No differences in ethnicity or gender were observed between those who completed the intervention and those who did not.

A significant difference in completion rates was observed across treatment groups ($\chi^2(3) = 9.21$, $p < .05$). Specifically, the lowest retention rates were observed for the Internet intervention (56.1%) and feedback groups (59%), while the highest retention rates were noted for the combined intervention group (79.5%) and the control group (80%). Across all four groups, 68.6% of participants completed post-intervention assessments, while 79.2% of participants attended at least three intervention sessions.

4.2 Baseline to Post-intervention Analyses

Significant post-intervention differences were found for the primary outcome, BMI, ($F(3,154) = 5.98, p < .05$, partial eta squared = .10) after controlling for the effect of baseline BMI. Planned contrasts revealed that the combined intervention group ($M = 24.13, SE = .09$) had significantly lower BMI scores than the control group ($M = 24.56, SE = .09, p < .05$); however, the Internet intervention group and feedback group did not significantly differ on BMI compared to the control group ($ps > .05$). Additionally, post-hoc comparisons using a Bonferroni test indicated that the mean BMI for the combined intervention group was significantly lower than the Internet intervention group ($M = 24.58, SE = .09$) and feedback group ($M = 24.59, SE = .09$). Nine participants changed BMI categories across groups (e.g. from overweight to obese). Table 1 provides a summary of BMI data across groups.

Also, analyses of covariance revealed significant group differences on an EBQ “number of cigarettes per day” item ($F(3, 27) = 3.65, p < .05$, partial eta squared = .29). A Bonferroni post-hoc test indicated significantly fewer cigarettes/day in the control group ($M = 3.76, SE = .44, p < .05$) compared to the feedback group ($M = 1.45, SE = .56$). There were no significant differences observed on any of the other measures. Table 2 provides baseline and post-intervention means for all measures.

Adherence—Variation in treatment adherence (measured as weeks of participation) was assessed using ANOVA for the three intervention arms (combined intervention, feedback intervention, and Internet intervention). A significant difference in adherence was observed among the intervention arms, $F(2,116) = 9.78, p = .000$, partial eta squared = .14. Post-hoc comparisons using a Bonferroni test indicated that the duration (measured as mean weeks of participation) for the feedback group ($M = 5.21, SD = 1.28$) was significantly higher than the combined intervention group ($M = 4.74, SD = 1.57, p = .015$) and the Internet intervention group ($M = 3.85, SD = 1.31, p = .000$). The percentage of participants who completed four or more weeks of participation was: 82.1% in the combined intervention group, 65.8% in the internet intervention group, and 89.9% in the feedback group.

4.3 Three-month Follow-up Analyses

A small number of participants ($n = 18$) completed follow-up measures. Thus, analyses of these data were not conducted.

5. Discussion

The transition to college has often been identified as a potentially critical period for increases in weight among young adults (e.g., Anderson et al., 2003; Butler, Black, Blue, & Gretebeck, 2004; Hovell, Mewborn, Randle, & Fowler-Johnson, 1985; Levitsky et al., 2004; Racette, Deusinger, Strube, Highstein, & Deusinger, 2005). In the current study, the effects of an Internet psychoeducation intervention with personalized weight and caloric intake feedback were compared to those of: 1) an Internet psychoeducation alone, 2) feedback alone, and 3) a no treatment control. In addition, these interventions were implemented among first year students in an ethnically diverse, urban university. Despite the higher rates of overweight and obesity among African Americans (Mokdad et al., 2003), previous studies of interventions targeting weight gain prevention among first year college students have not included ethnically diverse samples.

