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Development of interventions aimed at reducing obesity and cardiovascular disease risk in a diverse population of college-age young adults

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DEVELOPMENT OF INTERVENTIONS AIMED AT REDUCING OBESITY AND CARDIOVASCULAR DISEASE RISK IN A DIVERSE POPULATION OF COLLEGE-AGE YOUNG ADULTS

by

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DISSERTATION

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MAJOR: NUTRITION & FOOD SCIENCE

Approved by:

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Advisor Date

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DEDICATION

This work is dedicated

to my parents,

Virginia and Patrick Russell.

They are the very best there is.

It is not the critic who counts:
not the man who points out
how the strong man stumbles or where the doer of deeds could have done better.
The credit belongs to the man who is actually in the arena,
whose face is marred by dust and sweat and blood,
who strives valiantly, who errs and comes up short again and again,
because there is no effort without error or shortcoming,
but who knows the great enthusiasms, the great devotions,
who spends himself for a worthy cause;
who, at the best, knows, in the end, the triumph of high achievement,
and who, at the worst, if he fails, at least he fails while daring greatly,
so that his place shall never be
with those cold and timid souls who knew neither victory nor defeat.

- Theodore Roosevelt

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CHAPTER 1 INTRODUCTION

Despite the stated objective of Healthy People 2010 of reducing the prevalence of adult obesity to 15%, the most recent data indicate little progress is being made to meet this goal. Obesity in the United States has increased dramatically over the last 30 years. In 2004, an estimated 64.5 % of adults were either overweight or obese [1], and by 2008 the prevalence had increased to 68.3% [2]. Among children, obesity has increased most significantly in the 12-19 year old age group, and it has been estimated that as many as 35% of college students could be overweight or obese [3]. Determining the extent to which dietary habits contribute to weight gain among young adults is necessary to developing intervention programs designed to promote healthy eating habits early in this population. The long-term goal of this project is to develop dietary intervention programs aimed at reducing obesity in a diverse population of young adults.

It is well established that overweight is associated with markers of metabolic dysfunction that increase the risk of development of cardiovascular disease (CVD), and these have been reported in college students [4]. The rationale for developing dietary intervention programs targeted toward young adults is that the duration of obesity impacts disease development. Therefore, preventing obesity and resultant metabolic dysfunctions in young adults represents an opportunity to reduce the growing public health burden of CVD. Young adulthood is a critical life stage and a point at which an intervention to attenuate weight gain could be most effective. Curbing weight gain in the young adult population through an intervention could have significant impact on public health. It has been shown that higher BMI values throughout life are associated with substantially higher Medicare expenditures later in life [5], which illustrates the urgency in reducing the increasing healthcare burden imposed by the continued increase in obesity prevalence.

The transition from adolescence to adulthood is associated with weight gain. Normal weight gain is a hallmark of this transition, however a transition into obesity has become an increasingly prevalent trend in the young adult population. A standardized comparison of BMI values at five years documenting the transition from adolescence to adulthood showed the prevalence of obesity increased from 10.9% to 22.1% [6]. Further, the prevalence of obesity was highest among non-Hispanic black and Hispanic segments of the study population, which also emphasizes the urgency in developing a dietary intervention that can impact diverse populations. It is widely held that college students gain weight over the course of their first year, although disagreement exists as to the extent to which this occurs. Modest weight gain of an average of 2.3 kilograms has been reported among a sample of college freshmen over the course of their first semester [7], although factors that contributed to this gain were not established. Transition from high school to college is characterized by changes in lifestyle and dietary habits that are associated with weight gain [8], and patterns established at this critical life stage can affect long-term weight management. To date, there is little research examining the effects of contributing dietary factors to weight gain in this population.

Several factors contribute to the dietary habits of young adults, including time constraints, convenience, taste and cost. It has been shown that dietary habits become worse in young adulthood, and often college students do not meet recommendations for nutrient intake. Knowledge of current dietary guidelines has been positively correlated to healthier dietary habits [9]. One small study indicated an introductory nutrition course may attenuate weight gain in overweight, female freshmen [10], however there is currently no data that adequately measure the effects of completion of an introductory nutrition course on changes in dietary habits in college students.

Another factor associated with weight loss and maintenance is breakfast consumption. Breakfast consumption is associated with lower BMI in children and adolescents [11] as well as with better over-all nutritional status. Among 11th grade students surveyed, overweight and obese boys and obese girls were less likely to eat breakfast than normal weight subjects [12]. In a population of 12 to 16 year olds, those who consumed breakfast some days or every day were 3.1 or 4.0 times less likely to be obese than those who never ate breakfast [13]. Among adults, those who reported skipping breakfast regularly were 4.5 times more likely to be obese than regular breakfast consumers [14]. Regular breakfast consumption is a common behavioral characteristic of weight maintenance among those who have successfully lost weight. Among subjects of the National Weight Control Registry, 78% of those surveyed regularly ate breakfast every day [15], and higher frequencies of breakfast consumption has been associated with success in maintaining weight loss. The impact of breakfast consumption on attenuation of weight gain among college students has not been assessed.

Frequency of breakfast consumption decreases throughout childhood and adolescence. Breakfast consumption among adolescents has been shown to decline with age, dropping from approximately 76% at age 9 to 31% at age 19 [16].

Frequency of breakfast consumption is lower among ethnic minority groups. Decreased frequency of breakfast consumption is associated with ethnicity and socioeconomic status (SES). African-American and Hispanic adolescents have been shown to consume breakfast less frequently than Caucasians, and adolescents from lower socioeconomic households eat breakfast less frequently than those of higher SES [17]. A disparity in breakfast consumption frequency was seen between Caucasians and African-American 9-year old children, where 77% of white and 57% of black children ate breakfast each of the three test days. Among 19 year olds, the disparity had decreased to 32% and 22%, respectively [16].

Consumption of higher satiety foods is associated with decreased food intake at subsequent meals. It has been shown that consumption of higher satiety foods is correlated with reduced intake in the short term. In a study measuring food consumption 2 hours following a test meal, an inverse relationship was shown between test meal satiety score and kilocalories consumed in the test meal [18]. Foods with higher protein, fiber and water content have greater effects on satiety than foods higher in fat and carbohydrates. In a study comparing high fat, high protein or high carbohydrate breakfasts on subsequent energy intake, the high-fat breakfast resulted in greater subjective hunger before lunch compared to the protein or carbohydrate breakfasts [19].

Egg consumption is associated with increased satiety and reduced overall caloric intake. Eggs have a higher satiety index score than ready-to-eat cereals or white bread [20]. A breakfast containing eggs has been shown to promote satiety and decreased caloric intake in the short term. Overweight and obese subjects who consumed an egg breakfast reported significantly greater feelings of satiety through 90 minutes after the meal and consumed less overall energy than subjects fed an isocaloric bagel breakfast [21]. There is currently no long-term intervention assessing the inclusion of eggs at breakfast with attenuation of weight gain in young adults.

Breakfast consumption is associated with reduced cardiovascular disease risk. Along with increased BMI, dyslipidemia and insulin resistance are risk factors for cardiovascular disease. Compared to those who skipped breakfast, subjects who consumed breakfast had lower total cholesterol and LDL cholesterol, as well as greater insulin sensitivity [22].

With the association of high levels of plasma cholesterol and increased risk of CVD, reducing dietary cholesterol became a highly advocated strategy to reduce that risk. It has been estimated that eggs contribute approximately 30% of the dietary cholesterol to the diets of Americans [17], and eggs quickly became maligned as contributing to the rising prevalence of heart disease. However, for over two decades epidemiological evidence has indicated a link between egg consumption and increased risk of CVD does not exist [23], yet the stigma on eggs remains. The results of two large-scale prospective studies showed egg consumption of as much as one egg per day had no effect on the relative risk of coronary heart disease in either men or women, although an increase in risk was seen among diabetic subjects consuming more than one egg per day [24]. In a sample of adults, consumption of 2 eggs per day for six weeks had no effect on total plasma cholesterol or LDL cholesterol [25], despite the fact that one egg contains approximately 212 milligrams of cholesterol [26]. Further, an intervention designed to measure changes in LDL particle size in response to an increase in dietary cholesterol of 640 milligrams per day actually resulted in an increase in the less atherogenic large LDL (LDL-1) particles among those classified as “hyper-responders” to dietary cholesterol [27], indicating dietary cholesterol may actually have favorable effects on CVD risk.

Elevated plasma concentrations of LDL cholesterol have long been associated with increased risk of CVD, and this is considered one of the primary treatment targets to reduce risk [28]. Only recently has the heterogeneity of these particles been explored as to their contributory effects on CVD risk, and it has been shown by nuclear magnetic resonance (NMR) spectroscopy analysis that small, dense LDL particles are associated with increased cardiac events in women [29]. However, more recent data show that while NMR analysis provides a more detailed analysis of lipoprotein size distributions found in plasma samples, it offers only "comparable" risk assessment when compared to standard methods of lipid measurement [30].

It has been argued that current recommendations for cholesterol intake, under 300 milligrams per day for adults [31], are out of step with current research surrounding dietary cholesterol and heart disease and should be revised [32]. Because of the recommendation to limit dietary cholesterol, eggs may not be included in an otherwise healthy diet. Eggs, however, provide an economical source of protein to the diet [33] and they are also sources of carotenoids lutein and zexanthin that have been shown to be protective against macular degeneration [34]. Consumption of eggs for breakfast may also be an effective tool in weight management. In a study of overweight subjects, eggs were associated with a higher level of satiety and reduced caloric intake in a twenty-four hour period compared to an isocaloric bagel breakfast [35]. An eight week study of overweight men and women on reduced Calorie diets showed subjects consuming egg breakfasts had a 65% greater average reduction in weight compared to those assigned to bagel breakfasts for the study period [36]. A long-term study assessing the effects of eggs on weight management has not been conducted.

Since diet modification is the primary intervention for weight management, the broad, long-term goal of this study was to identify factors associated with weight gain in order to develop a dietary intervention program aimed at reducing obesity in a diverse population of college-age young adults. It has been shown that dietary habits become less healthy through young adulthood, and often college students do not meet recommendations for nutrient intake [37]. An objective of this Ph.D. proposal was to determine changes in dietary habits and the extent to which they contribute to weight change and CVD risk among college students. The rationale for the proposed research is that the duration of obesity impacts disease development, and preventing obesity and resultant metabolic dysfunctions in young adults represents an opportunity to reduce the growing public health burden of obesity-related chronic diseases. To that end, the following Specific Aims were pursued:

Specific Aim 1) To determine the effects of an introductory nutrition course on changes in weight and dietary patterns of college students. Knowledge of current dietary guidelines has been positively correlated with healthier eating habits in college students. One small study indicated an introductory nutrition course may attenuate weight gain in overweight, female freshmen [10], however there is currently no data that adequately measure the effects of completion of an introductory nutrition course on changes in dietary patterns and weight among college students. Technology has made possible the initiation of online course options, which have begun to compete with traditional live lecture courses for enrollment in university settings. Many factors influence a student's decision to enroll in an online section of a course rather than its lecture counterpart. Currently data does not exist that measure the efficacy of an online course compared to a lecture course on positively affecting the dietary habits of college students. In a longitudinal design, food frequency questionnaires and 3-day food diaries were administered at time points throughout one semester to assess nutrient status and dietary pattern among college students of all ages in both a live-lecture section and internet-based section of an introductory nutrition course. The hypothesis was that students in the live lecture nutrition courses would exhibit a greater positive change in dietary pattern than students in the internet-based course nutrition course. The study also aimed to document differences in student populations enrolled in the different types of courses, as this information has not previously been assessed.

Specific Aim 2) To document changes in dietary patterns and heart disease risk factors among incoming freshmen living in residence halls. Normal weight gain is a hallmark of the transition from adolescence to adulthood, although disagreement exists as to the extent to which this occurs [38]. A longitudinal study was carried out to document changes in weight and biomarkers of cardiovascular risk in incoming college freshmen living in residence halls. Over the course of the first semester, changes in dietary patterns, meal intake patterns, anthropometric measurements and biomarkers of CVD risk were documented at intervals throughout this period. Modest weight gain averaging between 1.3 to 3.1 kilograms has been reported among a sample of variable size of college freshmen over the course of their first semester [38], but it has also been reported that some students actually lose weight during this period [39]. This study aimed to establish a time course of weight change over four intervals throughout the semester and identify factors associated with weight change. Higher baseline BMI categories have been associated with a greater likelihood of weight gain, and it is hypothesized that a higher baseline BMI will be associated with greater increase in weight during the study. Food frequency questionnaires assessed food choices at time points during the study, and 3-day food diaries were used to assess nutrient composition of students' diets. Frequency of breakfast consumption has been associated with prevention of weight gain. Compared to those who skipped breakfast, subjects who consumed breakfast had lower total cholesterol and LDL cholesterol, as well as greater insulin sensitivity. It was hypothesized that attenuation of weight gain and lower total cholesterol and LDL cholesterol would be associated with a higher frequency of breakfast consumption. Although meal plan participation has been documented in college freshmen, changes in frequency of use over time have not been reported. This research will also electronically documented changes that occur in use of the residence hall dining plans throughout the semester through the use of university-issued identification cards.

