Journal of
Obesity & Weight Loss Therapy

Topp et al., J Obes Weight Loss Ther 2014, 4:4
DOI: 10.4172/2165-7904.1000237

Research Article Open Access

Effect of a Personal Health and Fitness Course on Dietary Intake, Physical Fitness and Attitudes toward Wellness among College Students

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Received: October 22, 2014; **Accepted:** November 20, 2014; **Published:** November 27, 2014

Abstract

The purpose of this study was to determine if a college course in Personal Health and Fitness that includes Fitness Interns (FI) can impact dietary intake, physical fitness and attitudes towards a healthy dietary intake and physical activity among college students. Two different versions of the intervention were delivered as a component of a 3-credit hour undergraduate "Personal Health and Fitness" course. The content of this course included a classroom lecture, weekly homework and a weekly meeting with FI who was an upperclassmen who was enrolled in Exercise Physiology. During the first version of the intervention (Class 1, n=20) the subjects met with the FI once per week to complete assigned homework. Subjects exposed to the second intervention (Class 2, n=29) also met with a FI once per week to complete the homework assignment and to engage in at least 30 minutes of a physical fitness activity per week with the FI. The course content and homework was based upon the Theory of Planned Behavior and was designed to improve the dietary intake and physical activity of the subjects in both intervention groups. Control subjects (n=24) who volunteered for the study were not registered for "Personal Health and Fitness" and had no access to the course content or the FIs. During the first and last weeks of fall semester all subjects completed an assessment of their dietary intake, physical fitness and attitudes (control beliefs and outcome expectations).

Both intervention groups exhibited significant ($p<.05$) reduced caloric intake and improvements in physical fitness and attitudes toward a healthy dietary intake and physical activity with Class 2 exhibiting a greater number of improvements compared to Class 1. The control group did not change on any outcome variables. These findings indicate the efficacy of a "Personal Health and Fitness" course on antecedents to weight gain among college students.

Keywords: Theory of planned behavior; College health; Health promotion; Health behavior

Introduction

Among adults and children, 2-19 years of age, obesity rates (adults BMI>30 children BMI>95th percentile for age and gender) have significantly increased between 1991 and 2004 from 17% to 36% [1,2]. This level of obesity has remained relatively unchanged into 2012 [3]. A similar trend has been noted among American college students who straddle the definition of children and adults with an age range of 17-23 years. In 1995, 20.5% of U.S. college students were classified as overweight or obese, with a Body Mass Index (BMI) greater than or equal to 25 (overweight or obese) [4]. This rate increased to 33% among U.S. college students by 2007 [5]. In another study the authors observed that the 18-29 year old age group exhibited the greatest increases in obesity (BMI>30 kg/m^2) between 1991 and 1997 [6]. Based upon longitudinal data over four years of incoming freshman Gropper et al. [7] concluded that the percentage of participants classified as overweight or obese (BMI>25) increased from 18% to 31%. These same authors reported weight gains among the sample during the first three years of the study averaging 2.1 +/- 4.7 kg with 70% of the sample gaining an average of 4.3 kgs. This weight gain was accompanied by a significant change in body composition as evidence of a 2.7 +/- 3.3% increase in body fat and a 2.3 +/- 3.5 kg% decrease in lean mass. The absolute gains in weight, BMI, and percent and absolute body fat were highest during the freshman year [8] with more than 25% of college freshman gaining greater than 2.3 kg within the first 8 weeks of Fall Semester [9]. These excessive weight gains experienced during early adulthood increase the probability of the individual being overweight or obese in later life with associated comorbidities [10].

Numerous factors appear to contribute to this trend of increasing adiposity among college students including adopting poor dietary intake and low levels of physical activity while enrolled in college [11]. In 1995, just over one-quarter (26.3%) of college age adults reported consuming 5 servings and fruit and vegetables per day. During this same year over 42% reported participating in vigorous physical activity at least 3 days per week [4]. In 2003 among 738 college students, investigators reported that 31% reported consuming five or more servings of fruits and vegetables per day while a majority of the sample participated in aerobic exercise fewer than three days per week. These suboptimal levels of fruit and vegetable intake and physical activity have been consistently observed by other authors among college students [12,13].

