

Weight Changes, Exercise, and Dietary Patterns During Freshman and Sophomore Years of College

Susan B. Racette, PhD; Susan S. Deusinger, PT, PhD; Michael J. Strube, PhD; Gabrielle R. Highstein, RN, PhD; Robert H. Deusinger, PT, PhD

Abstract. Weight gain and behavioral patterns during college may contribute to overweight and obesity in adulthood. The aims of this study were to assess weight, exercise, and dietary patterns of 764 college students (53% women, 47% men) during freshman and sophomore years. Students had their weight and height measured and completed questionnaires about their recent exercise and dietary patterns. At the beginning of freshman year, 29% of students reported not exercising, 70% ate fewer than 5 fruits and vegetables daily, and more than 50% ate fried or high-fat fast foods at least 3 times during the previous week. By the end of their sophomore year, 70% of the 290 students who were reassessed had gained weight (4.1 ± 3.6 kg, $p < .001$), but there was no apparent association with exercise or dietary patterns. Future research is needed to assess the contributions of fat, muscle, and bone mass to observed weight gain and to determine the health implications of these findings.

Key Words: body mass index, college students, diet, exercise, weight

An epidemic of overweight and obesity is evident among all age groups, including children and adolescents.¹ According to the 2002 report of the National Health and Nutrition Examination Survey,² 64.5% of American adults are overweight, the highest prevalence ever observed. The greatest increases in overweight and obesity seem to occur in persons between the ages 18 and 29 years, based upon results of the Behavioral Risk Factor Surveillance System,³ a cross-sectional telephone survey of women and men aged 18 years and older. These latter results suggest that the transition between

adolescence and adulthood, a common age for college attendance, frequently is accompanied by dramatic and inappropriate weight gain. Furthermore, evidence from the 1995 College Health Risk Behavior Survey^{4,5} indicates that dietary and activity patterns of many college students predispose them to future health problems.

Sedentary lifestyles and excess calorie intake contribute to overweight and obesity, and the period between adolescence and early adulthood is accompanied by lifestyle changes that predispose young adults to become less physically active.⁶⁻¹⁰ Data from the National Health Interview Survey,⁶ which included 10,645 males and females aged 12 to 21 years, and 43,732 men and women aged 18 years and older, indicate that participation in vigorous aerobic and strengthening activities declines progressively between the ages of 12 and 21 years. Similarly, the National Heart, Lung, and Blood Institute's Growth and Health Study,⁷ a 10-year annual assessment of physical activity in 2,322 girls beginning at ages 9 to 10, showed significant reductions in physical activity by age 18 to 19 years. The greatest deterioration in physical activity has been observed between the ages of 15 and 18 years, and a continuous decline is common between 18 and 29 years of age.⁶ Data from the Centers for Disease Control and Prevention (CDC)⁸ reveal that only 25% of high school students and 25% of adults in America engage in the recommended levels of physical activity, despite the overwhelming evidence that physical activity and exercise favorably affect weight control, disease prevention, and overall health at all ages.

Weight gain during the first year of college has been described as a problem for many students, but there is little evidence to support or refute these anecdotal reports. Because the United States is moving farther from, rather than toward, the physical activity and body mass index (BMI) goals established in *Healthy People 2010*,¹¹ it is

The authors are with Washington University in St. Louis, Missouri. Susan B. Racette is an assistant professor, Susan S. Deusinger is a professor and director of the program in physical therapy, Gabrielle R. Highstein is a research instructor, and Robert H. Deusinger is an assistant professor, all at Washington University School of Medicine. Michael J. Strube is a professor of psychology at Washington University.

important to understand the influence that college life has on these trends. We therefore sought to learn more about adolescents entering college as well as the impact of the first 2 years of college life on their body weight, exercise, and eating patterns. The 2 aims of this study were (1) to assess body weight, height, BMI, and exercise and dietary habits of first-year students upon entrance into college, and (2) to assess changes in these dimensions during freshman and sophomore years.

METHOD

We conducted this study at Washington University in St. Louis, Missouri, a medium-sized, independent university with student and faculty representation from all 50 states and more than 110 countries. Eligible participants included first-year (freshmen) students admitted to Washington University in 1999 and 2000 who were at least 18 years of age at the time of testing. We used a convenience sample because the goal was to enroll as many freshmen as possible. We recruited participants upon their arrival on campus in August of their freshman year. Recruitment involved mailing project announcements to students through campus or electronic mail, posting flyers in freshman dormitories, and asking dormitory resident advisors to inform students orally. As an incentive to participation, we offered students either a gift certificate to the campus bookstore or cash of equal value. Washington University administrators granted permission to conduct the study, and the university's Human Studies Committee approved the planned research. We obtained signed, informed consent from each volunteer before we began measuring participants.