Specific Aim 3) To compare the effects of breakfast type on the attenuation of weight gain among incoming college freshmen living in residence halls. A long-term intervention comparing egg-based breakfasts to non-egg-based breakfasts on attenuation of weight gain and biomarkers of CVD risk was conducted among incoming freshmen during the course of their first college semester. Conflicting data exist with respect to breakfast consumption and BMI. In children and adolescents, breakfast consumption is associated with a better overall nutritional profile as well as a reduced risk of overweight and obesity, despite greater energy intake than compared to those not consuming breakfast [22]. In adults, breakfast consumption is generally, but not consistently, associated with a reduced risk of overweight [40], [41]. Consumption of ready-to-eat cereal at breakfast has been shown to be associated with a reduced risk of overweight and obesity, while egg consumption has been associated with a greater risk [42]. However, a potential confounder in these studies is the categorical inclusion of eggs in a “meat/eggs” group in surveys administered to respondents. The combination of eggs with meats into one response category masks the contributory effects of consumption of common breakfast meats such as sausage or bacon, which are more energy dense than eggs, on intakes of Calories, total fat, saturated fat and cholesterol. A long-term intervention to assess the impact of egg consumption on weight maintenance has not been conducted, and it is expected that this intervention will build on previous data indicating eggs can be an integral part of a weight management program. It is hypothesized that consumption of eggs at breakfast will be associated with greater attenuation of weight gain than a non-egg breakfast over the course of the study period. Previous evidence shows dietary cholesterol consumption by healthy adults does not have a deleterious effect on biomarkers of CVD risk and may serve to promote a cardioprotective lipoprotein profile [43]. In accordance with previously published literature, it is expected that the egg breakfast group will not exhibit deleterious changes in plasma cholesterol as a result of the intervention.

CHAPTER 2 COMPARING THE EFFECTS OF INTERNET- AND LECTURE-BASED INTRODUCTORY NUTRITION COURSES ON AFFECTING CHANGES IN DIETARY PATTERNS AMONG COLLEGE STUDENTS

Introduction

The dramatic increase in obesity prevalence in the US has been most evident in the 12-19 year old age group, and as many as 35% of US college students could be overweight or obese [3]. While normal weight gain is a physiological characteristic of the transition from adolescence to adulthood, a transition into obesity has become increasingly prevalent. This trend is highest in minority populations, especially non-Hispanic black and Hispanic segments of the population [6]. Because Wayne State University draws from the diverse population of metropolitan Detroit, it is an ideal environment within which to assess a dietary intervention to attenuate weight gain in diverse populations.

College is associated with weight gain, which can be attributed to changes in dietary habits and lifestyle [8]. Patterns established at this critical life-stage can affect long-term weight management as well as risk of chronic diseases, yet there is little research examining factors that may mediate weight gain in this population. Determining the extent to which dietary habits contribute to weight change among young adults is necessary to developing intervention programs designed to promote healthy eating habits early in this population.

It is well established that overweight is associated with markers of metabolic dysfunction that increase the risk of development of cardiovascular disease (CVD), and these have been reported in college students [4]. Because the duration of these conditions impacts disease development, prevent obesity and resultant metabolic dysfunction in young adults represents an opportunity to reduce the public health burden of obesity-related chronic diseases.

Several factors contribute to the dietary habits of young adults, including time constraints, convenience, taste and cost of food. It has been shown that dietary habits become worse in young adulthood, and often college students do not meet recommendations for nutrient intake. Knowledge of current dietary guidelines has been positively correlated to healthier dietary habits in college students [9]. One small study indicated an introductory nutrition course may attenuate weight gain in overweight, female freshmen [10], however there is currently no data that adequately measure the effects of completion of an introductory nutrition course on changes in dietary habits among college students.

Technology has made possible the initiation of online course options, which have begun to compete with more traditional live lecture courses for enrollment in university settings. Many factors influence a student’s decision to enroll in an online section of a course rather than its lecture counterpart. Currently no data exists that measures the efficacy of an online course compared to a lecture course in positively affecting the dietary habits of college students.

This study was designed to determine characteristics of students who enroll in an online introductory nutrition course and those who enroll in the lecture style equivalent and to measure changes in dietary habits that occur after course completion. The central hypothesis is that completion of the live lecture course will have a greater positive impact on change in dietary habits among students than completion of the online alternative. A further objective of this study is to determine characteristics of students that enroll in the different course types.

Materials and Methods

The protocol for this study was approved by the Human Investigation Committee of Wayne State University (HIC #: 073308B3E, Coeus #: 0807006151). This study was conducted during the Fall 2008 semester through the Winter 2009 semester.

Students registered for Nutrition and Health (NFS 2030) during the Fall 2008 semester were recruited for participation in this study. Participants were recruited for the study by several different means. Students registered for the live lecture sections were recruited in person by direct appeal from the lead researcher. After the introductory meeting of each live lecture class (the first meeting of the semester), the lead researcher was introduced to the class by the instructor. Students were verbally given details of the study, and flyers advertising the study were also distributed at that time. Follow-up announcements were e-mailed by the lead researcher to all registered students in the live lecture sections.

Students in the online section of the course were e-mailed announcements of the study, and the course instructor included a brief written introduction to the study. A follow-up announcement of the study with more detailed information was then sent to these students by the lead researcher.

Conducting this two-phase e-mail solicitation for the online class was intended to mimic the announcement pattern of the live lecture courses.

Participants were offered up to 10 extra credit points toward their final grade in the course for participation in the study during the Fall semester. No monetary or course credit compensation was provided for the final measurement collection at the end of the following Winter semester

For this study, inclusion criterion was registration for either the live-lecture or online sections of Nutrition and Health (NFS 2030) during the Fall 2008 semester. Potential subjects who had completed a college-level introductory nutrition course in the previous 2 years were excluded from the study.

Students who expressed interest in participating in the study were contacted during the first week of the Fall 2008 semester by e-mail by the lead researcher and given instructions for study enrollment and the first measurement collection. Subjects were enrolled in the study after reading and signing consent forms. Students under age 18 were allowed to participate upon receipt of written assent and a consent form signed by a parent or legal guardian. A total of 102 subjects were successfully consented and enrolled.

Participants in both the online section and live lecture sections of Nutrition and Health completed a 114-item Block Food Frequency Questionnaire, which was adapted for online administration through Blackboard web pages specific to each section of the course. Students were asked to complete these online questionnaires during the first week of class, the last week of class and 3 months following the end of the class.

Participants were instructed to keep 3-day food diaries at the beginning and end of the course, and these were used to analyze nutrient intake status and changes in dietary habits that would occur during the study period. All students enrolled in NFS 2030 complete a food diary as part of the course requirement, and the timing of this activity was coordinated among the sections to occur at the same time and after instructions for their completion were given to study participants. This was done to eliminate potential bias that may occur with additional time spent verbally explaining the food diaries to the lecture sections, as a similar level of interaction might not occur within the context of the online section.

Anthropometric variables (weight, height, body mass index, body fat percentage) were to be measured at the beginning and end of the semester and again at three months following the end of the Fall semester. Height was measured using a standard rule, and weight and body composition were measured using a Tanita body composition analyzer (model TBF-300A, Arlington Heights, Illinois, U.S.A.).

All data were analyzed with SPSS version 17.0 statistical analysis software (Chicago, IL). Unless otherwise indicated, results are reported as means ± SD [44]. Independent and repeated measures t-tests were used to compare means between two groups. Analysis of variance (ANOVA) was used to compare means between three groups, repeated measures between-within ANOVA was used to determine differences over time and assess effect interactions, and chi-square tests were used to compare proportions within categorical variables. All statistical tests were based on an alpha level of significance of $p \leq 0.05$.

Results

A total of 102 subjects were successfully recruited and enrolled into the study, and 95 (93%) completed last anthropometric measurement at the end of the semester. Completion of both baseline and final body composition measurements was a requirement to earn full extra credit points for study participation. Fifty-nine subjects were enrolled in the live lecture (L) section of Nutrition and Health (NFS 2030), an entry-level nutrition course designed for non-science majors, and 43 subjects were enrolled in the web-based (W) course. Figure 1 (p. 19) shows the distribution of students among class ranks for each of the sections, and both sections follow similar distribution patterns. Freshmen accounted for the lowest proportion (L = 11.8%, W = 8.8%) in both sections. Approximately 60% of students in both sections were either sophomore or junior in rank. Chi-square analysis of proportions revealed no significant difference between the lecture course and the web-based course in the distribution of students among the class ranks.

Figure 2 (p. 20) shows the distribution among age groups for each of the sections. Among all subjects, the average age was 21.1 ± 5.6 years. There was no significant difference in mean age among students in the lecture course (20.8 ± 4.2) or the web-based course (21.7 ± 7.1). Chi-square analysis showed no significant difference between groups of proportions of students in each age range. In both sections, the largest proportion of students (L = 40.7% and W = 60.5%) was in the 17 to 18 year old age group.

Demographic characteristics of both sections are detailed in Table 1 (p. 21). The majority of subjects were female (76%), and this remained so within each section (L = 70% female, W = 84% female), with no significant differences in these proportions shown with chi-square analysis. Caucasian students represented a majority among all students (59%), and there was no significant difference between course types within this variable (L = 55% Caucasian, W = 64% Caucasian).

Table 2 (p. 22) shows the baseline descriptions for all subjects as well as by gender. A significant difference in baseline mean weight was observed between females (149.6 ± 37.3 lbs.) and males (171.8 ± 27.9, p=0.008). Mean body mass index for all subjects was 24.6 ± 5.3 kg/m^2. There was no significant difference found between males and females in body mass index (females = 24.7 ± 5.3, males = 24.4 ± 3.0, p=.378). Among all subjects, most (58%) were classified as "healthy weight." There was no significant difference between sections in proportions of subjects in the "healthy weight" (L = 55%, W = 68%), "overweight" (L = 23%, W = 24%) and "obese" (L = 14%, W = 8%) categories. Eight percent of students in the lecture section were categorized as being "underweight," and no students in the web section were in this category. BMI categories are defined as Underweight ≤ 18.5 kg/m2, Healthy Weight = 18.5-24.9 kg/m^2, Overweight = 25.0-29.9 kg/m^2, and Obese ≥ 30 kg/m^2.