A number of studies have attempted to impact the problem of weight gain among college students by introducing interventions designed to increase physical activity and improve dietary intake. Project GRAD involved evaluating the impact of a cognitive-behavioral or knowledge-oriented course among 338 senior college students on their physical activity [14]. The program produced no

lasting increases in physical activity within two years following the subject's graduation from college. A 10-week program administered to 30 incoming freshman by junior or senior college students enrolled in health-related majors resulted in gains in the freshmen's physical fitness, their perceived benefits to engaging in exercise and decreased their perceived barriers to engaging in exercise and a healthy diet [15]. In a follow-up to this study, King et al. [16] evaluated a 14-week intervention in which undergraduate students were again matched with an upperclassman intern enrolled in a health-related major in order to improve and/or maintain healthy nutrition and physical activity behaviors. The subject's perceptions of the health benefits of eating fruits and vegetables improved during the intervention, although the intervention was not effective in increasing the number of fruits and vegetables consumed by subjects residing on campus. Additionally, subjects living on campus reported decreased barriers to engaging in exercise compared to subjects living off campus, although the intervention did not increase physical activity in the sample [16]. A comprehensive review of the literature involving interventions to increase healthy dietary intake and physical activity yielded overall positive results, with 13 studies reporting significant health-related improvements among college students. Weight loss, physical activity and fitness, and/or dietary intake were the focus in more than half (n=9) of the studies [17].

In summary, weight gain is a significant problem among college students and seems to be associated with poor dietary intake and low levels of physical activity [11]. Excessive body weight during college is a strong predictor of excessive body weight throughout adulthood and is a significant predictor of a number of chronic health problems during adulthood. Previous researchers have examined education-based interventions on improving dietary intake and physical activity with limited success. This project will attempt to employ an intervention based upon the Theory of Planned Behavior administered through a formal college course that includes FIs. Thus, the purpose of this study was to determine if a college course (Personal Health and Fitness) Fitness Interns can impact dietary intake, physical fitness and attitudes toward diet and physical activity among college students. This purpose was achieved through empirically evaluating the following hypotheses:

H1: Undergraduate students who complete a three credit hour (Personal Health and Fitness) course will report improvements in attitudes toward a healthy diet and physical activity compared to controls.

H2: Undergraduate students who complete a three credit hour course (Personal Health and Fitness) will demonstrate higher physical fitness compared to controls.

H3: Undergraduate students who complete a three credit hour course (Personal Health and Fitness) will report improved dietary intake compared to controls.

Methods

Design

A nonrandomized three-group pretest-posttest quasi-experimental design with a no-intervention control (Control) and two intervention groups (Class 1, Class 2) was implemented to address the hypotheses of the study. All subjects provided written informed consent using an approved paper and pencil consent form (IRB# HR-2434) prior to any data being collected. Data were collected from Class 1 and Control subjects at the beginning and end of a 15-week Fall Semester with data collected from Class 2 subjects at the beginning and end of the following 15-week Fall semester during the following calendar year. Subjects self-selected their group assignment and neither the subjects nor the data collectors were blind to the group assignments.

Sample

Three groups of students were recruited to participate in this study. The subjects in the two experimental groups (Class 1 and Class 2) were recruited from the students enrolled in a general education course open to only undergraduate students titled Personal Health and Fitness (HEAL 1931). All but one student in these two courses consented to be involved in the study. Students enrolled in this course were recruited to participate in the study during two successive academic years since the course was only offered during Fall semester. During the first class session of the Personal Health and Fitness course a brief presentation of the study was made by a member of the research team. Students in this course who were interested in participating in the study were encouraged to call a member of the research team to discuss the study and schedule an appointment to provide informed consent. The Control group was recruited during the same fall semester that subjects were recruited for the Class 1 group. Control subjects were recruited from the general undergraduate student body by placing recruitment fliers in campus dormitories. The flier encouraged undergraduate students to call a member of the research team to discuss the study and if they wished to participate, schedule an appointment to provide informed consent and complete baseline data collection. Inclusion criteria were the subjects be 18-22 years of age, enrolled in full time study and able to complete all of the data collection protocols. Subjects were excluded from the study if they reported any health conditions which prohibited vigorous physical activity according the American College of Sports Medicine [18] or provided a positive response to any item on the Physical Activity Readiness Questionnaire (PAR-Q) [19].