Participants completed demographic and health history questionnaires. We also obtained demographic information for all freshman students at Washington University to determine whether our sample was representative of this college campus. We used a portable stadiometer to measure height and a balance scale to measure body weight. These measurements were performed with participants wearing no shoes, hats, outer garments, heavy belts, or jewelry, and with empty pockets. We calculated BMI by dividing body weight in kilograms by height in meters squared (kg/m^2). We classified students' weight as normal (5th to < 85th percentile), at risk for overweight (85th to < 95th percentile), or overweight (> 95th percentile), using the Centers for Disease Control BMI-for-age growth curves for females and males aged 2 to 20 years.^{12,13} In addition, we used the adult BMI criteria to distinguish between underweight (< $18.5 \text{ kg}/\text{m}^2$), normal weight (18.5 – $24.9 \text{ kg}/\text{m}^2$), and overweight (> $25 \text{ kg}/\text{m}^2$) students.¹⁴

On site, we administered a stages-of-change questionnaire to assess self-reported participation in aerobic, strengthening, and stretching exercises. The exercise questionnaire was based upon the transtheoretical model of behavior change,^{15,16} which distinguishes stages of readiness to engage in a particular behavior. The current study included 5 stages: *precontemplation* (lack of intention to

exercise), *contemplation* (thinking of exercising), *preparation* (planning to exercise), *action* (currently exercising), and *maintenance* (sustained exercise behavior). The first 3 stages signify lack of exercise, whereas the latter 2 stages represent current exercise participation.

The specific criteria definitions for the 3 types of exercise were based upon the recommendations of the American College of Sports Medicine¹⁷ and were stated in the exercise questionnaire. *Regular aerobic exercise* is any planned physical activity performed to increase physical fitness (eg, brisk walking, aerobics, jogging, bicycling, swimming, rowing), 3 to 5 days per week for 20 to 60 minutes daily at an intensity that increases one's breathing rate or causes sweating. *Regular strength training* is any planned physical activity performed to increase physical strength (eg, lifting free weights, using weight machines or resistance bands) on 2 to 3 days weekly with one set of 8 to 10 repetitions for the largest muscle groups. *Regular stretching* is any planned physical activity to improve flexibility (eg, yoga, tai chi), performed 2 to 3 days per week with the goal of developing and maintaining full range of motion. The 3-item exercise questionnaire can be completed in less than 2 minutes.

We used a dietary questionnaire to assess whether students were (1) meeting the guidelines established by the 5-a-Day campaign¹⁸ to eat at least 5 fruits and vegetables daily; (2) limiting fried food intake to less than 3 times during the previous week; (3) limiting intake of high-fat fast foods to less than 3 times during the previous week; and (4) consuming 64 ounces of noncaffeinated, nonalcoholic beverages daily. We included a stages-of-change questionnaire to assess the participants' readiness to adopt these 4 behaviors. The transtheoretical model of behavior change instruments have been validated for assessing readiness to make dietary changes^{19,20} and to provide a simple method for evaluating dietary behaviors.

Statistical Analyses

We computed simple descriptive statistics to provide basic information about the overall characteristics of the sample. In addition, we used either 2-sample *t* tests (for continuous outcome measures such as BMI) or chi-square tests (for categorical outcome measures such as exercise status) to examine differences between men and women. We also examined changes in outcome over time (from the beginning of the freshman year to the end of the sophomore year), using paired-samples *t* tests (for continuous outcome measures) or McNemar's change test²¹ for changes in status for categorical outcomes. We used a significance level of .05 for all tests; degrees of freedom vary slightly from test to test because of missing data.

RESULTS

Beginning of Freshman Year

Participants included 764 students; 274 freshmen in 1999 and 490 freshmen in 2000. The mean (\pm SD) age was 18.1 ± 0.3 years (range, 18–20 years). The gender and racial/eth-

nic distribution of students was similar in the 2 classes, with 53% female and 47% male students, 74% White, 10% Asian, 5% African American, 3% Hispanic, and 8% of other or unknown background. Because the baseline characteristics of the 2 freshman classes were not different, we combined the data from the 2 classes (Table 1).