Figure 1: Comparative Student Profile: Class Rank

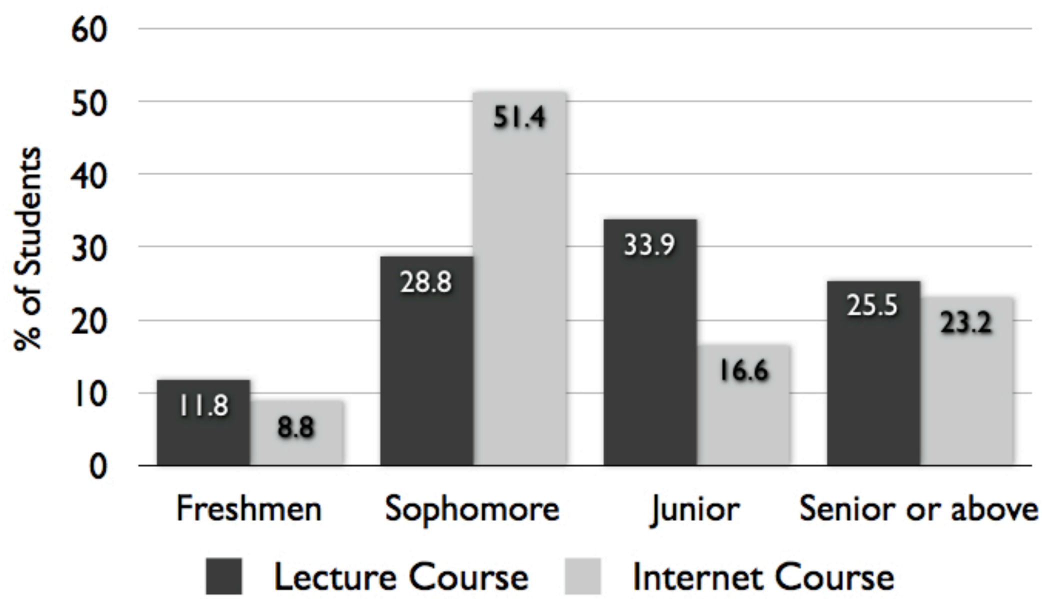


Figure 2: Comparative Student Profile: Student Ages

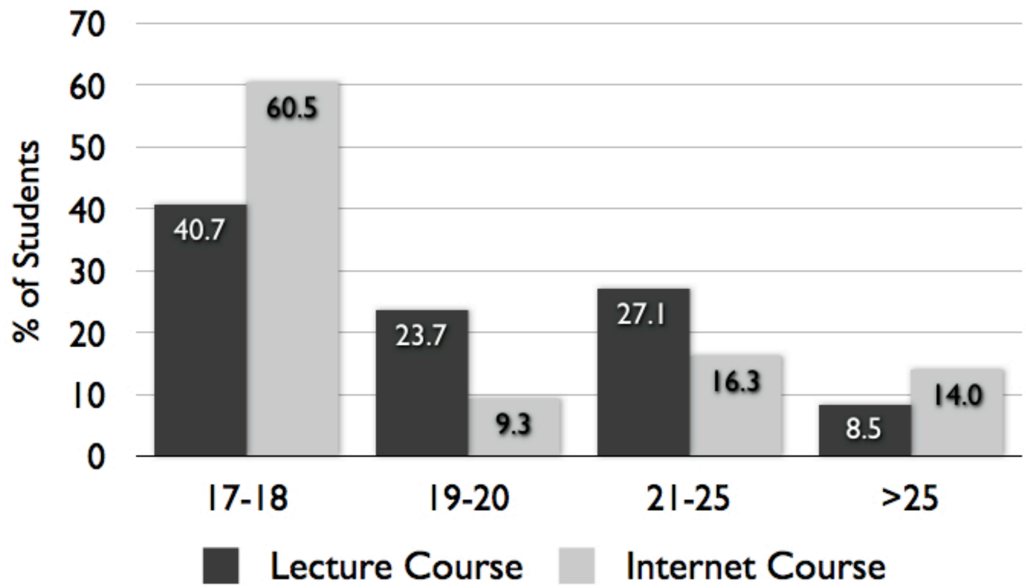


Table 1: Demographic Characteristics -- All Subjects and By Course Type

	All Subjects	Lecture Course	Internet Course	p=
n=	102	59	43	
Females	77 (76%)	41 (70%)	36 (84%)	NS
Males	25 (24%)	18 (30%)	7 (16%)	NS
Age (years)	21.1 ± 5.6	20.8 ± 4.2	21.7 ± 7.1	NS
Caucasian	56 (59%)	29 (55%)	27 (64%)	NS
African American	13 (14%)	10 (19%)	3 (7%)	NS
Hispanic	1 (1%)	0	1 (1%)	NS
Asian	6 (6%)	3 (6%)	3 (7%)	NS
Other Ethnicity	19 (20%)	11 (20%)	8 (19%)	NS

Means are reported ± SD. Significant differences in means between course types groups were determined using independent samples t-tests. Significant differences in proportions between groups were determined using Chi-square analysis. No significant differences were observed between course type groups.

Table 2: Baseline Descriptions -- All Subjects and By Gender

	All Subjects	Females	Males	p=
n=	102	77 (76%)	25 (24%)	
Age	21.1 ± 5.6	21.1 ± 5.8	21.1 ± 5.0	NS
Weight (lbs.)	155.1 ± 36.4	149.6 ± 37.3	171.8 ± 27.9	0.008
BMI (kg/m^2)	24.7 ± 5.3	24.7 ± 5.8	24.4 ± 3.0	NS
Underweight	6 (6%)	6 (8%)	0	NS
Healthy Weight	59 (58%)	42 (55%)	17 (68%)	NS
Overweight	24 (24%)	18 (23%)	6 (24%)	NS
Obese	13 (12%)	11 (14%)	2 (8%)	NS

Means are reported ± SD. Significant differences in means between course types groups were determined using independent samples t-tests. A significant difference in mean weight was observed between gender groups. Significant differences in proportions between groups were determined using Chi-square analysis.

BMI categories are defined as Underweight ≤ 18.5 kg/m^2, Healthy Weight = 18.5-24.9 kg/m^2, Overweight = 25.0-29.9 kg/m^2, and Obese ≥ 30 kg/m^2.

A comparison of baseline measurements for all subjects and by course type is presented in Table 3 (p. 24). There were no significant differences found between subjects in both course types as determined by independent samples Student's t-tests in mean weight (L = 156.1 ± 35.9 lbs., W = 153.6 ± 37.5 lbs., p= 0.082) or mean body mass index (L = 25.0 ± 5.1 kg/m^2, W = 24.2 ± 5.5, p= 0.097). Chi-square analysis revealed no significant difference in the proportions of students in each section having body mass indices under 25 kg/m^2 (L = 58%, W = 72%) or greater than or equal to 25 kg/m^2 (L = 42%, W = 28%).

Ninety-five subjects (93%) completed anthropometric measurements at the end of the semester. Table 4 (p. 25) details changes in mean body composition over the course of the semester study by course type. There was also no significant difference in weight change between the two groups (L = 0.5 ± 5.8 lbs., W = -1.2 ± 11.8, p = 0.996). The only significant difference was seen in the change in fat free mass, where those in the web course showed a mean decrease in fat free mass (-2.1 ± 7.4 lbs.) compared to subjects in the lecture course (0.5 ± 3.9 lbs., p = 0.026).

Changes in anthropometric variables were also analyzed by gender, and these are reported in Table 5 (p. 26). Compared to males, females showed lower mean baseline weight (F = 149.6 ± 37.3, M = 171.8 ± 27.9, p = 0.008), higher fat mass (F = 46.5 ± 26.9, M = 28.2 ± 10.8, p = 0.001) and lower mean fat free mass (F = 103.1 ± 12.2, 143.6 ± 19.8, p < 0.0001). There were no significant differences seen in the changes in these variables at the last measurement.

Table 3: Baseline Measurements -- All Subjects and By Course Type

	All Subjects	Lecture Course	Internet Course	p=
n=	102	59	43	
Females	77 (76%)	41 (70%)	36 (84%)	NS
Males	25 (24%)	18 (30%)	7 (16%)	NS
Mean Weight (lbs.)	155.1 ± 36.4	156.1 ± 35.9	153.6 ± 37.5	NS
Mean BMI (kg/m^2)	24.7 ± 5.3	25.0 ± 5.1	24.2 ± 5.5	NS
BMI <25	65 (64%)	34 (58%)	31 (72%)	NS
BMI ≥25	37 (36%)	25 (42%)	12 (28%)	NS
Mean % Fat	25.8 ± 10.1	25.9 ± 10.2	25.8 ± 10.2	NS

Means are reported ± SD. Significant differences in means between course types groups were determined using independent samples t-tests. Significant differences in proportions between groups were determined using Chi-square analysis. No significant differences were observed between course type groups.

Table 4: Mean Body Composition Changes By Course Type

	Lecture Course (n=53)	Web Course (n=42	p=
Mean Baseline Weight	156.1 ± 35.9	153.6 ± 37.4	NS
Weight Δ 2-1 (lbs.)	0.5 ± 5.8	-1.2 ± 11.8	NS
Mean Baseline Fat Mass	42.0 ± 24.6	42.9 ± 26.7	NS
Fat Mass Δ 2-1 (lbs.)	0.0 ± 6.4	0.8 ± 8.2	NS
Mean Baseline Fat Free Mass	114.1 ± 24.6	111.5 ± 19.6	NS
Fat Free Mass Δ 2-1 (lbs.)	0.5 ± 3.9	-2.1 ± 7.4	0.026

Means are reported ± SD. Significance between groups was assessed using independent measures t-tests at a significance level of $p \leq 0.05$.

One sample t-tests determined the changes to be non-significant.

Table 5: Mean Body Composition Changes By Gender

	Female (n=72)	Male (n=23)	p=
Mean Baseline Weight	149.6 ± 37.3	171.8 ± 27.9	0.008
Weight ∆ 2-1 (lbs.)	-0.7 ± 9.2	1.2 ± 7.6	NS
Mean Baseline Fat Mass	46.5 ± 26.9	28.2 ± 10.8	0.001
Fat Mass ∆ 2-1 (lbs.)	-0.2 ± 7.7	2.0 ± 5.1	NS
Mean Baseline Fat Free Mass	103.1 ± 12.2	143.6 ± 19.8	<0.0001
Fat Free Mass ∆ 2-1 (lbs.)	-0.5 ± 5.2	-0.8 ± 7.4	NS

Means are reported ± SD. Significance between groups was assessed using independent measures t-tests at a significance level of $p \leq 0.05$.

One sample t-tests determined the changes to be non-significant.

Table 6 (p. 28) reports changes in body composition measurements by weight change group. For the purposes of analysis, weight change was defined as a difference of two pounds or more from baseline body weight. Based on these established categories of weight change, 23 subjects were in the "lost weight" category, with a mean decrease of 6.3 ± 4.9 pounds, and 33 subjects were in the "gained weight" category, with a mean increase of 5.5 ± 3.9 pounds, and the differences were significant as assessed by independent samples student's t-test ($p < 0.0001$). Thirty-nine subjects did not experience a weight change of two pounds or more over the course of the semester.

Three-day written food records were collected at the beginning and end of the semester. Seventy-eight of the 102 enrolled subjects (76%) submitted food diaries for analysis at baseline. Table 7 (p. 29) details the food diary analysis for all subjects and by course type. There were no significant differences observed between course types in any variables analyzed using independent samples t-tests. A total of fourteen students submitted three-day food records for the second collection at the end of the semester. Table 8 (p. 30) details results of this and compares the means to those of the first food diaries collected using repeated measures analysis. Significant increases from baseline were observed in mean Calories consumed (Time 1 = 2059.4 ± 678.9, Time 2 = 2327.9 ± 660.6, $p = 0.045$) and Calories from fat consumed (Time 1 = 665.2 ± 264.2, Time 2 = 802.8 ± 251.2).

Table 6: Mean Body Composition Changes By Weight Change Group

	Lost ≥ 2 Lbs. (n=23)	Gained ≥ 2 Lbs. (n=33)	p=
Mean Baseline Weight	159.7 ± 27.3	159.9 ± 41.4	NS
Weight Δ 2-1 (lbs.)	-6.3 ± 4.9 *	5.5 ± 3.9 *	< 0.0001
Mean Baseline Fat Mass	44.5 ± 21.2	42.0 ± 29.1	NS
Fat Mass Δ 2-1 (lbs.)	-3.2 ± 4.8 *	4.9 ± 6.9 *	< 0.0001
Mean Baseline Fat Free Mass	115.2 ± 23.7	118.0 ± 23.8	NS
Fat Free Mass Δ 2-1 (lbs.)	-3.1 ± 6.7 *	0.6 ± 5.3	0.027

Means are reported ± SD. Significance between groups was assessed using independent measures t-tests at a significance level of $p \leq 0.05$.

* One samples t-tests assessed significance of changes to be different from zero, $p<0.05$

Table 7: Baseline 3-Day Average Nutrient Intake: All Subjects and Course Type

	All Subjects (n=78)	Lecture (n=41)	Web (n=37)	p=
Total Kcals	2005 ± 764	1973 ± 731	2240 ± 839	NS
Carbohydrate Kcals	1072 ± 441	1063 ± 419	1180 ± 506	NS
Protein Kcals	327 ± 200	310 ± 191	374 ± 249	NS
Total Fat Kcals	634 ± 278	628 ± 269	717 ± 283	NS
Saturated Fat Kcals	426 ± 215	208 ± 89	234 ± 94	NS
Fiber (g)	16 ± 13	16 ± 13	17 ± 16	NS
Cholesterol (mg)	328 ± 236	309 ± 227	402 ± 261	NS
% Kcals Carbohydrate	54 ± 9	54 ± 8	53 ± 9	NS
% Kcals Protein	16 ± 4	15 ± 4	16 ± 5	NS
% Kcals Fat	32 ± 9	32 ± 8	33 ± 10	NS
% Kcals Saturated Fat	11 ± 4	11 ± 3	11 ± 3	NS

Group means are reported ± SD. Significant differences between groups were determined by independent samples t-tests.

Table 8: 3-Day Average Nutrient Intake Comparison All Subjects

n=14	Food Diary 1	Food Diary 2	p=
Total Kcals	2059.4 ± 679.8	2327.9 ± 660.6	0.045
Carbohydrate Kcals	1127.1 ± 542.5	1162.5 ± 520.2	NS
Protein Kcals	308.6 ± 144.6	376.3 ± 95.5	NS
Total Fat Kcals	665.2 ± 264.2	802.8 ± 251.2	0.032
Saturated Fat Kcals	220.8 ± 121.9	254.2 ± 117.9	NS
Fiber (g)	18.4 ± 12.0	19.7 ± 10.5	NS
Cholesterol (mg)	182.8 ± 146.1	337.0 ± 203.1	NS
% Kcals Carbohydrate	52.4 ± 12.3	48.1 ± 10.9	NS
% Kcals Protein	14.9 ± 5.3	16.9 ± 5.3	NS
% Kcals Fat	32.7 ± 10.3	35.0 ± 8.4	NS
% Kcals Saturated Fat	11.0 ± 5.4	11.2 ± 5.1	NS

Fourteen subjects from all courses submitted food diaries at the second collection, and these results were compared to analysis of these subjects' food diaries collected at the beginning of the semester. Repeated measures t-tests were used to assess differences from Time 1 to Time 2. Mans are reported ± SD.