Data collection

During the Fall Semester when subjects were recruited into the study they completed data collection at the beginning and end of the 15-week fall semester. Demographic data were collected at the beginning of the semester only, while all other data were collected at both the beginning and the end of the semester. The same Graduate Research Assistants (GRAs) collected data from Control subjects while the Group 1 and Group 2 subject's data collection was conducted by the Fitness Intern (FI) they were assigned to as part of the course requirements during the semester. The GRAs and the FIs were upper division or graduate students enrolled in the Exercise Physiology program and had completed courses in fitness and nutrition assessment that included the data collection protocols.

Demographic data collected were collected through self-report using a paper and pencil questionnaire. Data collected included gender, race, class rank, relationship status, major area of study, age and number of credit hours enrolled.

Attitudes toward a healthy diet and physical activity were measured using two different instruments. Attitudes toward physical activity were assessed using the Physical Activity Belief Scales for Diabetes Risk [20]. This instrument was designed to assess 3 components of attitude toward physical activity which are not specific to diabetes although the instrument was developed among individuals who were

at risk for developing diabetes. This paper and pencil scale using a 5-point Likert response scales assessed the subject's attitude toward physical activity including behavioral belief, normative belief, and control belief with higher scores indicating a more favorable attitude toward physical activity. It was decided to drop the normative belief subscale from the analysis since a number of questions did not apply to the sample including questions about the subject's spouse or children. These subscales are consistent with the Theory of Planned Behavior (TPB) to predict one's intention to engage in physical activity. Psychometric analyses provided evidence of construct validity and reliability, internal consistency (α=.76-.95), and test-retest evaluations indicated scale stability (r=.79-.91) [20].

Attitudes toward a healthy diet were collected using a similar paper and pencil instrument titled "Healthful Eating Belief Scales for Persons at Risk of Diabetes" [21]. This instrument using 5-point Likert responses also measured three attitudes toward a healthy diet including behavioral beliefs, normative beliefs, and control beliefs with higher scores indicating a more favorable attitude toward a healthy diet. Again, normative beliefs were not collected as part of this study because the items were not relevant to the sample including questions about the subject's spouse and children. Psychometric characteristics of these subscales supported the internal consistency of the instrument (Cronbach alphas .80-.84, with acceptable test-retest reliability) [21].

Dietary intake was measured using analysis of a two-day twenty-four hour recall of dietary intake. Participants were interviewed and asked to recall everything they had eaten during the two previous 24-hour periods. These records were then coded into the Food Tracker program on the Choose My Plate website sponsored by the U.S. Department of Agriculture (http://www.choosemyplate.gov/). This program provided an average daily intake of the subject's total calories, sodium, iron, calcium, fat and percentage of calories from fat. Employing a 24-hour dietary recall has been demonstrated to provide a valid assessment of dietary intake [22].

Physical fitness was assessed by the subjects completing a number of testing protocols to that measured BMI, aerobic fitness, muscular strength, muscular endurance and flexibility using standardized measurement protocols. Aerobic fitness was assessed while the participant completed a 3-minute step test protocol. This protocol required the individual to step up and down on a 12-inch bench at a rate of 24 steps per minute for 3 minutes. A Polar heart rate monitor (Polar Electro, Finland) continuously monitored the heart rate of the participant during the test. Heart rate was recorded throughout the test and for two minutes following completion of the protocol. Aerobic fitness (Vo_2max ml/kg.min) was calculated employing a standard conversion formula using the subject's heart rate response to the exercise activity [23].

Muscle strength is defined as force generated through muscle fiber contraction. For the purposes of this study a one-repetition maximum lift of bench press and leg press were used to measure muscle strength. The 1-RM leg press assesses the maximum muscular strength of the major muscles of the lower body using a leg press machine. The 1-RM bench press assesses maximum muscular strength of the upper body using a barbell and plate loaded weight. The 1-RM for both of these exercises was determined by a standardized protocol that exhibits acceptable reliability [24].

Muscular endurance was assessed of the upper body, lower body and core using standard protocols [25]. Upper body muscular endurance was assessed by the number of push-ups the individual could perform in 30 seconds. Males completed this assessment position in the standard push-up position prone on their toes and hands with a single repetition involving lowering the body to the floor until their nose touches between their hands and then returning to the starting position. Females completed the same protocol only positioned on their palms and knees. Lower body strength was assessed by the number of sit-to-stand repetitions a subject could do in 30-seconds. Core strength was assessed by measuring the number of bent-knee sit-ups without restraint of their feet the participant could perform in 30-seconds. Finally, flexibility of the upper back, lower back and hamstrings was assessed using the standardized Sit-and-Reach test [26].