When we used the BMI-for-age criteria, 3% of students were classified as underweight, 84% as normal weight, 10% as at risk for overweight, and 4% as overweight. By comparison, the adult BMI criteria would categorize 5% as underweight, 76% normal weight, and 18% overweight. Because the adult BMI criteria generally are used for college students, we present the remainder of the data in terms of the adult criteria.

Results of the self-reported exercise and diet questionnaires are shown in Table 1. More men than women engaged in strength training, whereas women reported higher consumption of fatty foods. Fruit and vegetable consumption was inversely correlated with both high-fat fast food intake ($r = -0.43, p < .001$) and fried food intake ($r = -0.12, p = .009$). We observed a positive correlation

between consumption of high-fat fast foods and fried foods ($r = 0.43, p < .001$).

Changes From Beginning of Freshman Year to the End of Sophomore Year

At the end of sophomore year, 290 of the original 764 students (38%) returned for follow-up assessments. Weight, height, and BMI results are shown in Table 2. Body weight increased in 70% of the 290 students between the beginning of their freshman year and the end of their sophomore year. However, weight decreased in 26% of the students and remained the same in 3%. For those who gained weight, the mean increase was 4.1 ± 3.6 kg (~9 lbs, $p < .001$). BMI increased among 69% of the students.

Data on self-reported exercise and dietary patterns are shown in Table 3. Overall exercise participation did not change, but aerobic exercise behavior declined, and participation in stretching exercises increased. Consumption of fruits and vegetables and high-fat fast foods did not appear to change, whereas fried food consumption declined. We

TABLE 1. Baseline Characteristics of Participants in a Study of Weight Changes

Variable	Female (n = 405)	Male (n = 359)	All (N = 764)
Anthropometrics			
Height (cm)	163.2 ± 6.4	176.7 ± 7.2*	169.5 ± 9.6
Weight (kg)	59.5 ± 10.7	72.5 ± 12.4*	65.7 ± 13.2
Body Mass Index (kg/m ²)	22.3 ± 3.6	23.2 ± 3.4*	22.7 ± 3.6
Exercise (% of students)			
Aerobic exercise 3–5d/wk	60	58	59
Strength training 2–3 d/wk	35	55*	45
Stretching 2–3 d/wk	37	36	36
At least 1 of the above	66	75	70
No exercise	34	25	30
Diet during previous week (% of students)			
≥ 5 fruits/vegetables daily	30	29	30
≥ 3 fried foods	51	29*	41
≥ 3 high-fat fast foods	56	35*	46

* $p < .001$ male vs female students.

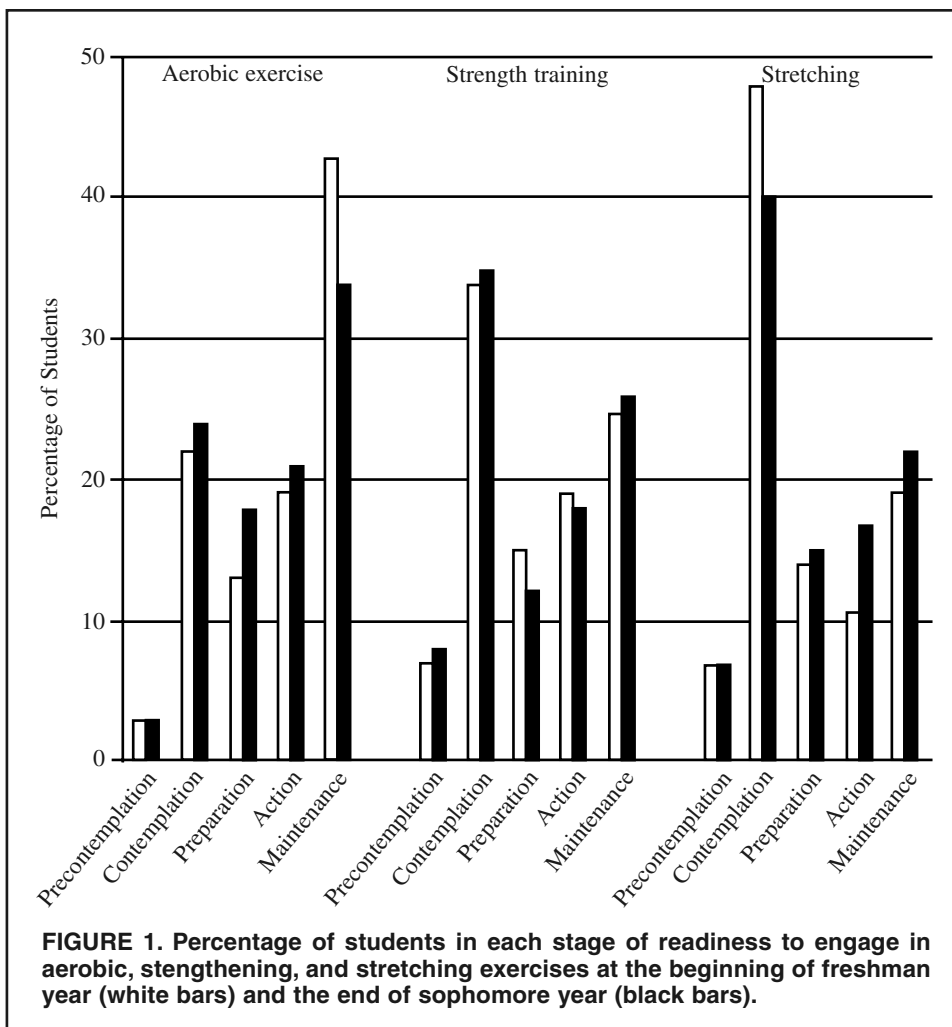
TABLE 2. Changes in Height, Weight, and Body Mass Index (BMI) After 2 Years of College