Food frequency questionnaires were used to determine changes in dietary patterns over the course of the semester. Table 9 (p. 32) shows changes in dietary variables by course type. No significant differences were seen between subjects of each course type in any measured variable. Table 10 (p. 33) shows changes in dietary variables by weight change category. For the purposes of this analysis, weight change was defined as greater than a two-pound difference from baseline body weight. There were no significant differences seen in changes in dietary variables between weight change groups.

There were no significant differences seen between course types in self-reported lifestyle variables of physical activity (Figure 3, p. 34), television viewing (Figure 4, p. 35) or computer use (Figure 5, p. 36).

Table 9: Changes in Diet Variables by Course Type

	Lecture (n=40)	Internet (n=13)	p=
Change in Fruit Servings	3.8 ± 4.9	4.4 ± 7.2	NS
Change in Veg. Servings	1.8 ± 6.4	0.2 ± 7.7	NS
Change in Dairy Servings	0.6 ± 3.2	-0.5 ± 3.1	NS
Change in Sweets Servings	-9.7 ± 18.9	-12.3 ± 19.4	NS

Group means are reported ± SD. Significant differences between groups were determined by independent samples t-tests. Number of subjects (n=) refers to the number of subjects in each categorical variable that completed the final food frequency questionnaire.

Table 10: Changes in Diet Variables by Weight Change Category

	Lost Weight (n=11)	No Change (n=24)	Gained Weight (n=18)	p=
Change in Fruit Servings	4.8 ± 4.5	4.5 ± 6.3	4.4 ± 5.1	NS
Change in Veg. Servings	-0.4 ± 7.6	1.4 ± 8.6	4.6 ± 3.3	NS
Change in Dairy Servings	-0.1 ± 2.7	-0.1 ± 2.5	-0.4 ± 2.6	NS
Change in Sweets Servings	-8.9 ± 19.3	-13.6 ± 19.7	-12.1 ± 19.5	NS

Group means are reported ± SD. Significant differences between groups were determined by independent samples t-tests. The number of subjects (n) refers to the number of subjects in each categorical variable who completed the final food frequency questionnaire (53 students total).

Figure 3: Physical Activity by Course Type

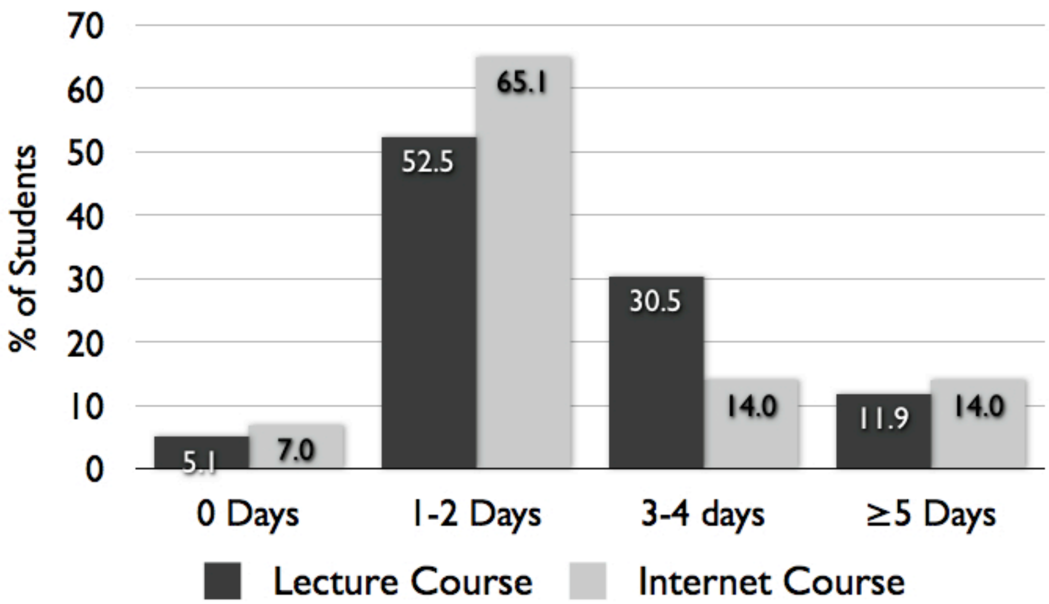


Figure 4: Time Spent Watching TV by Course Type

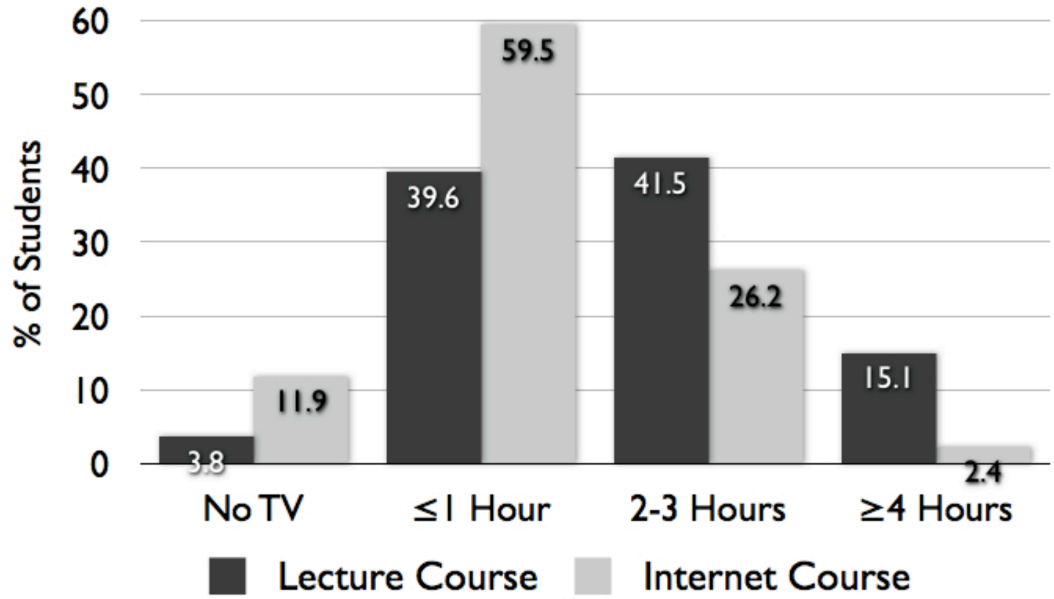
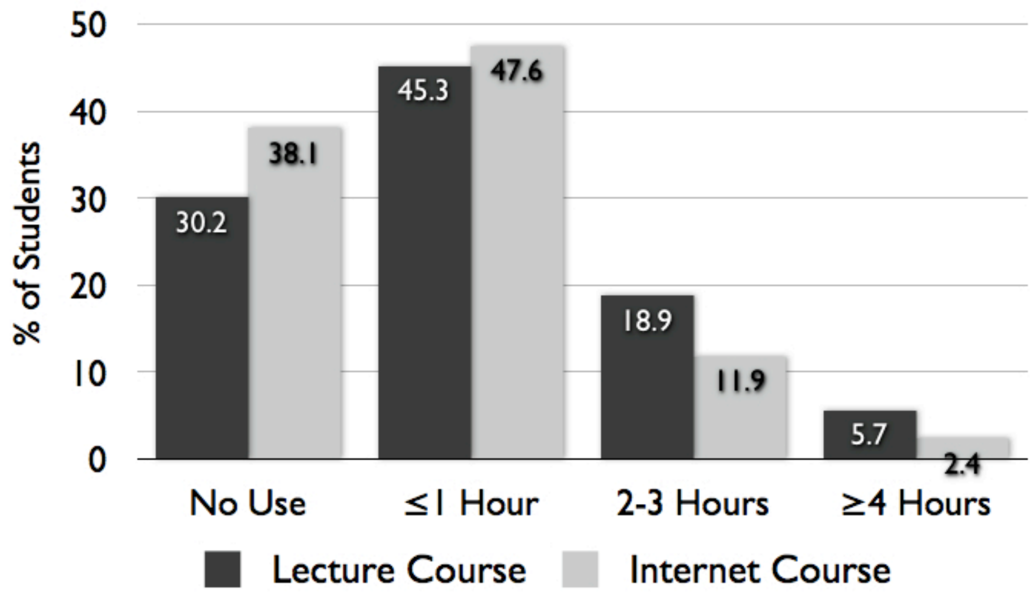


Figure 5: Computer Use by Course Type



Discussion

This study was designed to characterize differences in students and any changes in anthropometric and dietary variables resulting from completion of different formats (lecture-based and internet-based) of introductory nutrition courses. Within the limitations of the study, including a small sample size and the fact that subjects were self-selected, the results of this study show that the method of delivery of an introductory nutrition course has little effect on changes in anthropometric or dietary variables.

Follow-up was a substantial limitation of this study. The original design called for subjects to return for an anthropometric measurement at the end of the semester following the conclusion of the original nutrition course. Despite repeated attempts to contact students, only four returned for the follow-up measurement (4%). This extremely low response rate is likely due to the fact that no incentive was offered to return, where extra credit had been offered for full completion of the first two measurements taken during the time the students were enrolled in the nutrition course. This is comparable to previously published work. In a study examining the effects of an introductory nutrition course on weight control, participation in the post-course measurement fell to approximately 5% of the original study population [45]. Another study using students from a fall semester introductory nutrition course as subjects offered $30 gift cards to participants who returned for the spring measurement and had a 40% response rate at that measurement [46]. Because no compensation was offered for the spring measurement collection, retention of active participants was a concern, and the low return rate, while disappointing, was expected.

Further, subject participation in the submission of the second three-day food diary was lower than expected. Seventy-eight subjects (78%) of students who completed baseline anthropometric measurements submitted food diaries for the first collection (at the beginning of the semester), 41 students in the lecture class and 37 in the online class. From both class types, a total of 14 students submitted the second food diary. This may be due to the timing of the collection, which was the week before final exams, which may have added too much burden onto students' schedules during the end of the semester, a traditionally busy time for students. Also, it is possible that students felt confident enough with their grades at the end of the semester and did not choose to put forth the extra effort to keep a written records of all foods consumed for three days.

This study showed no significant differences in the distributions of students in class ranks and no differences in the distribution of ages between course types. The course, Nutrition and Health, is an introductory nutrition course designed for non-science majors and could be taken in fulfillment of Wayne State University's Life Science General Education requirement. As such, it was expected that a high proportion of students would be in the early stages of their college careers. Approximately 65% of students in both courses were either sophomores or juniors. However, 40.7% of students in the live lecture course and 60.5% of students in the online course were in the 17-18 year-old age group.

With the expected exception of weight, there were no differences between course format types with respect to proportions of students in the various BMI categories at baseline. Of all subjects, 6% were classified as underweight, 58% were classified as healthy weight, 24% were overweight, and 12% were classified as obese. This is substantially lower to the current prevalence data for the country which estimates that 35% of all adults are overweight and 33.8% are obese [2]. Among those in the 17 to 19 year old age category, 33% were classified as healthy weight, 13% were overweight, and 9% were considered obese. This is comparable to the national obesity prevalence for 12 to 19 year olds of 12.6% [47].

There were also no significant differences in these proportions when analyzed by gender, with 23% of females and 24% of males classified as overweight, and 14% of females and 8% of males classified as obese. Most recent gender-specific data shows the prevalence obesity among women to be estimated at 35.5% and 32.2% among men [2]. As expected, there were gender differences in baseline anthropometric variables, where females reported lower average weight compared to males, higher baseline fat mass and lower baseline fat free mass. However, there was no significant change observed in any of these variables over the course of the study for either females or males.

While no significant changes in weight or fat mass were observed between course format groups over the course of the semester-long study, those in the web-based course showed a significant average decrease in fat free mass compared to those in the lecture-based course. This change was not explained by the self-reported lifestyle variables of physical activity, television viewing and computer use, which did not differ significantly between course format groups. It is likely that the difference, while statistically significant, is too small to be detected with self-reported measures of physical activity, television watching or computer use.

Of the 102 subjects who participated in the first anthropometric measurement, only 78 (76%) turned in three-day food records (Lecture = 41, Web-based = 37). No significant differences were seen between the lecture course and the web-based course in any measured dietary variable. Only 14 students submitted food diaries at the end of the course (L = 9, W = 5), which is inadequate from which to draw any meaningful comparisons. However, within that very small subject pool, significant increases from baseline were seen in Calories consumed and Calories from total fat consumed.

Students in both course formats completed Block food frequency questionnaires. These were administered electronically and data were used to assess changes in dietary patterns from baseline to the end of the semester. No differences were seen Table 9 (p. 32) compares changes in dietary variables between those whose weight changed by two pounds or more over the course of the semester.