The two similar interventions (Class 1 & Class 2) were delivered as a component of a 3-credit hour undergraduate "Personal Health and Fitness" course that was offered during two consecutive fall semesters at a private Midwestern university. The overall objective of this course was, upon successful completion, the students would be able to pursue a healthier lifestyle by making informed decisions regarding their own physical activity and dietary intake. The class content for both Class 1 and Class 2 were identical and included weekly lectures from a variety of disciplines regarding the personal, social, cultural, physical and environmental factors enabling and/or inhibiting students to engage in recommended dietary intake and physical activity (Table 1). In addition to these lectures students were expected to meet weekly with fitness intern (FI) who was an upperclassmen enrolled in Exercise Physiology. These FIs were completing an advanced elective course in Exercise Science designed to increase their practical application of their knowledge, including fitness assessment, cardiovascular and resistance programming, program variable modification, goal setting, and motivation, employing standard American College of Sports Medicine (ACSM) and National Strength and Conditioning Association (NSCA) protocols. During Class 1, (n=20) the subjects met every week with their assigned FI to complete an assigned homework activity. Subjects exposed to the second intervention in Class 2, (n=29) were required to meet with their assigned FI once per week to complete the same homework assignments as those completed by Class 1 subjects and to engage in at least 30 minutes of physical activity with their FI per week. The content was designed to improve the dietary intake and physical activity of the subjects in both intervention groups. Control subjects (n=24) who volunteered for the study were not registered for "Personal Health and Fitness" and had no access to the course content or contact with the FIs or any member of the research team between the two data collection points.

The content of the two 3-credit hour undergraduate "Personal Health and Fitness" courses was based upon the Theory of Planned Behavior [27]. This theory states that behavioral beliefs, subjective norms and perceived behavioral control shape an individual's intentions and likelihood of engaging in a particular behavior. Behavioral beliefs are individual's beliefs about the consequences, positive or negative, that will result from a particular behavior. Subjective norms are an individual's perceptions about significant others (family, friends, important others) expectations about engaging or not engaging in a particular behavior. Finally, perceived behavioral control includes the individual's self-efficacy to engage in a particular behavior. The content of the lectures in this course, delivered from a wide variety of disciplines, was designed to favorably change the student's behavioral beliefs about eating a healthy diet and increasing their physical activity. The homework activity with the FI was designed to favorably impact the subject's subjective norms regarding their FI's expectations about their eating a healthy diet and being more

physically active. Finally, the homework activity was also designed to increase the subject's self-efficacy to eat a healthy diet and engage in more physical activity through the FI modeling the desired behavior and the subject engaging in the desired behavior with the FI.