Variable	Freshman year fall semester (n = 290)	Sophomore year spring semester (n = 290)	Change	p
Height (cm)	168.5 ± 9.1	168.6 ± 9.1	+0.1 ± 1.5	NS
Weight (kg)	64.3 ± 11.9	66.1 ± 12.8	+1.8 ± 5.2	< 0.001
BMI (kg/m ²)	22.6 ± 3.3	23.2 ± 3.5	+0.6 ± 1.8	< 0.001

Note. NS = nonsignificant.

TABLE 3. Exercise and Dietary Patterns (% of Students) During Freshman and Sophomore Years

Variable	Freshman year fall semester	Sophomore year spring semester	<i>p</i>
Exercise (<i>n</i> = 290)			
Aerobic exercise 3–5d/wk	62	55	.039
Strength training 2–3 d/wk	43	45	<i>NS</i>
Stretching 2–3 d/wk	30	38	.007
At least 1 of the above	70	71	<i>NS</i>
No exercise	30	29	<i>NS</i>
Diet during previous week (<i>n</i> = 208)			
≥ 5 fruits/vegetables daily	30	32	<i>NS</i>
≥ 3 fried foods	54	43	.004
≥ 3 high-fat fast foods	50	47	<i>NS</i>



observed no correlations between changes in body weight (or BMI) and changes in exercise or dietary behaviors.

The stages-of-change results for engaging in regular exercise and following 4 healthy dietary behaviors are shown in Figures 1 and 2, respectively, for the beginning of freshman year and the end of sophomore year. Significant changes included a reduction in the percentage of students

in the maintenance phase for aerobic exercise participation, an increase in the percentage of students in the combined action and maintenance stages for stretching, and a corresponding decrease in the percentage of students in the contemplation stage for stretching. We observed no significant changes for readiness to engage in the healthy dietary behaviors.