This study aimed to determine the effects of an introductory nutrition course on changes in weight and dietary habits of college students. It was shown that course delivery type did not have an effect on changes in dietary variables, and only minimal differences were seen in measured change in body fat mass between the two groups. It is therefore reasonable to conclude that the method of delivery of an introductory nutrition course does not affect changes in body composition or dietary habits among students in the short term.

This is a positive finding in terms of students' access to education. It was hypothesized that students in the lecture course would show more positive changes in eating habits after completion of the course than those in the online course due to the increased exposure and access to the teacher. The results of this study show no significant differences in these variables by course delivery type, which means the impact of the material to affect students' behaviors is similar in both course delivery types.

CHAPTER 3 DETERMINING CHANGES IN DIETARY PATTERNS AND EFFECTS ON NUTRITIONAL STATUS AND CARDIOVASCULAR RISK AMONG INCOMING FRESHMEN STUDENTS LIVING IN CAMPUS RESIDENCE HALLS

Introduction

This observational study was designed to assess changes in body composition and markers of cardiovascular risk as well as changes in dietary habits of incoming college freshmen over the course of their first semester at college. A longitudinal study was conducted over the course of the first semester of college, and dietary habits, meal intake patterns and changes in anthropometric measurements and fasting plasma lipids and glucose were measured. The specific aims were to assess changes in nutrient composition of students' diets from the beginning of the semester to the end, to determine and assess changes in the frequency of breakfast consumption over the course of the semester, and to establish a time course of body composition and plasma lipid and glucose changes over the course of the first semester.

This study was also used as a pilot study to assess the feasibility of conducting a larger-scale breakfast intervention study at a later semester that would utilize the same population, facilities and departments and organizations within the university.

Materials and Methods

The study protocol was approved by the Human Investigation Committee of Wayne State University (HIC #: 073408B3E, Coeus #: 0807006152). The study was conducted in the fall semester of 2008.

The study was advertised in several different ways. Announcements of the study with general details and relevant contact information were approved by Wayne State University's Human Investigation Committee and were distributed to all incoming freshmen residents on the day they moved into the residence halls. These were also posted on walls and bulletin boards throughout the residence halls. The lead researcher of the study was present at all move-in days to promote the study and gather names and contact information of interested students. HIC-approved advertisement flyers were also e-mailed to the WSU e-mail addressed of all incoming freshmen living in the residence halls.

Subjects were recruited by both active and passive methods. Subjects were recruited passively through direct response to study advertisements that were both distributed to students directly and posted in locations throughout the residence halls and undergraduate library. This method yielded only two enrollments (3% of total). Subjects were also recruited directly by a group of research assistants trained by the lead researcher to provide information about the study to prospective subjects. This phase occurred during the move-in period and in the immediate days before the start of classes for the semester, and due to a limited collection of prospective participants, it was extended through the first week of classes. During this phase, research assistants collected contact information from prospective subjects interested in participating and advised them they would be contacted via e-mail with further information and details pertaining to study enrollment. Research assistants conducted this phase at all meal service times (breakfast, lunch and dinner), and they were positioned proximally to the dining hall entrance at a table with a Wayne State University Department of Nutrition and Food Science table cover. On the table were additional flyers advertising the study as well as an assortment of Department of Nutrition and Food Science pens and key chains that the students could take. Research assistants also entered the dining hall and talked to students during meal services. Approximately 170 students indicated interest in the study and provided contact information during this collection period.

E-mails were sent to all prospective study subjects who had given their contact information on the same day it was received. The e-mail contained details about the study including its purpose, duration, participation details including compensation paid to participants, as well as enrollment details. Prospective subjects were asked to reply to the e-mail (by using the "reply" function) to indicate their interest in enrolling in the study. The purpose of this 2-tired enrollment process was to eliminate those potential subjects who may have been initially attracted to the compensation offered to participants but who may not have been fully committed to participating in the entire study. As the study design was participation-intensive for an extended period of time, it was decided that having an active, "opt-in" style of enrollment might serve to reduce the drop-out rate.

Actual enrollment for the study was conducted during the first week of the semester. These sessions were held in the same activity room (near the entrance to the dining hall) where recruitment had previously taken place. Sessions were held in conjunction with lunch service in the dining hall, which was determined to be a time where most potential subjects could most readily attend. Enrollment was also made available by appointment for those potential participants who could not attend the lunchtime sessions. Prospective participants filled out a screening questionnaire and read and signed the consent form. The lead researcher was present at all sessions to respond to any questions and explain the consent form and study details. Once a consent form was obtained, study subjects were given instructions as to how to participate in the first measurement collection session. A total of 54 subjects were enrolled in the study. This represents 32% of those who had originally indicated an interest in participating in the study.

Subjects to be included in the study were incoming freshmen students at Wayne State University, aged 17-20, who lived in the residence halls and were enrolled in the University meal plan (a requirement for all residence hall freshmen residents). Exclusion criteria included weight loss or weight gain of greater than 5% in the three months prior to the study, current participation in any weight loss program, unstable cardiac conditions, major systemic illness, history of drug abuse or eating disorders, uncontrolled diabetes or hyperthyroidism, familial hyperlipidemias, any condition for which weight loss would be contraindicated including pregnancy, allergies to or dislike of eggs and participation in college athletics. A screening questionnaire was given to prospective subjects, and their responses were used to determine eligibility.

Participants in this observation study were compensated for their time and inconvenience during study participation. Total compensation provided was up to \$40.00. Actual compensation paid was in proportion to each student's actual participation in the study.

This study was a prospective observation design that aimed to document changes in health parameters and dietary habits over the course of the first semester of college. It was also aimed to assess the feasibility of conducting a larger scale intervention study using the same population, facilities and various University departments.

Patterns of dining hall meal frequency were determined electronically using University-issued identification cards (One Cards), which are required for admittance into residence hall dining facilities. This phase of the project was administered through cooperation with WSU residence halls and their management staff, as well as staff in the WSU Parking Office, which administers One Cards. Meal times in the dining halls adhere to a fixed schedule throughout the semester. Students gain admittance to dining halls by swiping their One Cards through card readers, which electronically document each person admitted to a particular dining site. Once the scheduled meal period has ended, data is compiled to reflect the number of diners in attendance at that particular meal at each dining facility. This data was compiled for each scheduled meal period (breakfast, lunch, dinner), and data from every residence hall dining facility for each day of the semester was made available by the WSU Parking Office. These raw datasets contained information from every member of the University community that used a One Card to access a dining facility, and data from those not enrolled in the study were eliminated. The study aimed to assess breakfast frequency among these subjects as preliminary data in support of a breakfast intervention study to be conducted the following year.

Food diaries were collected at two time points during the study. They were collected during the second week of the study and again at the final measurement collection session during the last week of the study. Study participants were verbally instructed as to how to complete their food diaries by the lead researcher, and they were shown examples of food diaries showing the level of detail requested. Subjects were also given written instructions for completion of the food diaries, and they were given the opportunity to ask questions and have them answered by the lead researcher. Food diaries were analyzed using NAT Verson 2.0, an online database created and maintained by the University of Illinois Department of Food Science and Human Nutrition. The database is composed of the USDA Handbook #8 as well as data from various food companies, and it is a dietary assessment tool recommended by the USDA.

Subjects were asked to complete a series of four online food frequency questionnaires. A 124-question Block food frequency questionnaire was modified for online administration on Wayne State University's Blackboard online course administration system, and questions were included to explore demographic characteristics and lifestyle factors that are known to contribute to weight status, including physical activity, television watching, computer use and alcohol consumption [7]. The requested completion schedule for these was weeks 2, 6, 11 and 15. The first and last questionnaires administered were analyzed for this study.

Anthropometric measurements were taken in a residence hall activity room in the mornings prior to breakfast consumption at baseline (Week 2) and at weeks 6, 11 and 15 of the study. Height and weight were measured with subjects wearing light clothing with all materials removed from pockets. Weight and body composition were assessed with a Tanita body composition analyzer (model TBF-300A, Arlington Heights, Illinois, U.S.A.).

Body mass index (BMI) was calculated as kg/m^2 and is reported as such. Current recommendations for defining BMI in children and adolescents aged 2 through 19 years are based on the relation of BMI to the 2000 Centers for Disease Control and Prevention (CDC) age- and sex-specific weight-for-recumbent-length growth charts [48]. Prevalence estimates of childhood overweight and obesity have been traditionally based on two cut-off values: the 85^{th} percentile to designate what has been termed "at risk for overweight" and the 95^{th} percentile to designate "overweight" categories. Recently, nomenclature describing these cut-off points has changed to "overweight" and "obese," respectively [48]. This now corresponds to adult BMI classification labels of 25.0 to 29.9 kg/m^2 as overweight and ≥ 30 kg/m^2 as obese. As "college students" and "college freshmen" are frequently referred to as "young adults," and their markers for risk of chronic disease are often compared to those of the adult population, BMI is typically reported for this special population in terms of the adult scale and nomenclature. BMI values reported in this study will follow that convention and are reported as BMI of 18.5 to 24.9 kg/m^2 as being "healthy weight," BMI of 25.0 to 29.9 kg/m^2 as "overweight" and BMI ≥ 30 kg/m^2 as "obese."

Fasting plasma lipids were assessed at weeks 2, 6 and 15 of the study. Subjects were asked to report to the activity room located inside of the residence hall at the entrance to the dining hall on the designated dates. Subjects were instructed to report to the blood draw sessions in a fasted state, having not consumed any food or drink after going to sleep the night before (no later than 10:00 PM was given as a guideline). Fasting glucose measurements and plasma total cholesterol, HDL, LDL and triglycerides were taken from collected blood samples using Cholestech LDX mobile units (Hayward, California, U.S.A.) and Lipid Profile Plus Glucose cassettes.

All data were analyzed with SPSS version 17.0 statistical analysis software (Chicago, IL). Unless otherwise indicated, results are reported as means ± SD [44]. Independent and repeated measures t-tests were used to compare means between two groups. Analysis of variance (ANOVA) was used to compare means between three groups, repeated measures between-within ANOVA was used to determine differences over time and assess effect interactions, and chi-square tests were used to compare proportions within categorical variables. All statistical tests were based on $\alpha \leq 0.05$ as a level of significance.

Results

Fifty-four subjects were successfully enrolled in the study, and at the baseline measurement collection, these 37 females and 17 males completed anthropometric measurements. The mean BMI at baseline for all subjects was 23.9 ± 5.9 kg/m^2. Among all subjects, 6% had BMIs under 18.5 kg/m^2, 67% were in the "healthy weight" range of 18.6-24.9 kg/m^2, 18% were in the "overweight" category of 25-29.9 kg/m^2 and 9% were "obese" with BMI of ≥ 30 kg/m^2. Significant differences were observed between genders (Table 11, p. 52) in mean weight at baseline (female = 136.0 ± 31.2, male = 174.5 ± 47.2, p=0.001). No significant difference was observed between genders in mean BMI at baseline, but female subjects had a significantly higher body fat percentage (female = 26.4 ± 9.9%, male = 17.1 ± 9.9%, p<0.002). Chi-square analysis of the proportion of each gender in baseline BMI categories of <25 kg/m^2 (73% of all females and 71% of all males) and ≥25 kg/m^2 (27% of all females and 29% of all males) revealed no significant differences between proportions of females and males in these BMI categories.

Thirty-two subjects (59%) completed the final anthropometric measurement session, which was held during the final week of the semester (Week 15). Only one subject "officially" dropped out of the study. At week eight the subject submitted a written request to end participation in the study, citing a demanding school schedule and workload. Table 12 (p. 53) reports baseline anthropometric characteristics and fasting plasma cholesterol and glucose measurements for those who completed the final measurement collection and those who did not. Compared to those who completed the final measurement (C), subjects who did not complete the final measurement (NC) had a significantly higher mean weight (C = 136.3 ± 31.7, NC =165.3 ± 46.9, p=0.009) and BMI (C = 22.6 ± 5.5, NC = 25.8 ± 6.1, p=0.048) at baseline. No significant difference between completers and non-completers was seen for any other measured baseline variable. No significant difference was seen between completers and non-completers in dining hall breakfast attendance frequency until week 13 (C = 1.1 ± 1.0, NC = 0.5 ± 0.7, p=0.041), and only again at week 15 (C = 2.09 ± 1.6, NC = 1.2 ± 1.4, p=0.043), and at those time points, completers showed a higher mean frequency of breakfast attendance.