Wk	Discipline	Class Topic	Brief Description of Activity with FI
1	Nursing Physician Assistant	Introduction to Health Behavior Theories Food Sustainability on Campus	Develop a family tree identifying patterns of physical activity, healthy diet and chronic disease; Plant cold weather community garden.
2	Health Education	Maintaining Motivation	Complete the goal setting worksheet by identifying short and long-term process and outcome physical fitness and nutrition goals, List sources of motivation for these goals and at least two efficacy challenges for meeting each of the outcome goals.
3	Health Education	Developing goals and beginning a change	Select two health behaviors you are trying to adopt. Complete a readiness to change ruler for each of these health behaviors you are trying to adopt. Discuss 3 responses/questions/ discussion points in reply to your response to the readiness for change ruler and the theoretical objective you are trying to achieve with the response.
4	Nutrition Science	Healthy Nutritional Intake	Complete a 2-day diet recall and enter the foods you ate into Super Tracker.gov. Compare your dietary intake and recommendation with what your FI ate over 2 days.
5	Health Education	Healthy Eating and Physical Activity-On Campus	Engage in one not performed previously physical activity on and off campus. Eat at one campus and one off campus food source you have not previously accessed. Discuss the benefits and barriers of each.
6	Exercise Science	What is Physical Fitness	Discuss the "F as in Fat" article and answer the following questions: a. List 2 chronic health conditions related to obesity. What are the current rates of these conditions in the U.S. and in Wisconsin compared with the rates of these conditions 20 years ago? b. What do you believe will happen to the rates of obesity and the two conditions you listed in your response to item a. above, over the next 20 years? And why do you believe this will happen? c. What are 3 things the government can do to address the problem of obesity in the U.S.? d. What are 3 things you can do to address the problem of obesity in the U.S. (these activities are not to decrease your personal chances of developing obesity rather these activities are what you can do to impact the problem of obesity in the nation)?
7	Physical Therapy	Physical Activity & Musculoskeletal Injury: Rehab, Alternative Exercise, & Prevention	1. Identify potential injuries that you are prone to developing. 2. List acute rehab strategies and resources available on campus to address activity-related injury or pain. 3. Identify at two alternative exercise activities that you might engage in if you experience one of the potential injuries you identified in item #1.
8		Fall Break	
9	Advertising & Marketing	Business influences on PA, nutrition & health	Document during a 24-hour period the number and types of food advertisements you see. Including the time, product being advertised, medium and your response.
10	Sociology	Social influences of PA, nutritional intake and body composition	Select one meal that is characteristic your upbringing and cultural background/heritage. 1. Provide the dietary assessment of this meal using Super Tracker. 2. List three positive and three negative outcomes of ingesting this meal (e.g. physical, psychological, social etc.). 3. Develop a healthier version of this meal that reduces calories per serving, fat and sodium.
11	Biomedical Sciences	Triggers to Eating Behavior (Biomedical Sciences)	Take 2 days, preferably one weekend and one weekday (Sunday and Monday), and fill out the following table about the time of day you ate, your motivation to eat, what you ate and your assessment of the health value of the food
12	Exercise Physiology	Developing a personal physical fitness program	Using the campus as the target community develop three interventions that will positively change the dietary intake (e.g. less refined sugar, more fruits and vegetables, less fat, fewer calories, less sodium) and three interventions that will increase the energy expenditure of this community. For each of these interventions estimate the degree of impact of your intervention (groups being affected), the potential resistance that might be experienced for each intervention.
13	Construction Engineering & Management	Built Environment	For the next 5 days wear a pedometer and document the number of steps you take per day then answer the following questions a. List at least three barriers you confronted to achieving the goal of 10,00 steps/day

			b. Describe three modifications that could be made to your built environment that would facilitate you to achieve this goal of 10,00 steps/day c. Explain three reasons you believe your built environment inhibits you from taking 10,000 steps/day.
14	11/28	Thanksgiving Break	
15	Communications	Messages in the media about diet and alcohol consumption.	1. Briefly describe a situation you are aware of involving alcohol consumption that had negative outcomes 2. Describe how the person involved in this situation could have avoided the negative outcomes using an approach other than "Not drinking" 3. If you were a friend of the individual involved in this situation what could you have done to avoid the negative outcomes using an approach other than "Keep them from drinking" 4. What actions do you believe the individual involved in this situation could take to avoided the negative outcomes other than "Don't drink in the future"
16	12/6	Final exam	

Data analysis

Analysis of the data was completed in two phases. In phase one, the demographic data collected at the beginning of the semester only, were compared between the three study groups. The second phase of the analysis involved comparing the three study groups to address the three study hypotheses. Repeated measures ANOVA were calculated to determine the effect of group (Control, Class 1, Class 2), time (Beginning & End of semester) and the interaction of group and time on the outcome variables of attitudes toward diet and physical activity, physical fitness and dietary intake. Significant ($p<.05$) main or interaction effects were further addressed through calculating Tukey's least significant different post hoc comparisons to determine differences between group/time means.

Results

As Table 2 indicates the study groups significantly differed ($p<.05$) on gender distribution, class rank, major area of study and age. These findings appear to indicate that the Controls were younger had a greater proportion of females, freshman rank, and major area of study in biological and health sciences compared with the two intervention groups.

Demographic Characteristic		Control (n=24)	Class 1 (n=20)	Class 2 (n=29)	Statistic	P<
Gender	Female Male	22 (92%) 2 (8%)	15 (75%) 5 (25%)	17 (59%) 12 (41%)	χ^2=7.46	.024
Race	White Other	19 (79%) 5 (21%)	18 (90%) 2 (10%)	28 (97%) 1 (3%)	χ^2=4.09	.13
Class Rank	Freshman Sophomore Junior Senior	21 (88%) 2 (8%) 0 1 (4%)	9 (45%) 1 (5%) 7 (35%) 3 (15%)	5 (17%) 9 (31%) 10 (36%) 5 (17%)	χ^2=30.19	.00
Committed Relationship	Yes No	19 (79%) 5 (21%)	5 (25%) 15 (75%)	10 (35%) 19 (65%)	χ^2=1.31	.52
Major Area of Study	Biomedical Sciences Business Health Sciences Other	13 (54%) 1 (4%) 10 (42%) 0	5 (25%) 12 (10%) 2 (60%) 1 (5%)	7 (24%) 12 (41%) 8 (28%) 2 (7%)	χ^2=19.09	.00
Age		18.21+.72	19.30+1.13	19.55+1.02	F=13.69	.00
Credit Hours		16.48 1.46	16.70 1.34	16.38 1.64	F=.31	.73

Table 2: Comparing demographic characteristics of the 3 study groups.

