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Review

THE COLLEGE EXPERIENCE: PHYSICAL ACTIVITY, NUTRITION, AND IMPLICATIONS FOR INTERVENTION AND FUTURE RESEARCH

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ABSTRACT

Ferrara CM. The college experience: physical activity, nutrition, and implications for intervention and future research. **JEP***online* 2009;12(1):23-35. Recent research suggests that approximately 35% of all college students are overweight or obese, with many at risk for weight gain during the college years. Poor nutrition and physical inactivity contribute to the increased risk of weight gain and prevalence of overweight and obese individuals in this population. Only a few research studies have examined the success of exercise, nutrition, and weight loss programs designed specifically for the college student, taking into consideration their schedules, food and physical activity preferences. College campuses are an important setting where promotion of healthy lifestyle habits can occur. Future studies need to focus on how best to address the issues of healthy eating, exercise, and physical activity in the college student population, and how to encourage the maintenance of these habits after graduation and into adulthood. Exercise and nutrition professionals will play an important role in the development and implementation of new policies and programs designed to promote healthy eating and physical activity in college students.

Key words: College Students, Exercise, Diet, Obesity Risk.

TABLE OF CONTENTS

INTRODUCTION

Recent evidence suggests that more than half of the adult population in the U.S. is overweight or obese, with the percentages increasing significantly over the last 15 years (1). The number of children who are overweight or obese is also increasing at an alarming rate, with more than 17% of children in the U.S. being overweight or obese, and even higher percentages among African American and Hispanic children (1). Results from the Behavioral Risk Factor Surveillance Survey suggest that the greatest increases in obesity occur in individuals between the ages of 18 to 29 years, during the transition from adolescence to adulthood when many attend college (2). Physical inactivity, poor dietary choices, increased caloric intake, increased stress and disturbed sleep patterns, in addition to many other factors, contribute to the increased weight gain and obesity in college-aged young adults (3,4,5,6). In many cases, increased body weight contributes to the development of the metabolic syndrome in adolescents and young adults, including impaired glucose tolerance, insulin resistance, hyperlipidemia, elevated blood pressure, and increased abdominal fat (7,8,9,10,11). Reducing the amount of weight gained during adolescence and young adulthood by increasing physical activity and improving dietary choices may help to reduce the risk of diabetes and cardiovascular disease in adulthood.

The purpose of this review is to critically analyze the current evidence on the prevalence and risk of obesity as well as physical activity and dietary behaviors in the college student population. In addition, the review will address the issues in the development of successful nutritional and physical activity interventions designed to reduce the risk of obesity and increase physical activity in this population.

THE HIGH SCHOOL TO COLLEGE TRANSITION: THE "FRESHMAN FIFTEEN"

The transition from high school to college is one critical period in life where the risk of weight gain is significantly higher than other time periods (12,13). Weight gain for university women can be as high as 0.75 kg/month (approximately 9 kg or 20 lb per year), significantly higher than community-dwelling women of the same age (12,13). College freshman are exposed to a variety of new experiences and potential lifestyle changes that may influence their health and risk of obesity, including changes in eating habits, living environment, and daily physical activity, and possibly increased alcohol intake (14,15). In addition, increased stress associated with academics or life issues may also contribute to

the risk of weight gain in college students (4,5,16). These changes in lifestyle and stresses may increase the risk of gaining weight during the first year of college, and thus increase the risk of becoming overweight or obese in adulthood.

Some controversy exists as to whether men and women gain weight during their first year of college. While some studies suggest that the amount of weight gained is not significant (17,18,19), other studies indicate that both men and women gain weight during the first year of college, although the amount of weight gained may be less than the fifteen pounds (approximately 7 kg) suggested by the "Freshman fifteen" (13,15,20,21,22,23). Some studies suggest that this weight gain occurs during the first year of college, with weight stabilization in the later years of college (12,13). In contrast, others observe a significant weight gain continuing into the sophomore year of college in both men and women (14).