Table 11: Baseline Measurements -- All Subjects and By Gender

	All Subjects	Females	Males	p=
n=	54	37	17	
Mean Weight (lbs.)	148.1 ± 40.8	136.0 ± 31.2	174.5 ± 47.2	0.001
Mean BMI (kg/m^2)	23.9 ± 5.9	23.2 ± 5.5	25.4 ± 6.6	NS
BMI <25 kg/m^2	39 (72%)	27 (73%)	12 (71%)	NS[a]
BMI ≥25 kg/m^2	15 (28%)	10 (27%)	5 (29%)	NS
Mean % Fat	23.5 ± 10.6	26.4 ± 9.9	17.1 ± 9.5	0.002
Total Cholesterol (mg/dL)	163 ± 32	164 ± 34	162 ± 29	NS
Triglycerides (mg/dL)	104 ± 58	96 ± 46	120 ± 78	NS
LDL Cholesterol (mg/dL)	88 ± 30	85 ± 31	94 ± 27	NS
HDL Cholesterol (mg/dL)	50 ± 13	53 ± 13	44 ± 9	0.040
Glucose (mg/dL)	85 ± 20	81 ± 12	94 ± 30	0.051

Means are reported ± SD. Significant differences in means between groups were determined using independent samples t-tests. Significant differences in proportions between groups were determined using Chi-square analysis.

[a] No significant difference was seen in proportions of subjects with baseline BMI <25 and those with baseline BMI ≥ 25 between gender groups, Chi-square(1)=0.033, p=0.856.

Table 12: Baseline Measurements By Final Measureme Completion Status

	Completed Last Measurement (Week 15)	Did Not Complete Last Measurement (Week 15)	p=
n=	32	22	
Female	24	8	NS[a]
Male	13	9	NS
Mean Weight (lbs.)	136.3 ± 31.7	165.3 ± 46.9	0.009
Mean BMI (kg/m^2)	22.6 ± 5.5	25.8 ± 6.1	0.048
BMI <25 kg/m^2	26	6	NS[b]
BMI ≥25 kg/m^2	13	9	NS
Mean % Fat	22.0 ± 11.0	25.6 ± 6.1	NS
Total Cholesterol (mg/dL)	165 ± 32	160 ± 33	NS
Triglycerides (mg/dL)	101 ± 59	109 ± 59	NS
LDL Cholesterol (mg/dL)	93 ± 31	79 ± 27	NS
HDL Cholesterol (mg/dL)	49 ± 11	52 ± 15	NS
Glucose (mg/dL)	81 ± 9	90 ± 28	NS
Mean Total Bfasts	33.0 ± 20.1	23.7 ± 21.0	NS
Mean Bfasts/Wk	2.2 ± 1.3	1.6 ± 1.4	NS

Means are reported ± SD. Significant differences in means between groups were determined using independent samples t-tests. Significant differences in proportions between groups were determined using Chi-square analysis.

[a] No significant difference in completion of final measurement was seen between proportions of females and males, Chi-square(1)=1.530, p=0.216.

[b] No significant difference in completion of final measurement was seen between baseline BMI categories, Chi-square(1)=3.191, p=0.074.

Among all subjects who completed the final measurement collection (n=32, 59% of enrolled subjects), a mean weight change of 2.9 ± 4.7 pounds was observed. Among these subjects, nine (28%) lost greater than one pound of their baseline body weight, and 19 (59%) experienced weight change of greater than one pound of their baseline body weight. Four subjects (12%) experienced no weight changed in excess of one pound from baseline to the final measurement. Table 13 (p. 55) compares baseline measurements between those who lost more than one pound and those who gained more than one pound over the course of the study. No significant differences in any measured baseline variables were seen between these two weight change groups.

Mean changes in body composition by baseline BMI category are reported in Table 14 (p. 56). Subjects in these categories showed significantly different measurements at baseline, with those in the higher BMI category having higher mean weight, fat mass and fat free mass. A mixed between-within analysis of variance was conducted to assess the impact of baseline BMI on changes in weight and percentage of body fat variables over time. There was a large main effect for time that was significant for weight change (Wilks Lambda = 0.528, F = 7.145, $p<0.001$, partial eta squared = 0.472) but not for any other variables. A significant interaction effect was seen for time and baseline BMI category on weight change (Wilks Lambda = 0.705, F = 3.342, $p=0.036$, partial eta squared = 0.295). However, these results should be interpreted with caution, as the small sample size resulted in an observed power of only 68%.

Table 13: Baseline Measurements -- By Final Weight Change Status

	Lost > 1 Lb.	Gained > 1 Lb.	p=
n=	9	19	
Females	6 (67%)	16 (84%)	NS
Males	3 (33%)	3 (16%)	NS
Mean Weight (lbs.)	146.8 ± 20.7	133.4 ± 37.2	NS
Mean BMI (kg/m^2)	22.4 ± 2.1	23.1 ± 6.8	NS
BMI <25 kg/m^2	8 (89%)	14 (74%)	NS[a]
BMI ≥25 kg/m^2	1 (11%)	5 (26%)	NS
Mean % Fat	22.4 ± 8.9	23.3 ± 12.4	NS
Total Cholesterol (mg/dL)	150 ± 21	172 ± 36	NS
Triglycerides (mg/dL)	104 ± 96	99 ± 37	NS
LDL Cholesterol (mg/dL)	81 ± 11	97 ± 37	NS
HDL Cholesterol (mg/dL)	48 ± 10	50 ± 12	NS
Glucose (mg/dL)	84 ± 11	81 ± 8	NS

Means are reported ± SD. Significant differences in means between groups were determined using independent samples t-tests. Significant differences in proportions between groups were determined using Chi-square analysis.

Independent samples t-tests revealed no significant differences in variable means between those who gained > 1 lb. and those who lost > 1 lb. during the course of the study.

[a] No significant difference was seen in proportions of subjects with baseline BMI <25 and those with baseline BMI ≥ 25 between weight change groups, Chi-square(1)=1.982, p=0.371.

Table 14: Time Course of Body Composition Changes By Baseline BMI Category

	Baseline BMI <25	Baseline BMI ≥25	p=
Mean Baseline Weight	(n=39) 132.5 ± 21.9	(n=15) 188.7 ± 50.6	0.0001
Weight Δ 2-1 (lbs.)	(n=27) 1.6 ± 2.0	(n=7) 1.8 ± 1.9	NS
Weight Δ 3-1	(n=29) 1.1 ± 3.6	(n=9) 3.4 ± 3.5	NS
Weight Δ 4-1	(n=26) 2.3 ± 4.7	(n=6) 5.6 ± 3.9	NS
Mean Baseline Fat Mass	25.6 ± 10.9	67.6 ± 34.6	0.0001
Fat Mass Δ 2-1 (lbs.)	-0.2 ± 1.3	-3.0 ± 6.7	0.043
Fat Mass Δ 3-1	1.1 ± 2.6	-2.2 ± 7.5	0.049
Fat Mass Δ 4-1	-0.8 ± 2.7	-0.2 ± 6.5	NS
Mean Baseline Fat Free Mass	106.9 ± 20.4	121.6 ± 31.2	0.047
Fat Free Mass Δ 2-1 (lbs.)	1.8 ± 1.5	4.8 ± 7.5	NS
Fat Free Mass Δ 3-1	0.0 ± 2.2	8.6 ± 11.1	0.0001
Fat Free Mass Δ 4-1	2.3 ± 4.7	5.6 ± 3.9	NS

Timing of measurements is defined as: Time 1 (Baseline) = Week 2, Time 2 = Week 6, Time 3 = Week 11, Time 4 = Week 15. Changes were calculated as the change from baseline at each particular time point.

Means are reported ± SD. Significance between groups was assessed using independent measures t-tests at a significance level of $p \leq 0.05$.

Table 15 (p. 58) shows mean differences in body composition changes over the course of the study by final weight change categories of "Lost ≥ 1 Pound" (n=9) and "Gained ≥ 1 Pound" (n=19), defined as a change at the final measurement of greater than one pound from baseline body weight. Four subjects in the study experienced no weight change in excess of one pound from baseline to the final measurement. There was no significant difference in baseline anthropometric measurement variables between those who lost weight and those who gained weight as observed at the final measurement (see Table 13, p. XX). Among those who lost weight in excess of one pound, the average weight loss was 2.3 ± 1.2 pounds, and among those who gained in excess of one pound, the average weight gain was 6.0 ± 3.5 pounds ($p<0.0001$). No significant differences between these weight change groups were seen at time point 2 (Week 6), but significant differences were seen at time points 3 (Week 11) and 4 (Week 15). Subjects who lost weight lost an average of 2.7 ± 1.2 pounds of body fat by the final measurement, and subjects who gained weight gained an average of 1.2 ± 4.0 pounds of body fat, and these differences were significant ($p<0.007$). No significant differences in mean change in fat free mass were observed between weight change groups at any time point until the final measurement. At the final measurement, subjects who had lost weight showed an average change in fat free mass of 0.4 ± 0.6 pounds, while those who gained weight showed a statistically different increase of 4.6 ± 5.1 pounds ($p=0.022$). Taken together, the results of the fat mass changes and fat free mass changes indicate weight change in subjects gaining more than one pound over the course of the study

Table 15: Time Course of Body Composition Changes By Final Weight Change Category

	Lost > 1 Pound	Gained > 1 Pound	p=
Mean Baseline Weight	(n=9) 146.8 ± 20.7	(n=23) 133.4 ± 37.2	NS
Weight Δ 2-1 (lbs.)	(n=9) 1.2 ± 2.0	(n=19) 2.0 ± 1.7	NS
Weight Δ 3-1	(n=9) -1.6 ± 3.1	(n=22) 3.8 ± 3.1	0.0001
Weight Δ 4-1	(n=9) -2.3 ± 1.2	(n=23) 6.0 ± 3.5	0.0001
Mean Baseline Fat Mass	32.3 ± 13.4	34.8 ± 31.9	NS
Fat Mass Δ 2-1 (lbs.)	-0.1 ± 1.6	-1.1 ± 4.6	NS
Fat Mass Δ 3-1	-0.8 ± 2.2	1.2 ± 4.6	NS
Fat Mass Δ 4-1	-2.7 ± 1.2	1.2 ± 4.0	0.007
Mean Baseline Fat Free Mass	114.5 ± 25.0	98.6 ± 13.1	0.035
Fat Free Mass Δ 2-1 (lbs.)	1.3 ± 1.0	3.1 ± 5.2	NS
Fat Free Mass Δ 3-1	-0,8 ± 1.7	4.1 ± 7.8	NS
Fat Free Mass Δ 4-1	0.4 ± 0.6	4.6 ± 5.1	0.022

Timing of measurements is defined as: Time 1 (Baseline) = Week 2, Time 2 = Week 6, Time 3 = Week 11, Time 4 = Week 15. Changes were calculated as the change from baseline at each particular time point.

Means are reported ± SD. Significance between groups was assessed using independent measures t-tests at a significance level of $p \leq 0.05$.

was primarily due to increases in fat free mass.

Changes in body composition by gender are reported in Table 16 (p. 60). There was no significant difference between gender groups in changes in any variable. A mixed between-within analysis of variance was conducted to assess the impact of gender on changes in weight and percentage of body fat variables over time. There was a large main effect for time that was significant for weight change (Wilks Lambda = 0.514, F = 7.579, p<0.001, partial eta squared = 0.486). There was no significant interaction effect seen for time and gender on weight change.

The mean frequencies of breakfast consumption each week were determined by analyzing One Card data provided by the University. Each time students enter a dining facility, their University-issued identification cards (One Cards) are swiped through an electronic reader, and this information is collected from all vending outlets that accept One Cards for payment. Meal times are defined and scheduled by the University, and data for each day was separated into meal service periods (breakfast, lunch, dinner). To determine frequencies of breakfasts consumed during each week, data files for residence hall dining facilities were obtained from the University, and data pertaining only to study subjects was extracted by study researchers. Data for each subject from each residence hall was combined for analysis. Reported means of dining hall breakfast frequency for each week by study completion status are found in Table 17 (p. 61). All subjects (n=54) combined attended a combined average of 2.0 ±

Table 16: Time Course of Body Composition Changes By Gender

	Females	Males	p=
Baseline Weight (lbs.)	(n=37) 136.0 ± 31.2	(n=17) 174.5 ± 47.2	0.001
Weight Δ 2-1	(n=27) 1.8 ± 2.0	(n=7) 0.9 ± 1.3	NS
Weight Δ 3-1	(n=28) 1.9 ± 3.5	(n=10) 1.1 ± 4.2	NS
Weight Δ 4-1	(n=24) 3.0 ± 4.1	(n=8) 2.6 ± 6.4	NS
Baseline Fat Mass (lbs.)	38.7 ± 25.4	33.6 ± 32.1	NS
Fat Mass Δ 2-1	-0.7 ± 3.6	-1.2 ± 1.2	NS
Fat Mass Δ 3-1	0.7 ± 4.1	-0.6 ± 5.4	NS
Fat Mass Δ 4-1	-0.2 ± 3.7	0.4 ± 3.3	NS
Baseline Fat Free Mass (lbs.)	97.2 ± 8.1	140.9 ± 21.3	0.001
Fat Free Mass Δ 2-1	2.5 ± 4.0	2.1 ± 1.8	NS
Fat Free Mass Δ 3-1	2.2 ± 6.7	1.7 ± 6.8	NS
Fat Free Mass Δ 4-1	3.2 ± 4.8	2.2 ± 3.3	NS

Timing of measurements is defined as: Time 1 (Baseline) = Week 2, Time 2 = Week 6, Time 3 = Week 11, Time 4 = Week 15. Changes were calculated as the change from baseline at each particular time point.