Table 3 presents the results of the repeated measures ANOVA of the outcome variables. The Control group did not change on any of the attitude outcome variables over the duration of the study. Class 1 and Class 2 significantly improved their control beliefs about physical activity and eating a healthy diet. Class 2 also improved their outcome expectations for physical activity over the duration of the study to a

level that was significantly higher than the control group at the end of the semester. Although these instruments that measured attitudes toward a healthy diet and physical activity were designed for those at risk for diabetes [20] measures of these instruments taken at the beginning of the semester among the sample yielded acceptable internal consistency (Chronbach's alpha>.80).

	Control		Class 1		Class 2	
Attitudes Towards Physical Activity and a Healthy Diet						
Outcome	Beginning	End	Beginning	End	Beginning	End
Outcome Expectations of Physical Activity [T I]	19.01 ± .76	18.89 ± .84	19.13 ± .74	20.43 ± .82	17.30 ± .65	20.47 ± .72#*
Control Beliefs of Physical Activity [T]	8.54 ± .39	15.98 ± .79	8.15 ± .38	17.22 ± .77#	7.98 ± .32	17.28 ± .65#
Outcome Expectations of Healthy Diet	16.76 ± .60	17.04 ± .72	16.72 ± .60	17.69 ± .71	16.72 ± .51	17.56 ± .60
Control Beliefs of Healthy Diet [T]	11.90 ± .57	12.53 ± .66	11.88 ± .56	13.31 ± .65#	12.54 ± .47	14.45 ± .55#
Physical Fitness						
Outcome	Beginning	End	Beginning	End	Beginning	End
BMI	22.29 ± .54	22.14 ± .62	23.21 ± .60	23.68 ± .65	22.63 ± .50	22.79 ± .55
Sit & Reach [G I]	21.44 ± 0.66	21.35 ± 0.72	18.56 ± .72*	18.66 ± .79*	16.92 ± .61*	18.17 ± .66
Estimated VO_2max.ml.kg.min	31.13 ± 1.03	32.10 ± 1.33	30.92 ± 1.14	32.00 ± 1.43	33.62 ± .94	33.09 ± 1.18
Sit-ups in 30 sec [T I]	14.92 ± 0.99	15.54 ± 0.97	14.20 ± 1.09	15.90 ± 1.05	11.40 ± .92*	14.82 ± .88#
Push-ups in 30 sec [T]	22.17 ± 1.50	23.83 ± 1.55	18.05 ± 1.74	20.10 ± 1.81	22.17 ± 1.59	23.83 ± 1.66#
Sit-to-stand in 30 sec [G T I]	26.92 ± 1.25	26.04 ± 1.19	23.50 ± 1.39	25.65 ± 1.36#	19.04 ± 1.17*	21.71 ± 1.15#
1 RM bench press lbs [T G]	71.08 ± 10.82	74.48 ± 10.24	96.25 ± 11.85	98.75 ± 11.21	105.71 ± 10.02	117.41 ± 9.48#*
1 RM leg press lbs [T I]	271.25 ± 20.59	274.79 ± 20.03	282.25 ± 22.52	302.00 ± 22.78	288.39 ± 19.03	325.89 ± 19.25#*
Reported Dietary Intake						
Outcome	Beginning	End	Beginning	End	Beginning	End
Total kCal [T]	1881.83 ± 147.28	1680.94 ± 127.17	1753.48 ± 149.04	1475.73 ± 119.08#	2203.04 ± 125.96	1907.43 ± 100.64#
Sodium (gms)	2786.17 ± 271.51	2955.27 ± 276.54	3132.88 ± 290.09	2531.38 ± 295.76	3528.35 ± 240.60	3320.60 ± 245.61
Iron (mg)	16.00 ± 1.41	16.63 ± 1.65	13.20 ± 1.50	15.93 ± 1.70	17.31 ± 1.24	16.83 ± 1.41
Calcium (mg)	1067.69 ± 95.89	1032.15 ± 124.45	862.85 ± 99.46	865.48 ± 120.00	1117.83 ± 82.59	1052.91 ± 99.58
Fiber (gms)	22.98 ± 2.35	20.04 ± 2.34	16.42 ± 2.31	17.28 ± 2.30	19.41 ± 1.92	18.79 ± 1.91
% of Cal from Sat. fat [G]	9.40 ± .01	9.80 ± .01	10.70 ± .01	10.20 ± .01	12.10 ± .01*	11.10 ± .01