A few of the studies suggest possible reasons that contribute to the weight gain during the freshman year. These include nutrition-related factors, such as increased consumption of junk food, recent dieting, increased snacking, and "all you can eat" dining halls (13). A significant decrease in physical activity, which results in a decrease energy expenditure and can result in a decrease in resting metabolic rate, may also contribute to weight gain in college (15,20,22). In addition, individuals with a negative body image, those who were overly concerned about their weight, or individuals who are responsive to external or environmental cues about food, such as the sight or smell of food, may be more at risk for gaining weight during the freshman year of college (18,24). Interventions designed to reduce weight gain need to address psychosocial, nutrition, and physical activity related factors in order to facilitate long-term healthy lifestyle behaviors in these young adults.

OBESITY RISK AND PHYSICAL ACTIVITY BEHAVIORS IN COLLEGE STUDENTS

Recent studies suggest that approximately 30-35% of college students are overweight or obese based on body mass index (BMI, weight in kg/height in meters^2), with 65-70% of the undergraduate population at a healthy weight (14,15,25). These percentages are well within the goal of Healthy College 2010 (60% of the student population at a "healthy" BMI, $18.5 \leq BMI < 25$ kg/m^2) (26). Unfortunately, the results of these and other studies strongly suggest that the number of overweight and obese adolescents and young adults continues to increase, resulting in higher percentages of young adults with diabetes and risk factors for heart disease (11,14,15,27).

In spite of the growing number of overweight and obese college students, only 40% participate in any kind of regular physical activity, with 30% or more of all students not participating in any exercise at all on a weekly basis (14,15,25,28,29,30). This suggests that more than half of college students do not meet the minimum goal of 150 minutes of moderate physical activity each week or approximately 30 minutes of exercise at least five days per week, as proposed by the Centers for Disease Control (CDC) and American College of Sports Medicine (31). Most investigators report higher rates of inactivity in women compared to men, with 10-37% of the college-aged men and 22-48% of the college-aged women reporting no physical activity in the past month (30,32). In addition, higher rates of physical inactivity are reported in minority compared to Caucasian students, although this trend is not observed by all investigators (30,32).

Physical activity patterns of college students and factors influencing physical activity in this population have been examined by a number of researchers (28,29,33,34). Most college students are more active on weekdays compared to weekends, suggesting that different types of intervention strategies might be needed to encourage physical activity in college students (33). While college students who exercise on a regular basis are most likely to participate in jogging/running, weight training, cycling,

and aerobics, walking is not a popular form of exercise (28). In addition, Pinto et al. (29) reported that women were significantly more likely than men to report participation in aerobics and moderate activities such as walking, whereas the men were significantly more likely than women to report participation in weight lifting. The intensity and duration of physical activity may be related to the proximity of exercise facilities, suggesting the importance of access to exercise and recreational facilities on campus, as well as qualified staff to assist students in starting and maintaining a regular exercise program (34). As in other population groups, support from family and friends, perceived enjoyment and self motivation, accessibility of recreational facilities, adequate transportation, weather, and campus safety are also major determinants of physical activity in college students (28). Examination of the importance of each of these determinants and their impact on physical activity in the college student population is essential to the development of successful interventions to encourage physical activity.

A few studies have examined changes in physical activity during the first two years of college, using a longitudinal study design. Racette et al. (15) observed reduced participation in aerobic exercise and increased participation in stretching exercises during the first two years of college in men and women at a medium-sized independent university in an urban setting. The changes in physical activity in this study contributed to a significant weight gain (4.1 ± 3.6 kg, $p<0.001$) during the first two years of college. In contrast, Pinto and colleagues (35) found that exercise participation did not change from the first to second year of college in men and women at a private university in an urban setting. Of interest, these investigators observed that 42% of the students were sedentary or exercising below the recommended guidelines at least 30 minutes of moderate intensity exercise on most days of the week. This information suggests that college students increase participation in low intensity activities, and exercise at a lower intensity or duration than current recommendations.

INTERVENTIONS DESIGNED TO IMPROVE NUTRITION AND PHYSICAL ACTIVITY BEHAVIORS OF COLLEGE STUDENTS

The increased prevalence of physical inactivity and obesity in the college student population strongly suggests that college students are excellent candidates for programs designed to improve nutritional habits and increase daily physical activity. Some research studies have examined the effect of a nutrition education program or a physical activity program on weight maintenance and increased physical activity in small groups of college students. These studies provide the groundwork for future investigations examining the effects of nutrition and exercise interventions on the adoption and maintenance of healthy eating and increased physical activity in undergraduate college students. In addition, adopting a healthy lifestyle may help college students to deal more effectively and positively with daily stresses and reduce their risk of obesity-related disorders (36).