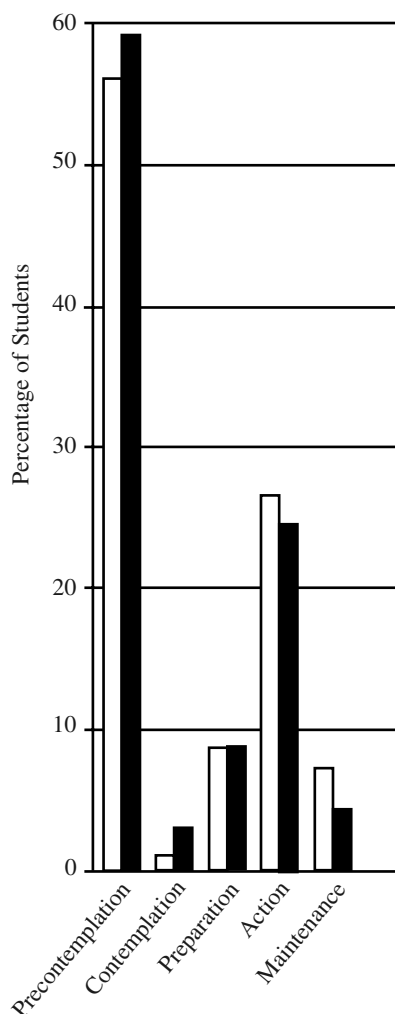


FIGURE 2. Percentage of students in each stage of readiness to engage in 4 healthy dietary behaviors (eating ≥ 5 fruits/vegetables everyday; limiting consumption of fried foods to ≤ 2 times/week; limiting consumption of high-fat fast food to ≤ 2 times/week; and drinking 64 ounces of noncaffeinated, nonalcoholic beverages per day) at the beginning of freshman year (white bars) and at the end of sophomore year (black bars).

Changes During Freshman Year

To understand what proportion of the weight change by the end of sophomore year was attributable to weight gain during freshman year alone, we measured a subgroup of 118 students (66 women, 52 men) at the beginning and end of freshman year. We observed increases for both body weight ($+2.5 \pm 5.0$ kg, $p < .0001$) and BMI from 22.4 ± 3.7 to 23.3 ± 3.8 kg/m²; $F(1, 115) = 23.5$, $p = .00001$, but height did not change significantly. Eighty-eight of these 118 students (75%) showed an increase in BMI, which tended to increase more in the women than in the men, $F(1, 115) = 2.5$, $p = 0.12$. Exercise participation was approximately 50% at the beginning and end of freshman year. Although we observed no changes in aerobic or strengthening exer-

cises, more students reported engaging in stretching exercises at the end of freshman year, 41 vs 22%, $\chi^2(1, N = 118) = 16.33$, $p = .0001$.

COMMENT

Overall, our findings demonstrate a potentially significant weight gain (~9 lb) in 70% of the students during the first 2 years of college and also highlight the inactivity and unhealthy dietary behaviors that characterize many students during their early college years. Only a few studies have reported changes in weight during the college years. In a sample of 44 freshmen, 59% gained weight (4.6 lb), whereas 36% lost weight, for a mean change of -1.5 pounds during freshman year.²² Among 61 freshman women, mean weight did not change during a 6-month period, although 28% of the students gained more than 1.8 kg (4 lb).²³

Our observation that approximately 18% of incoming freshmen in the sample were overweight according to the adult BMI criteria is less than reported in some published survey results, but more than others. In the 1995 National College Health Risk Behavior Survey,⁵ 35% of the 4,609 undergraduate students were classified as overweight, based upon self-reported height and weight values and the current definition of overweight for adults (ie, BMI > 25 kg/m²).²⁴ In a sample of nearly 700 undergraduate and graduate students, 28% were overweight.²⁵ By contrast, a survey of more than 16,000 university students in 21 European countries²⁶ found that fewer than 8% of students were overweight, with BMI values of 22.0 and 20.5 kg/m² in male and female students, respectively. In a survey of 340 undergraduate women in the United States,²⁷ the mean BMI (calculated from self-reported height and weight values) was 21.9 ± 1.8 kg/m², which is lower than our measured BMI of 22.7 ± 3.6 kg/m². Some of these differences might be explained by women's tendency to underestimate and underreport their weight.²⁸ It is also important to note that BMI has the limitation of not differentiating between lean body mass and fat mass, and therefore misclassifies some athletic individuals (particularly men) as overweight.

The college environment promotes changes in many aspects of a student's life. Of concern in this study are physical activity and dietary behaviors that do not meet recommended levels and that may contribute to unhealthy weight gain or future health problems. Consistent with previous surveys, only about half of our participants engaged in regular aerobic exercise, and 30% did not engage in any exercise on a regular basis. The National College Health Risk Behavior Survey⁵ indicated that 37.6% of students engaged in vigorous activity, whereas 19.5% engaged in moderate physical activity. Another study involving undergraduate, graduate, and medical students revealed that 54% exercised regularly (> 3 times/wk), 28% exercised irregularly (1–2 times/wk), and 18% were inactive (< 1 time/wk).²⁹ Similarly, 58% of 332 freshmen met the recommended exercise guidelines, and overall exercise participation did not change the following year, despite shifts in exercise behavior among

several students.³⁰ In studies of college women, between 33%³¹ and 49%³² exercised regularly.