Table 3: Comparisons of 3 study groups of the semester on attitudes, physical fitness and dietary intake. Note: # indicates a significant change within the study group between Beginning and End; * indicates a significant difference between the intervention group (Class 1 or Class 2) and the Control at a specific data collection point; T: Significant effect of Time; G: Significant effect of Group; I: Significant effect of Interaction of Time and Group.

Similarly, the Control group did not change on any of the measures of physical fitness over the duration of the study. As well, Class 1 and Class 2 exhibited no changes in their BMI or aerobic fitness (Vo_2max ml/kg.min) over the duration of the study. Class 1 maintained a lower sit & reach than the Controls at both data collection times, while Class 2 began the study with a lower sit & reach score but had a similar sit & reach score as compared to the Control by the end of the study. The only other physical fitness variable that improved over the duration of the study within Class 1 was sit-to-stand. Class 2 demonstrated significant improvements in sit-ups, push-ups, sit-to-stand, 1-RM bench press and 1-RM leg press over the duration of the study. A significant interaction effect was detected indicating that Class 2 subjects began the semester being able to perform significantly fewer sit-ups and sit-to-stands than the Control group, while significantly

increased on these measures to a level equal with the Controls at the end of the semester. A significant interaction effect was also detected in the 1RM-leg press measure with post hoc comparisons indicating that the increases in this variable observed within Class 2 subjects were to a level significantly greater than the Controls at the end of the semester.

The Control group also reported no changes in their dietary intake over the duration of the study. Both Class 1 and Class 2 reported significant declines in total caloric intake during the 15-week study. Neither Class 1 nor Class 2 reported significant changes in any other dietary intake variables.

Discussion

The statistical findings generally support the study hypotheses that the three credit hour course (Personal Health and Fitness) favorably improved attitudes toward diet and physical activity, physical fitness and dietary intake while Control subjects did not change on these measures over the course of the study. There are a number of explanations for these findings. First, the data appear to support the Theory of Planned Behavior [27]. The improvements in both intervention groups in control beliefs toward physical activity appears to indicate that the lecture and homework with the FI components of the course had a favorable impact on the individual's control beliefs (self-efficacy) to engage in a more physical activity. Further the findings also seem to indicate that the addition of requiring the subjects to engage in 30 minutes of exercise with the FI per week included in Class 2 only also resulted in increased outcome expectations about the benefits of physical activity. The improvements in both outcome expectations and self-efficacy toward physical activity observed in Class 2 may have contributed to these subjects engaging in more physical activity and thus realizing significant improvements in a larger number of their physical fitness outcomes over the duration of the study. Without the requirement of engaging in 30 minutes of exercise per week, outcome expectations appeared to be unaffected in Class 1. Improvements in both outcome expectations and self-efficacy toward physical activity may be necessary prerequisites for individuals to engage in more physical activity that results in improvements in their physical fitness.

These findings are consistent with previous authors who have examined components of the Theory of Planned Behavior (TPB) and physical activity. Numerous authors have reported moderate associations between components of the TPB and intention and actual physical activity [28]. Fewer researchers have attempted to operationalize components of the TPB into an intervention. Duangpunmat, Kalampakorn et al. developed an intervention based upon the TPB that included health information, group discussion in exercise barriers, modeling and experience exchange, and walking exercise practice [29]. These investigators reported attitudes towards exercise, perceived behavior control, walking exercise intention, walking exercise, weight, and BMI significantly improved compared to those in the comparison group. Jemmott et al. developed an intervention based on the TPB that included interactive exercises, games, brainstorming, role-playing, take-home assignments, group discussions, and videos to increase physical activity among South African Men [30]. The intervention was designed to bolster beliefs, attitudes, self-efficacy, and skills to adhere to physical-activity guidelines and resulted in significant increase in physical activity among the intervention group. In contrast a six-month online, theory based, health behavior intervention had no effect on fruit and vegetable intake, or physical activity among university students. The authors of this study concluded that this lack of effect was attributable to a lack personal engagement with the intervention [31]. Based upon the limited number of intervention studies incorporating components of the TPB, and the findings of the current study, a critical component of an intervention to increase physical activity and impact physical fitness appears to be activities with another individual that increase one's outcome expectations and control beliefs or self-efficacy toward physical activity. The current study appears to have successfully operationalized these theoretical concepts through requiring the subjects in Class 2 to regularly engage in the physical activity with their FI in addition to the course content and completing the weekly homework activity with the FI.