Effects of nutrition programs on healthy eating habits and optimal weight maintenance in college students

Several studies have examined the effects of a college-level nutrition or weight management course or a specific weight control program including diet and behavior therapy on students' dietary behaviors and their ability to achieve or maintain an optimal body weight (Table 1). Sloan et al. (37) designed a 12-week weight loss program utilizing diet and behavioral therapy techniques for students who needed to lose weight, with individual weight losses ranging from 1.6 to 6.7 kg. Skinner et al. (38) and Matvienko et al. (39) examined the effect of a one-semester nutrition science course on changes in dietary behaviors and weight gain. Matvienko et al. (39) recruited college freshman women and randomly assigned them to the intervention group (a one semester nutrition science course) or a control group. The authors observed that the nutrition course resulted lower fat, protein,

and carbohydrate intakes in women with a high BMI (>24 kg/m^2) compared to women with a high BMI in the control group. In addition, the dietary changes were associated with maintenance of baseline body weight in the women with a high BMI in the intervention group in contrast to a 9.2±6.8 kg weight gain in the women with a high BMI in the control group. Skinner et al. (38) reported on changes in

Table 1. Studies involving nutrition-related interventions.

Study	*Intervention*	*Subjects*	*Results*
Matvienko et al. (39)	Semester-long nutrition course	College freshman women	Better weight maintenance in those with a high BMI
Skinner et al. (38)	Semester-long nutrition course	College students (men and women)	Significant ⇓ in total calories and fat in women No change in dietary intake in men
Sloan et al. (37)	12-week weight loss program, combining behavior and diet therapy	Overweight college women	Significant ⇓ in body weight
Hudiburgh (40)	Semester-long nutrition and exercise class for women who needed to lose weight	Overweight college women	Significant ⇓ in body weight
Levitsky et al. (21)	Weekly feedback on changes in body weight in women in their first semester of college	College freshman women	Significantly reduced weight gain compared to control group

dietary behaviors, as measured by self-reported 3-day food records, in college-aged men and women volunteers who were taking an introductory nutrition class. The authors observed that participation in the nutrition course resulted in a significant decrease in total calories (1732±43 vs. 1581±36 kcals, $p \leq 0.05$) and fat intake (69±2 vs. 63±2 g, $p \leq 0.05$) in female participants. In contrast, no significant dietary changes were observed in male participants, although their mean intake of calories

(2711±119 vs. 2505±113 kcals) and fat (107±6 vs. 96±6 g) decreased pre to post-testing. Hudiburgh (40) utilized the combination of nutrition education and exercise as part of the intervention designed to promote weight loss in college-aged women. Study participants were invited to take an undergraduate course "Weight Modification" to learn safe and effective methods for weight control. The class included lectures about proper nutrition and sound dieting practices along with three hours per week of exercise. The average weight loss was 4.7 kg (range of +1.1 to -15.5 kg). Only eight of the original twenty participants attended the one year follow-up testing. Six of these eight participants had maintained the weight loss or lost additional weight at the follow-up testing. Seven reported that they were still exercising on a regular basis, as during the study intervention. In summary, these studies strongly suggest that a college nutrition course or nutrition education program can be an effective way to facilitate changes in the dietary behaviors and weight loss in college students. Only one of these studies monitored students after completion of the program to see if the weight loss or dietary changes were maintained. The need for follow-up is important, since many individuals revert to previous habits after completion of a nutritional program.

At least one study has taken a novel approach to reduce weight gain during the first year of college. Levitsky et al. (21) reported that providing weekly feedback on changes in body weight to female students during the first semester of college may be an effective technique to prevent weight gain. The weekly feedback was determined based on an algorithm called the "tissue monitoring system," which is derived from daily readings of body weight. These results suggest that having female students weigh themselves on a daily basis and providing direct feedback on weight gain and calorie consumption to maintain body weight may be an easy and cost effective way to reduce weight gain during the college years. In addition, this system may be an effective means to achieve and maintain optimal body weight after graduation from college and in other groups at risk for overweight and obesity. Unfortunately, although frequent weighing may be an effective and relatively easy way to prevent significant weight gain in college-aged women, it may also contribute to a preoccupation with weight and food and an increased risk of disordered eating in college-aged women at risk for eating disorders (41).