Means are reported ± SD. Significance between groups was assessed using independent measures t-tests at a significance level of $p \leq 0.05$.

Table 17: Mean Weekly Breakfast Frequency By Study Completion Status

	Completed Final Measure (n=32)	Did Not Complete Final Measure (n=22)	p=
Week 1	1.6 ± 1.5	1.5 ± 1.8	NS
Week 2	2.8 ± 2.0	2.4 ± 2.0	NS
Week 3	2.8 ± 1.8	2.1 ± 1.8	NS
Week 4	2.4 ± 1.7	1.9 ± 2.2	NS
Week 5	2.3 ± 1.5	1.6 ± 1.9	NS
Week 6	2.1 ± 1.5	1.5 ± 1.5	NS
Week 7	2.8 ± 1.9	2.0 ± 2.1	NS
Week 8	2.8 ± 1.8	1.9 ± 2.3	NS
Week 9	2.0 ± 1.9	1.5 ± 1.8	NS
Week 10	1.7 ± 1.9	1.7 ± 1.9	NS
Week 11	2.0 ± 1.9	1.2 ± 1.5	NS
Week 12	2.5 ± 2.0	1.6 ± 1.7	NS
Week 13	1.1 ± 1.0	0.5 ± 0.7	0.041
Week 14	1.9 ± 1.8	1.1 ± 1.1	NS
Week 15	2.1 ± 1.6	1.2 ± 1.4	0.043

Weekly mean breakfast frequency is reported ± SD, and significant differences between groups were determined by independent samples t-tests.

For the purposes of this analysis, study completion status was determined by participation in the final anthropometric measurement at Week 15. Subjects who completed the Week 15 anthropometric measurements were classified as "Completed," and those who did not complete the anthropometric measurement at Week 15 were classified as "Non-completers."

There were no significant differences in mean breakfast attendance frequency between study completion groups until Week 13 and only once more at Week 15. Both groups showed a low but steady rate of breakfast attendance frequency throughout the semester.

1.4 breakfasts per week over the course of the study. Comparisons of weekly mean frequencies of breakfast consumption by gender are reported in Table 18 (p. 63). Males attended significantly more breakfasts in sum (38.9 ± 20.2) over the course of the semester than did females (24.7 ± 19.8, p=0.018), as well as on average per week (male = 2.6 ± 1.3, females = 1.7 ± 1.3, p=0.018). There was also a significant difference seen between genders in total dining hall meals attended over the course of the semester, with males attending the dining hall meal services more than females (male = 160.0 ± 33.5, females = 115.9 ± 42.0, p≤0.0001).

When comparing frequency of dining hall breakfast attendance by final weight change status category (lost > 1 lb., gained > 1 lb.), a significant difference was seen only at Week 3, with those who lost weight showing a higher frequency of dining hall breakfast attendance (3.8 ± 1.8) than those who gained weight (2.4 ± 1.7, p=0.047). No significant difference between final weight change categories was seen in overall mean breakfast attendance frequency per week (lost > 1 lb. = 2.4 ± 1.2, gained > 1 lb. = 2.3 ± 1.4, p= 0.908). There was also no significant difference seen in overall mean breakfast attendance frequency between baseline BMI categories (BMI < 25 = 1.9 ± 1.4, BMI ≥ 25 = 2.3 ± 1.6, p=0.385).

Changes in frequency of attendance of dining hall breakfasts over the course of the semester were assessed for all subjects. A general time effect was observed with breakfast frequency decreasing from baseline over the course of

Table 18: Mean Weekly Breakfast Frequency By Gender

	Females (n=37)	Males (n=17)	p=
Week 1	1.2 ± 1.4	2.2 ± 1.8	0.018
Week 2	2.4 ± 2.1	3.2 ± 1.6	NS
Week 3	2.2 ± 1.9	3.2 ± 1.4	NS
Week 4	1.8 ± 1.8	3.1 ± 2.0	0.027
Week 5	1.7 ± 1.6	2.6 ± 1.7	NS
Week 6	1.5 ± 1.4	2.7 ± 1.6	0.006
Week 7	2.0 ± 1.8	3.5 ± 2.0	0.010
Week 8	2.0 ± 1.9	3.4 ± 2.0	0.023
Week 9	1.5 ± 1.8	2.5 ± 1.9	0.055
Week 10	1.3 ± 1.6	2.6 ± 2.1	0.020
Week 11	1.4 ± 1.7	2.4 ± 1.9	NS
Week 12	1.9 ± 1.8	2.6 ± 2.0	NS
Week 13	0.8 ± 0.9	1.0 ± 1.0	NS
Week 14	1.4 ± 1.6	2.1 ± 1.5	NS
Week 15	1.6 ± 1.5	2.0 ± 1.7	NS

Weekly mean breakfast frequency is reported ± SD, and significant differences between groups were determined by independent samples t-tests. Frequencies at Week 13 are low due to the Thanksgiving holiday break.

the semester ($p<0.0001$) for all subjects, but no significant difference between genders in this decline was observed ($p=0.568$). Repeated measures analysis for all subjects shows significant mean reductions from baseline in breakfast attendance frequency beginning at Week 5 (-0.7 ± 1.8, $p=0.008$) and continuing to Week 6 (-0.8 ± 1.6, $p=0.001$), but no significant difference from baseline was observed in Weeks 7 or 8. However, a significant decline from baseline was observed for every week thereafter.

Three-day food diaries were collected at two time points during the study, during the second week of the study (first full week of classes) and again at the final measurement collection session during the last week of the study (Week 15). Thirty subjects (56%) completed and turned in 3-day food records for the first collection, and 19 (35%) completed 3-day food records for the second collection at the end of the semester. Data compiled of food diary nutrient analysis for all subjects completing food diaries are presented in Table 19 (p. 65). Only 16 subjects completed both the first and the second food diaries, and these were used to perform repeated measures analysis to assess changes in nutrient intake over the course of the semester. Results of this analysis are reported in Table 20 (p. 66). Among those who completed 3-day food records at both time points, significant changes were seen in total Calories (T1 = 2052 ± 626, T2 = 2356 ± 653, $p = 0.010$) with results of paired differences showing an average increase of 304 ± 413 Calories, and Calories from total fat (T1 = 667 ± 267 ± 856 ± 310, $p = 0.005$) with an average increase of 53 ± 157 Calories from total fat.

Table 19: 3-Day Average Nutrient Intake Comparison All Subjects

	Week 2 (n=30)	Week 15 (n=19)
Total Kcals	2355 ± 831	2316 ± 648
Carbohydrate Kcals	1132 ± 445	1136 ± 487
Protein Kcals	412 ± 231	361 ± 96
Total Fat Kcals	769 ± 448	825 ± 311
Saturated Fat Kcals	298 ± 257	258 ± 136
Fiber (g)	18 ± 11	17 ± 10
Cholesterol (mg)	304 ± 267	296 ± 181
% Kcals Carbohydrate	51 ± 11	48 ± 11
% Kcals Protein	17 ± 7	16 ± 5
% Kcals Fat	32 ± 11	36 ± 9
% Kcals Saturated Fat	12 ± 7	11 ± 5

This table shows mean values for variables collected at baseline and the final collection of food diaries for all subjects. Repeated measures analysis for subjects that completed both food diaries, shown in Table 20 (p. XX), reports the statistical comparison of food diary data at baseline and Week 15.

Table 20: Repeated Measures Analysis of Changes in 3-Day Average Nutrient Intake All Subjects

n=16	Baseline (Week 2)	Week 15	p=
Total Kcals	2051 ± 626	2356 ± 653	0.010
Carbohydrate Kcals	1098 ± 503	1136 ± 486	NS
Protein Kcals	314 ± 144	372 ± 87	NS
Total Fat Kcals	667 ± 267	856 ± 310	0.005
Saturated Fat Kcals	219 ± 114	272 ± 142	NS
Fiber (g)	16 ± 12	17 ± 11	NS
Cholesterol (mg)	190 ± 140	315 ± 188	NS
% Kcals Carbohydrate	52 ± 13	47 ± 10	NS
% Kcals Protein	15 ± 5	16 ± 5	NS
% Kcals Fat	33 ± 10	37 ± 8	NS
% Kcals Saturated Fat	11 ± 5	12 ± 5	NS

Group means are reported ± SD. Significant differences between groups were determined by repeated measures t-tests.

Analysis of 3-day food diaries by gender is presented in Table 21 (p. 68). No significant difference was seen between genders in 3-day mean Calories consumed (females = 2058.0 ± 626.9, males = 2505.5 ± 684.1, p=0.045). Males consumed more cholesterol (477.2 ± 323.9 mg) than did females (257.8 ± 188.5, p=0.01), and average intake of male subjects exceeded dietary intake recommendations of less than 300 mg per day.

Analysis of 3-day food diaries collected at baseline by final weight change group is presented in Table 22 (p. 69). There were no significant differences at baseline in any variable between those who lost >1 pound and those who gained >1 pound over the course of the study. Of the 19 subjects who turned in the final food diary, 12 gained greater than one pound over the course of the study, and only three lost more than one pound. Repeated measures analysis was done for the weight gain group to assess changes in intake at these two time points. A significant mean increase of 429 ± 326 in total Calories (T1 = 2141 ± 601, T2 = 2570 ± 614, p = 0.001) and a mean increase of 229 ± 239 Calories from total fat (T1 = 676 ± 252, T2 = 904 ± 333, p = 0.007) were observed, but there were no other significant changes among any other of these measured variables from baseline to the end of the semester.

Results of baseline 3-day food diaries analyzed by baseline BMI category are reported in Table 23 (p. 70). Significant differences between these groups were observed in 3-day average mean total Calories consumed (BMI<25 = 2062.5 ± 542.2, BMI ≥25 = 2605.0 ± 854.7, p=0.048). Those in the lower BMI category also consumed

Table 21: Baseline 3-Day Average Nutrient Intake By Gender

	Females (n=20)	Males (n=10)	p=
Total Kcals	2058.0 ± 626.9	2505.5 ± 684.1	0.006
Carbohydrate Kcals	1048.5 ± 466.7	1300.4 ± 363.4	NS
Protein Kcals	334.2 ± 171.6	567.7 ± 264.7	0.007
Total Fat Kcals	675.4 ± 282.6	745.9 ± 345.2	NS
Saturated Fat Kcals	223.0 ± 112.1	446.7 ± 387.2	0.022
Fiber (g)	15.9 ± 10.5	23.1 ± 11.9	NS
Cholesterol (mg)	218.9 ± 188.5	477.2 ± 323.9	0.010
% Kcals Carbohydrate	50.3 ± 12.0	52.4 ± 7.7	NS
% Kcals Protein	16.5 ± 7.4	18.1 ± 4.9	NS
% Kcals Fat	33.2 ± 11.3	29.5 ± 8.9	NS
% Kcals Saturated Fat	11.0 ± 4.8	15.2 ± 9.2	NS

Group means are reported ± SD. Significant differences between groups were determined by independent samples t-tests.

Table 22: Baseline 3-Day Average Nutrient Intake By Final Weight Change Category

	Lost > 1 lb. (n=6)	Gained > 1 lb. (n=19)	p=
Total Kcals	1990.4 ± 623.7	2235.3 ± 610.7	NS
Carbohydrate Kcals	968.5 ± 352.2	1110.9 ± 469.3	NS
Protein Kcals	276.3 ± 93.7	387.8 ± 168.3	NS
Total Fat Kcals	745.7 ± 312.0	736.5 ± 294.4	NS
Saturated Fat Kcals	219.9 ± 123.4	282.2 ± 149.0	NS
Fiber (g)	18.7 ± 10.7	14.5 ± 10.6	NS
Cholesterol (mg)	190.7 ± 199.1	314.2 ± 242.0	NS
% Kcals Carbohydrate	48.4 ± 6.6	49.0 ± 12.4	NS
% Kcals Protein	14.5 ± 5.8	17.6 ± 6.8	NS
% Kcals Fat	37.2 ± 8.8	33.4 ± 10.8	NS
% Kcals Saturated Fat	14.3 ± 6.2	11.3 ± 4.9	NS

Group means are reported ± SD. Significant differences between groups were determined by independent samples t-tests.