The lack of changes in most reported dietary intake measures, except for the significant reductions in total caloric intake, were initially curious although upon further consideration appear plausible. The weekly interaction with the FI in both Class 1 and Class 2 did not include regularly participating in any desired dietary intake behavior. Without engaging in the desired dietary intake behavior with the FI the subjects in both Class 1 and Class 2 did not appear to change their outcome expectations for this behavior and consequently did not change the components of their diet other than decreasing overall caloric intake. This assumption is supported by the lack of change in the all intervention sample's dietary sodium, iron, calcium, fiber and percentage of calories from saturated fat. This finding appears to indicate that both intervention groups reported eating fewer overall calories without changing the nutrient content of the foods they consumed. This conclusion is supported by the observation that the groups did not change their sodium intake, percentage of calories from saturated fat, or their dietary intake of iron, calcium or fiber. Thus, these findings appear to indicate that without demonstrating the desired behavior with the FI, the intervention groups did not change their outcome expectations of a healthy diet and did not appear to change the components of their diet other than reduce the overall amount of dietary intake.

Finally, none of the study groups exhibited any change in BMI over the duration of the study although average total calories decreased in both treatment groups and BMI remained unchanged. This finding is in contrast to previous investigators who documented significant weight gain among their college-student samples [5-8]. These findings may be attributable to a number of factors. First, the 16-week semester may not be long enough duration to detect a change in BMI. Although the interventions did reduce caloric intake and improved in physical fitness and attitudes toward a healthy dietary intake and physical activity these favorable changes are assumed to precede changes in body weight. A second explanation was that subjects in the intervention groups gained knowledge in proper nutrition and employed this knowledge to report reduced caloric intake as a result of a Hawthorne effect at the end of the intervention. As well, the BMI of the sample did not indicate many of the subjects were overweight or obese and thus losing weight may be appropriate.

Limitations

These findings must also be interpreted cautiously because a number of limitations of the study threaten the validity of the findings. First, measures of BMI and aerobic fitness (VO_2max ml/kg.min) were not responsive to the intervention. These findings could be attributed to the insensitivity of the 3-minute step test to detect changes in aerobic fitness following 14 weeks of training. This insensitivity may

also be applied to the measure of BMI which is a gross measure and not sensitive to changes in body composition including fat to lean ratios that may occur without an overall change in body weight and height. Future studies may consider using a more sensitive measure of body composition that quantifies lean and non-lean percentages of total body mass. Secondly, the normative belief subscales for physical activity and eating a healthy diet were found to be inappropriate for the sample. If this variable was measured it may have further described the efficacy of the two interventions. The moderate sample size and the demographic differences between the study groups may have diluted the effect of the intervention. Further, the long-term impact of the intervention beyond the 15-week course was not considered. Finally, the sample was homogenous, drawn from a single college campus and likely doesn't represent all college undergraduate students.

Conclusion

Low levels of physical activity and unhealthy dietary intake during college years are evidenced in the increasing weight gain experienced by undergraduate students. College students are susceptible to trying different lifestyle choices that may include consuming a healthy diet and increased levels of physical activity that result in increased physical fitness. The interventions studied in this trial attempted to operationalize the Theory of Planned Behavior constructs into an academic course designed to facilitate students to increase their physical activity and improve their dietary intake. Both intervention groups exhibited reduced caloric intake and improvements in physical fitness and attitudes toward a healthy dietary intake and physical activity. The intervention (Class 2) that offered the opportunity to engage in physical activity with the FI had the greatest impact on attitudes toward physical activity and measures of physical fitness. The control group did not change on any outcome variables.

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