As hypothesized, participants in the combined intervention had significantly lower BMI scores at post-testing than those in the Internet intervention, feedback intervention, and control groups. It was hypothesized that participants in all intervention arms would have significantly lower BMIs at post-testing than the control group. This was not supported; the BMIs of participants

in both of the single-component interventions (the feedback group and Internet intervention group) did not significantly differ from the BMIs of the control group at post-testing. Thus, it appears that the combined intervention was more effective at preventing increases in BMI than the other interventions. This finding suggests that the combination of participant monitoring, feedback, and education delivered in the combined intervention had a stronger effect on healthy lifestyle behaviors than addressing each of these components separately. It is unclear whether the combination of interventions or the intensity of treatment (i.e., more participation time) influenced the results. Nevertheless, this finding suggests that interventions designed to prevent weight gain during the transition to college need to include multiple components and be highly structured to achieve the desired results. Similar results have been yielded in other studies utilizing Internet interventions for weight loss (Bennett & Glasgow, 2009) and binge eating (Jones et al., 2008). This is not surprising when one considers how difficult it is to change eating and exercise behaviors; most obesity prevention studies (79%) have proven ineffective in reducing weight gain (Stice, Shaw, & Marti, 2006).

Nonetheless, while the observed differences in BMI across intervention groups were statistically significant, on average, participants in all groups appeared to be more successful in maintaining their weight than were first year students included in previous studies of weight gain during the transition to college. As noted previously, studies of first year college students have reported an average weight gain between 4.2 and 7.8 pounds (Hoffman, Policastro, Quick, & Lee, 2006; Levitsky et al., 2004; Lloyd-Richardson et al., 2006; Racette et al., 2005). In contrast, the average weight gain ranged from -.12 to 1.47 pounds across the current study's groups. The current results might be also be influenced by the inclusion of an urban, ethnically diverse sample (which differs from the predominantly White samples used in previous studies), compensatory rivalry among groups, or an attention effect. In addition, some studies (e.g., Hivert et al., 2007; Levitsky et al., 2006; Matvienko, Lewis, & Schafer, 2001) assessed students over the entire first year, while the current investigation included only one semester (i.e., a 6 week intervention, with 10 weeks elapsing between pre and post-assessments). Students might be likely to gain more weight over a longer time period. Finally, it is possible that, regardless of assignment, simply knowing that they were involved in a study addressing weight and related behaviors likely sensitized individuals in all groups (including the control condition) and might have made them more aware of their relevant behaviors. This awareness, in turn, could have limited weight gain in the entire sample.

Additionally, Levitsky et al.'s (2006) study found that participants in an Internet based weight and caloric feedback intervention maintained their initial weight while control participants gained weight ($M = 2.0$ to 3.1 kg or approximately 4.4 to 6.8 pounds) in the first semester of college. However, the current study found no significant BMI differences between the feedback and control groups. Interestingly, yet unexpectedly, a relatively high percentage of control participants lost weight (approximately 10% lost at least four pounds) compared to the feedback group in which no participant lost more than four pounds. The inconsistency between these studies might be related to Levitsky et al.'s (2006) small, predominantly White, female sample ($N = 34$) or as mentioned previously, attention effects or compensatory rivalry.

Although participants in the combined intervention had lower post-test BMIs than the Internet intervention, feedback, and control groups, there were no differences among groups in rates of health-promoting behavior such as higher fruit and vegetable intake, lower fat intake, and more physical activity. The self-report measures used in this study might have limited the ability to detect significant changes in physical activity and eating behaviors (due to potential social desirability effects). Thus, additional studies using a range of assessment methods (e.g., accelerometers) are needed to examine the behavioral changes that facilitated weight change among groups.

Interestingly, Internet feedback participants smoked more cigarettes daily compared to controls. This finding is concerning as smoking is associated with numerous physical health problems (Kandel & Merrick, 2003; Miller, Wilbur, Chandler, & Sorokin, 2003; Tyc, Klosky, Throckmorton-Belzer, Lensing, & Rai, 2004) as well as with disordered eating behaviors (Welch & Fairburn, 1998), including binge eating (Tomori, Zalar, Kores, Ziherl, & Stergar, 2001), and restraint (Jerry, Coombs, Polivy, & Herman, 1998). In addition, results of a recent study suggested that disordered eating behavior and body dissatisfaction mediate the relationship between smoking and general distress in college students (Trace, Mitchell, Gow, & Mazzeo, In progress). The current study's finding might suggest that weight monitoring, in the absence of psychoeducation and support, could promote body dissatisfaction and unhealthy weight management behaviors designed to suppress appetite. Future research should evaluate further the relations among weight monitoring, disordered eating behaviors, and smoking in college students.