Our findings provide evidence that many students in our sample are neither consuming adequate fruits and vegetables nor limiting their consumption of fried and fast foods to appropriate levels. In fact, more than 55% of the students in our sample were in the precontemplation stage for adopting healthier eating behaviors at both the beginning of freshman year and at the end of sophomore year. The National Cancer Institute and the Produce for Better Health Foundation^{18,33} launched the 5-a-Day campaign in 1991 to promote consumption of at least 5 fruits and vegetables each day, but our sample indicated that only 30% of the students achieved this goal at the beginning of their freshman year. Similarly, only 26% of the students in the National College Health Risk Behavior Survey⁵ consumed at least 5 fruits and vegetables during the preceding day, whereas only 15% of female students³¹ and 18% of male and female²⁵ college students met this goal in other studies. A further analysis of the latter study revealed that 31% of the nearly 700 students met the recommended fruit servings (2–4/d), but only 1.3% of the students met the recommended vegetable servings (3–5/d).²⁵

More than half of the students in our sample reported eating high-fat fried or fast foods at least 3 times during the previous week. By comparison, 21.8% of the students in the National College Health Risk Behavior Survey⁵ consumed at least 3 high-fat foods during the preceding day, and 66% of the college women in another study exceeded the recommended intake of saturated fat.³¹ These trends do not meet the recommendations of the National Cancer Institute, the American Heart Association,³⁴ the Dietary Guidelines for Americans,³⁵ and the Institute of Medicine³⁶ to limit saturated fat and trans-fatty acid intake. In the Coronary Artery Risk Development in Young Adults (CARDIA) Study,³⁷ a cohort study of 2,909 healthy young adults aged between 18 and 30 years, dietary fat intake was inversely associated with physical activity over a 10-year period.

Limitations

We should note 4 limitations in our study. First, the use of BMI to classify college students as overweight is not always appropriate, because BMI does not differentiate between fat and fat-free masses. Therefore, it is likely that some of the students in our sample whose BMI was in the overweight range were lean athletes with increased muscle mass. Second, because we did not assess body composition, it is impossible to determine whether the observed increases in body weight and BMI were a result of growth, muscular development, or increases in adiposity. Third, our diet and exercise questionnaires were not sensitive to small increases in exercise or vegetable consumption by amounts that still do not meet the defined criteria but that may be meaningful for health.

Furthermore, the diet questionnaire asked about behaviors during the previous week only, which may not have represented participants' dietary patterns throughout the

semester. Fourth, a potential self-selection bias may have affected our results. For example, it is possible that students with very low or high body weights did not volunteer, or that students who returned for follow-up assessments were those whose weight increased the least, which may have biased our results toward smaller weight gains. Our assessment procedures assured privacy so that students with concerns about body image would not feel uncomfortable. A community interest in health and personal information (as well as small remuneration) apparently attracted a wide range of student participants. The 38% return rate may be attributed to the students' having more varied housing and dining arrangements, as well as busier schedules at the end of sophomore year compared with the beginning of freshman year. Nevertheless, we do not know whether the sophomores who returned for assessment were representative of the baseline sample; future studies should address ways to minimize this potential bias.

In the United States, more than 12 million students, the majority (57%) of whom are between 18 and 24 years of age, are enrolled in 3,600 colleges and universities.³⁸ College students represent a readily accessible population in whom assessment and intervention are feasible and important for effecting positive changes in physical activity and dietary behaviors. Preventive measures to reduce the incidence of overweight are critical for improving our nation's health.³⁹

In summary, weight gain, lack of regular exercise, and unhealthy eating patterns appeared to be common among students in our sample during the first 2 years of college. These findings highlight potential adverse behaviors of college students that may contribute to overweight during adulthood. Because nearly two thirds of the adult population in America is classified as overweight, it is important to understand the role that the college environment may play in this epidemic, and to consider institutional strategies that might encourage college students to pursue healthy exercise and eating habits and maintain healthy body weight throughout college. Future studies are needed to identify behavioral patterns in need of improvement and the means to promote healthy eating and exercise behaviors on college campuses. Promotion of healthy lifestyle behaviors early in college may have long-term benefits throughout adulthood that would serve to reduce the rising incidence of physical inactivity, overweight, and obesity in our society.

NOTE

For comments and further information, please address correspondence to Susan S. Deusinger, PT, PhD, Director, Program in Physical Therapy, Washington University School of Medicine, Campus Box 8502, 4444 Forest Park Blvd, Suite 1101, St Louis, MO 63108 (e-mail: deusingers@wustl.edu).

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