Effects of physical activity programs on adoption and maintenance of physical activity in college students

Previous studies have examined whether participation in a physical activity-related course during college results in adoption and maintenance of regular physical activity after graduation from college (Table 2). Slava et al. (42) and Brynteson and Adams (43) examined the influence of participation in a conceptually based physical education class during college on attitudes about exercise and physical activity behaviors two to eleven years after graduation. The philosophy of the conceptually based physical education class is that students will learn about the benefits of exercise and how to start their own personal exercise program. This knowledge will make them more likely to make the right decisions regarding exercise and physical activity (44). The results of these studies suggest that participation in a college level conceptually based physical education class improved alumni's exercise attitudes and increased the frequency and types of physical activity that they participated in after graduation (42,43). In addition, Adams and Brynteson (45) noted that there was a positive relationship between the number of classes necessary to fulfill the physical activity requirement and perceived knowledge about the benefits of exercise and the alumni's attitude towards exercise. D'Alonzo et al. (46) observed significantly increased daily Digiwalker pedometer step counts compared to baseline after completion of a 16-week aerobic exercise program (7084±2884 vs. 7727±392 steps/day, mean±SD, $p<0.001$) and at an 8-wk follow-up period (8187±496 steps/day, $p=0.01$ compared to baseline) in African-American and Hispanic college-aged women who had high attendance in a 3 d/wk, 16-wk exercise program. Leslie et al. (47) also reported higher levels of self-reported physical activity in college students after an 8-week Active Recreation on Tertiary Education

Table 2. Studies involving physical activity-related interventions.

Study	*Intervention*	*Subjects*	*Results*
Brynteson and Adams (43)	Participation in college conceptually-based physical activity and lecture class	College alumni, 2-11 years after graduation	Improved attitudes about exercise ⇑ Frequency and types of exercise after graduation
Slava et al. (42)	Participation in college conceptually-based physical activity and lecture class	College alumni, 3-5 years after graduation	More likely to choose an active lifestyle
D'Alonzo et al. (46)	3 d/wk, 16 week exercise program	African American and Hispanic college-age women	In those with high attendance rate: ⇑ Daily physical activity ⇑ Aerobic fitness, flexibility, strength, and ⇓ body fat ⇑ Exercise self efficacy
ARTEC study *Leslie et al. (47)*	8 week program of activity classes	Australian college students	⇑ Self-reported physical activity
Project GRAD *Calfas et al. (48), Sallis et al (49)*	Physical activity lecture and laboratory-based course	Senior college students	⇑ Physical activity in women, but not in men Returned to baseline values two years after completion of program
Hivert et al. (51)	24 month healthy lifestyle seminar vs. control group	College freshman	Better weight maintenance No change in physical activity or fitness
Project TEAM *Buckworth (53)*	Participation in college physical activity class	College students	Change in physical activity related to readiness to start an exercise program