The small to moderate effect size observed for BMI differences among groups in this study (partial eta squared = .10; Cohen's $d = .29$) is relatively consistent with Stice et al.'s (2006) meta-analysis results of obesity prevention studies which have yielded a mean effect size that was small ($r = .04$). The current study might have had a smaller effect size because the interventions were less intense than some previously used. For example, Matkienko et al. (2001) and Stice et al. (2006) evaluated interventions that were approximately 15 weeks in duration. Similarly, participants in Levitsky et al.'s study (2006) participated for seven consecutive days. Larger effect sizes have been associated with interventions less than 16 weeks (Stice et al., 2006); however, the current study findings suggest that a larger effect size may be obtained with interventions longer than 6 weeks, but less than 16 weeks.

Retention rates were best for the combined and control groups; more individuals dropped out of the feedback and Internet intervention groups. This might be due to greater investment by combined intervention participants given the greater time demand for this group. On the other hand, control participants had the least time demands while benefiting from the same number of credits. Thus, their incentive was greatest to complete the study.

In addition, individuals who chose to participate in the intervention after completing baseline measures had significantly higher body dissatisfaction at baseline than individuals who only completed pre-test measures. Thus, the intervention might have been more appealing to students who were dissatisfied with their weight/shape compared to those who were more comfortable with their bodies. This intervention was designed for individuals concerned about their eating or weight and, thus, from this perspective, the targeted audience received the intervention. Also, intervention participants (vs. those who elected not to be randomized to any of the intervention arms) reported higher fruit and vegetable intake at baseline, suggesting that these individuals were more interested and possibly more motivated to engage in health behavior change. Furthermore, some research suggests that moderate levels of body dissatisfaction can be adaptive in facilitating weight loss through increased health behaviors among individuals who are overweight or obese (Millstein et al., 2008). Nonetheless, research is needed to understand better the needs of individuals who did not participate in the intervention.

Other limitations of this study should be noted as well. Specifically, the use of self-report measures of diet and exercise is less ideal than direct measures. Dietary intake interviews and the use of tools such as accelerometers were not within the budget available to conduct this pilot study. Future studies should incorporate these more objective measures. Also, this study's sample size might have limited the ability to assess significant differences among treatment groups, especially as effect sizes for these obesity intervention studies are typically small to moderate. Further, three month follow-up retention was poor, likely because fewer participants

were enrolled in psychology courses (i.e., had no incentive to participate as a part of their course). Participants might have been more motivated to receive research credit than to prevent weight gain in their first semester of college. Finally, the results of this investigation might not generalize to individuals who are not enrolled in college.

Nevertheless, this study had several strengths including the use of random assignment, direct measures of BMI, comparison of multiple treatment conditions to a control group, and the use of rigorous intent to treat analyses. Also, the current study implemented and evaluated theory-based interventions. Thus, this study was both unique and produced significant effects in a short period of time with an ethnically diverse sample. This study was also relatively cost-effective as it used an Internet platform (i.e., Blackboard©) that is already widely used across universities, and thus, does not place a significant financial burden on interventionists.

In sum, this study demonstrated the feasibility of an inexpensive Internet-based intervention in preventing weight gain among college students in the first semester of college. In particular, the combination of weight and caloric feedback with an Internet based intervention showed promising results. These results suggest that a lower intensity intervention, such as the Internet only or feedback only group, is less effective in preventing weight gain. Further, the results of this study indicate that interventions aimed at preventing weight gain might be more successful if they are interactive, targeted at at-risk populations, and are available on the Internet. Online interventions allow individuals to participate at their convenience, and provide anonymity in discussion groups and the weight feedback process. Delivery of this intervention might be feasible with other young adults outside of college given the popularity and accessibility of the Internet.

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Table 1

Summary of group means for pre- and post-intervention comparisons of BMI and weight change.

	Combined Intervention		Internet Intervention		Feedback Intervention		Control Group	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Unadjusted Mean BMI (SD)	23.64 (5.18)	23.39 (5.14) ^{abc}	25.02 (5.41)	25.21 (5.40) ^a	24.70 (4.93)	24.91 (4.94) ^b	24.12 (4.72)	24.30 (4.68) ^c
Adjusted Mean BMI (SE)	--	24.13 (.09)	--	24.58 (.09)	--	24.59 (.09)	--	24.56 (.09)
Underweight (n)	4	4	2	2	0	0	0	0
Normal Weight (n)	24	24	22	20	26	26	26	26
Overweight (n)	6	8	10	12	8	8	9	10
Obese (n)	5	3	7	7	5	5	5	4
Weight (lbs) Change (SD)	--	-1.12 (2.92)	--	1.47 (3.22)	--	1.20 (2.55)	--	1.04 (3.45)

* corresponding letters indicate significant differences among groups

Table 2

Baseline and post-intervention means by group

	Combined (Internet & Feedback)		Internet Intervention		Feedback		Control	
	Baseline Mean (SD)	Post Mean (SE)	Baseline Mean (SD)	Post Mean (SE)	Baseline Mean (SD)	Post Mean (SE)	Baseline Mean (SD)	Post Mean (SE)
BES	9.84 (7.39)	8.36 (.72)	8.39 (8.66)	9.74 (.69)	9.38 (7.85)	10.05 (.76)	9.76 (5.35)	9.91 (.72)
BRS Discrepancy	-0.68 (1.33)	-.92 (.15)	-0.62 (1.02)	-.89 (.14)	-1.35 (1.07)	-.88 (.14)	-0.94 (0.95)	-.69 (.14)
EDI Drive for Thinness	19.66 (10.11)	21.96 (.70)	21.04 (8.76)	21.24 (.67)	22.71 (10.05)	21.43 (.70)	22.26 (8.54)	22.08 (.67)
EDI Body								
Dissatisfaction	29.80 (12.79)	29.95 (.82)	28.22 (10.41)	29.73 (.79)	31.59 (12.15)	30.99 (.82)	29.35 (11.12)	30.44 (.81)
Block Fat	105.95 (18.04)	104.60 (2.30)	104.70 (28.59)	102.58 (2.19)	106.30 (22.25)	102.03 (2.31)	95.39 (19.16)	104.56 (2.30)
Block Fiber	14.44 (4.70)	15.81 (.57)	15.48 (4.32)	15.66 (.56)	14.54 (5.00)	15.09 (.58)	15.35 (4.23)	14.80 (.57)
Block Fruit/Veg	1.32 (1.67)	1.73 (.21)	1.87 (1.54)	1.63 (.21)	1.46 (1.64)	1.57 (.22)	1.80 (1.43)	1.44 (.21)
TFEQ Restraint	6.33 (4.30)	9.20 (.59)	7.21 (5.27)	8.71 (.56)	8.61 (4.26)	8.71 (.58)	8.33 (4.77)	8.88 (.63)
TFEQ Disinhibition	8.79 (3.53)	9.01 (.29)	9.00 (3.81)	8.89 (.29)	8.95 (3.94)	8.58 (.30)	8.76 (3.15)	8.99 (.30)
TFEQ Hunger	8.58 (4.20)	9.56 (.36)	8.82 (4.41)	9.26 (.35)	10.50 (4.36)	8.74 (.37)	9.20 (3.80)	8.53 (.37)
IPAQ Total	2782 (2845)	4119 (563)	4725 (56)	3059 (541)	4678 (6041)	5005 (576)	3289 (3108)	4304 (560)
IPAQ Walk	937 (675)	2203 (466)	2278 (3414)	1377 (446)	2258 (3371)	2588 (475)	1382 (1718)	2145 (461)
IPAQ Moderate	620 (1812)	914 (233)	828 (1315)	899.30 (227)	629 (1302)	1128 (233)	505 (1033)	772 (230)
IPAQ Vigorous	1037 (1468)	939 (229)	2786 (4407)	909 (223)	1942 (3236)	1479 (229)	1138 (1305)	1270 (226)
EBQ Cigs/day	.67 (2.15)	2.36 (.61)	1.58 (4.04)	2.36 (.41)	1.48 (3.23)	3.76 (.44) ^a	1.27 (4.27)	1.45 (.56) ^a

* corresponding letters indicate significant differences among groups