Campuses (ARTEC) initiative at a single Australian college campus. "Project GRAD" (Graduate Ready for Activity Daily) randomly assigned undergraduate men and women in their senior year (177 women and 144 men) to either a physical activity lecture and laboratory experience course (intervention group) or a knowledge-oriented course about a variety of health issues (control group) (48,49). The physical activity lecture course discussed health benefits and risks of physical activity, recommended physical activity patterns to promote health and fitness, principles or injury prevention, and principles of behavioral self-management. The laboratory experience, led by "peer health facilitators", emphasized learning specific physical activities and self-management techniques to start and maintain a personal exercise program. Physical activity was assessed using the 7-day Physical Activity Recall questionnaire at baseline, immediately post-intervention, and one and two years post-intervention (50). After completion of the intervention, "Project GRAD" reported higher levels of self-reported physical activity compared to the control group in women but not in men, with levels of physical activity returning to baseline values two years after completion of the program (48,49). Hivert et al. (51) randomly assigned healthy, moderately active, first and second-year university students to an educational and behavioral intervention designed to maintain a healthy lifestyle (47 women and 10 men) or no specific intervention (control group, 47 women and 11 men) for a 24-month intervention period. The educational and behavioral intervention (EBI) involved small-group interactive seminars offered every 2 weeks for the first two months of the academic year and every month thereafter for the remaining two years. The topics discussed included the benefits of maintaining a healthy body weight, dietary and exercise recommendations for the maintenance of health, and behavior modification strategies to maintain a healthy lifestyle. After the 24-month intervention period, the authors observed differences in the change in body weight (0.7 ± 0.6 vs. -0.6 ± 0.5 kg, mean$\pm$SE, $p=0.04$, control vs. EBI), but no significant differences in the amount of daily physical activity (2.88 vs. 3.18 kcal/kg/day, control vs. EBI) or VO_{2max}. Project TEAM (Teaching Exercise/Activity Maintenance), a campus-based physical activity intervention based on the Transtheoretical Model for Behavioral Change (52), examined changes in physical activity in students enrolled in physical activity conditioning classes at a large Midwestern university (53). The Transtheoretical Model for Behavior Change, also known as the Stages of Change Model, defines adoption and maintenance of health behaviors as a process that occurs through specific stages (53, Table 3). Preliminary results suggest that the change in the amount of physical activity during a college-level activity class is associated with the individual's "readiness" to start or maintain an exercise program. Higher levels of physical activity are observed in individuals who are planning to start exercising on a regular basis (Preparation stage, 53). Evaluation of the effect of Project TEAM on long-term maintenance of physical activity has not yet been reported. It is important to determine

Table 3. Exercise Stages of Change (53)

Stage	*Definition*
Precontemplation	Inactive, not considering exercise
Contemplation	Inactive, may start exercise within next 6 months
Preparation	Occasionally active, plan to begin program within 1 month
Action	Active for $\leq$ 6 months
Maintenance	Active for > 6 months

what factors and types of programs will improve long-term participation in physical activity and regular exercise in young adults. Future research will need to carefully address these issues.

In conclusion, studies demonstrate that interventions designed to increase physical activity can be effective in the college student population. Unfortunately, the success of these interventions appears to be limited to the duration of the intervention, with increases in physical activity not maintained after completion of the programs. This limitation underscores the importance of age-appropriate incentives and environmental and institutional changes on college campuses that will encourage physical activity and regular exercise in the college student population.

CONCLUSIONS AND IMPLICATIONS FOR INTERVENTION AND FUTURE RESEARCH

In conclusion, many college students are overweight or obese, and fail to meet the minimum physical activity guidelines as established by the CDC. This may place them at significant risk for a number of lifestyle-related chronic diseases, including diabetes, hyperlipidemia, hypertension, and cardiovascular disease. Although exercise programs have been effective in improving physical fitness and body composition in the college student population, most programs have not adequately addressed long-term maintenance of increased physical activity.

Colleges and universities are potentially important settings for the promotion of regular exercise and weight maintenance strategies. The college campus offers the possibility of creating an environment that encourages physical activity and a healthy lifestyle. Possible strategies include increasing accessibility to safe walking and bicycle trails, provision of bicycle racks, and bicycle share programs as a healthy alternative mode of transportation on campus and in the community. In addition, enhancing stairwells in buildings around campus by new paint, carpeting, artwork, or music may encourage individuals to use the stairs (54,55). Providing health-related information and campus walking and biking maps via an on-line website may also increase accessibility to information on health and opportunities for physical activity. Requiring students to take a course in nutrition and physical activity, increasing accessibility to recreational facilities (34), and increasing the opportunities for physical activity on campus are important in promoting physical activity in the campus community. These changes may result in increased physical activity by students during the college years and after graduation (47). In addition, offering health and wellness services, such as health and fitness appraisal, nutrition counseling, individualized exercise prescription, and electronic newsletters, may also be important to health promotion on campus. Such programs, although potentially increasing costs for colleges and universities, will help to promote physical activity and healthy eating, which may help students to deal more effectively with daily stressors (36). These changes will reduce the risk of obesity-related disorders and improve the health of the entire college and university community. Exercise physiologists, nutritionists, and other health professionals will play an important role in the development of these new policies and programs.

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