Table 23: Baseline 3-Day Average Nutrient Intake By Baseline BMI Status

	BMI ≤ 25 (n=22)	BMI ≥ 25 (n=8)	p=
Total Kcals	2046 ± 506	3204 ± 985	<0.0001
Carbohydrate Kcals	1026 ± 342	1423 ± 582	0.028
Protein Kcals	348 ± 146	587 ± 332	0.010
Total Fat Kcals	688 ± 297	995 ± 697	NS
Saturated Fat Kcals	233 ± 118	475 ± 428	0.020
Fiber (g)	17 ± 11	23 ± 11	NS
Cholesterol (mg)	261 ± 238	427 ± 320	NS
% Kcals Carbohydrate	50 ± 10	55 ± 13	NS
% Kcals Protein	17 ± 7	16 ± 7	NS
% Kcals Fat	33 ± 10	29 ± 13	NS
% Kcals Saturated Fat	11 ± 5	15 ± 9	NS

Group means are reported ± SD. Significant differences between groups were determined by independent samples t-tests.

significantly fewer Calories from carbohydrates (1026.5 ± 342.0) than did those in the higher BMI category (1423.6 ± 581.7, p=0.028), although there was no significant difference between these groups in the percentage of total Calories from carbohydrates.

Of the 19 subjects who turned in the final food diary, 12 had baseline BMI scores of ≥25, and four had baseline BMI scores of ≤24. Repeated measures analysis was done for the high BMI group to assess changes in intake at these two time points. These results are presented in Table 24 (p. 72). Subjects in this category showed a mean increase of 326 ± 440 total Calories (T1 = 1875 ± 495, T2 = 2201 ± 659, p = 0.026). Within that, significant mean increases in Calories from protein (T1 = 294 ± 10, T2 = 394 ± 85, p = 0.007), Calories from total fat (T1 = 614 ± 241, T2 = 815 ± 343, p = 0.012) and Calories from saturated fat (T1 = 194 ± 98, T2 = 286 ± 161, p = 0.044) were observed. A significant mean decrease in percent energy from carbohydrates (T1 = 52 ± 12%, T2 = 45 ± 11%, p = 0.017) was observed, while significant increases in percentage of energy from fat (T1 = 23 ± 9, T2 = 36 ± 9, p = 0.037). An increase in intake of dietary cholesterol (T1 = 172 ± 116, T2 = 350 ± 190, p = 0.014) was also seen among these subjects.

Data from analysis of 3-day food records were used to assess subjects' adherence to dietary recommendations on fat, saturated fat and fiber. Results are shown in Table 25 (p. 73). Of those completing and turning in the first 3-day food diary (n=30, 56% of enrolled subjects), only 40% were within the desirable range of fat intake. Of the 60% of subjects whose intakes of fat fell outside of the

Table 24: Changes in 3-Day Average Nutrient Intake Among Subjects with Baseline BMI ≥25

n=12	Baseline (Week 2)	Week 15	p=
Total Kcals	1875 ± 495	2201 ± 659	0.026
Carbohydrate Kcals	1021 ± 411	1048 ± 479	NS
Protein Kcals	294 ± 110	394 ± 85	0.007
Total Fat Kcals	614 ± 241	815 ± 343	0.012
Saturated Fat Kcals	194 ± 98	286 ± 161	0.044
Fiber (g)	15 ± 12	17 ± 12	NS
Cholesterol (mg)	172 ± 116	350 ± 190	0.014
% Kcals Carbohydrate	52 ± 12	45 ± 11	0.017
% Kcals Protein	15 ± 5	18 ± 5	NS
% Kcals Fat	32 ± 9	36 ± 9	0.037
% Kcals Saturated Fat	11 ± 5	13 ± 5	NS

Group means are reported ± SD. Significant differences between time points were determined by repeated measures t-tests.

Table 25: Comparison of Selected Nutrient Intakes to Recommendations: All Subjects

	Proportion of Subjects Baseline (n=30)	Proportion of Subjects Week 15 (n=19)
Percentage of Energy as Total Fat		
< 20%	20%	0%
20-35%	40%	42%
> 35%	40%	58%
Percentage of Energy as Total Sat Fat		
≤ 10%	33%	58%
> 10%	67%	42%
Grams of Dietary Fiber		
< 25 g/day	42%	53%
≥ 25 g/day	58%	42%

Data is derived from 3-day food diary records (n=30). Chi-square analyses revealed no significant differences in any variables by gender, baseline BMI category or final weight change category.

guidelines, 20% consumed less than 20% of total Calories from fat, and 40% consumed more than 35% of their total Calories from fat. Only 33% of food diary respondents met the intake guidelines for saturated fat of ≤10% total energy, but 58% did have fiber intakes of >20 grams per day. Results of those completing the last food diary (n=19, 34% of enrolled subjects) follow a similar pattern. Fifty-eight percent of subjects exceeded the recommendation for total fat intake, and 42% had intakes of saturated fat that exceeded the recommendation of under 10% of energy from saturated fat. Fifty-three percent of subjects consumed fewer than 20 grams of fiber on average per day.

Fasting plasma cholesterol measurements were taken at weeks 2, 6 and 15 of the study period. Cholestech LDX lipid screening units were used. Combined results for all subjects from the Cholestech portable lipid screenings taken at the three time points are presented in Table 26 (p. 75). Fasting lipid and glucose measurements are were analyzed by gender, and these results are presented in Table 27, (p. 76). Independent samples t-tests revealed significant differences in HDL at time 1 (female = 57 ± 13 mg/dL, male = 44 ± 9, p=0.001) and time 2 (female = 53 ± 13 mg/dL, male = 40 ± 11, p=0.040) but at time point 3. Females had lower mean blood glucose at time 1 (females = 81 ± 12 mg/dL, male = 94 ± 30, p=0.051), which approached statistical significance. Comparison of baseline BMI categories revealed a significant difference between groups only in HDL at time 1 (BMI<25 = 53 ± 13, BMI ≥25 = 42 ± 8, p=0.013), and no

Table 26: Time Course of Changes in Fasting Plasma Lipids and Glucose -- All Subjects

	Week 2	Week 6	Week 15	p=
Total Cholesterol (mg/dL)	(n=46) 163 ± 32	(n=37) 168 ± 31	(n=30) 171 ± 25	NS
Triglycerides (mg/dL)	(n=46) 104 ± 58	(n=35) 105 ± 51	(n=28) 102 ± 25	NS
LDL Cholesterol (mg/dL)	(n=41) 88 ± 30	(n=34) 97 ± 30	(n=28) 96 ± 23	NS
HDL Cholesterol (mg/dL)	(n=42) 50 ± 13	(n=36) 52 ± 15	(n=29) 49 ± 11	NS
Glucose (mg/dL)	(n=46) 85 ± 20	(n=38) 96 ± 9	(n=28) 90 ± 8	NS

Means are reported ± SD. Differences in means between time points were assessed by independent samples t-tests. There were no significant mean differences among subjects observed for any variable between time points.

Table 27: Time Course of Changes in Fasting Plasma Lipids and Glucose By Gender

	Week 2		Week 6		Week 15	
	Female	Male	Female	Male	Female	Male
Total Cholesterol (mg/dL)	(n=31) 164 ± 34	(n=15) 162 ± 29	(n=27) 171 ± 31	(n=10) 161 ± 32	(n=22) 172 ± 23	(n=8) 170 ± 31
Triglycerides (mg/dL)	(n=31) 96 ± 46	(n=15) 120 ± 78	(n=26) 102 ± 53	(n=9) 116 ± 64	(n=21) 102 ± 26	(n=7) 104 ± 27
LDL Cholesterol (mg/dL)	(n=27) 85 ± 31	(n=14) 94 ± 27	(n=25) 95 ± 30	(n=9) 101 ± 32	(n=21) 97 ± 22	(n=7) 96 ± 28
HDL Cholesterol (mg/dL)	(n=28) 53 ± 13^{a}	(n=14) 45 ± 9^{a}	(n=26) 57 ± 13^{b}	(n=10) 40 ± 11^{b}	(n=21) 51 ± 11	(n=8) 43 ± 8
Glucose (mg/dL)	(n=31) 81 ± 12	(n=15) 94 ± 30	(n=28) 96 ± 9	(n=10) 96 ± 10	(n=21) 89 ± 9^{c}	(n=7) 94 ± 7^{c}

Cholesterol measurements were taken at weeks 2, 6 and 15 of the study period.

Independent samples t-tests were conducted to assess differences between genders, which are indicated with matching superscript letters.

a: $p = 0.040$

b: $p = 0.001$

c: $p = 0.05$

significant differences between final weight change groups (< 1 lb. and > 1 lb.) were observed for any variables at any time point.

Discussion

A previous study showed that students living on campus had no significant differences in nutrient or energy intakes compared to students living off campus [49], so the results of this work may be generalized to the entire student population of incoming freshmen.

Fifty-four subjects were successfully recruited for this observational study at the start of the 2008 Fall semester. One subject dropped out citing a demanding class schedule and workload, and 32 (60%) completed the final measurement collection. As this study was undertaken as a pilot with the aim of assessing logistics for conducting a larger-scale intervention study at a future semester, there were lessons to learn with respect to retention of subjects. In order to maximize the time under observation, final measurements were collected during the final week of the semester. Throughout the semester, these had been conducted over a three-day period to allow students as much scheduling flexibility as possible. However, during the last week of the semester, this coincided with final exams. It is likely that this was a contributor to the lower than expected participation in the final measurement collection. Because there were only small changes in study variables observed over the course of the semester, it was unlikely that the additional week allowed for observation resulted in better quality data, and it was determined that for the large intervention study to be conducted the following year, holding the final measurement session the week before final exams would increase the participation rate for this session among subjects.

When considering the feasibility of conducing a future study using this population of freshmen to assess the effects of an intervention on weight change, subject retention and consistent participation would be critical to the collection of quality data. Compared to those who completed the final measurement, subjects who did not complete the final measurement had a significantly higher mean baseline weight and BMI. While there is no way to know for sure the reasons for subjects' failures to attend the final measurement, it was determined that a higher compensation might serve to increase the retention rate. Subjects in this study were compensated $40 for their time and inconvenience, which may not have been enough of an incentive to complete the study.

One aim of this study was to document changes in dining facility use over the course of the first semester of college for students living in the residence halls and participating in the University meal plan. Meal plan participation has been documented in previous literature [50] with respect to comparing nutrient status of students enrolled in meal plans to those who are not, although the frequency of dining hall use was not reported. This study is the first to document changes in frequency of meal plan use over time. Electronic data from use of University-issued One Cards to gain admittance to dining halls were used to quantify meal frequencies throughout the semester. It was shown that males attended all dining hall meals more frequently than females throughout the semester, and males attended breakfasts with greater frequency than did females. The overall mean frequency of breakfast consumption among students participating in the study was very low, and there was no significant change in the pattern of breakfast frequency seen over time among all subjects. While low, these results are consistent with previously reported data showing breakfast consumption frequency in young adults is very low. In a survey of 7,788 young adults, 30% reported consuming breakfast at least four times per week [51]. In the present study, only five subjects (9%) consumed breakfast an average of four times per week or more at the dining halls. However, because our data relies on use of University-issued identification card data, which was acquired based on admittance to residence hall dining facilities, we cannot determine whether students chose alternative breakfast venues each week. Therefore, it is possible that students had a higher frequency of breakfast consumption at venues other than university dining halls, which was not detected in our study. Because this study was designed as a pilot study to assess the logistics of conducting a larger scale breakfast intervention study the following year, the consistently low frequency of breakfast attendance was seen as an indication that getting subjects to consume breakfasts 5 times per week was going to be a significant challenge.

Those subjects who did not complete the final measurement attended breakfast less frequently than those who completed the final measurement at only two time points at the end of the study (Week 13 and Week 15). Subjects in this study were not instructed to attend breakfasts. Their attendance patterns were monitored to give an indication of the potential difficulty of getting subjects to consume breakfasts with the frequency necessary to collect meaningful data in a breakfast intervention study. Frequency of breakfast consumption among our sample was low (2.0 ± 1.4 breakfasts per week), although it was comparable to what has been observed in a national sample where 30% of 15-18 year olds reported skipping breakfast on the day of the survey [52]. Another study reported that 59% of urban high school students skipped breakfast more than three times the previous week [53].

In our sample of 54 incoming freshmen subjects, 72% were classified as being in the "Healthy Weight" body mass index category, defined as having a BMI between 18.5 and 24.9 kg/m^2. Twenty-eight percent of subjects had body mass indices greater than or equal to 25 kg/m^2. It has been estimated that the prevalence of overweight and obesity in adolescents was 17.4% in 2004 [1], which is lower than what our sample reported.

Overweight in adolescence is associated with a greater risk overweight and obesity in adulthood, and stemming weight gain in young adults has a tremendous potential impact on public health. Weight changes over five years during the CARDIA study revealed that BMI increases were greater among the 18-24 year old age group compared to the 25-30 year old age group [54], making college-aged young adults a critical population of which to target weight management strategies. One recent study showed obese adolescents were significantly more likely to develop severe obesity than normal weight or overweight adolescents [55].

Modest weight gain averaging between 2.9 to 6.8 pounds (1.3 to 3.1 kilograms) has been reported among variably sized samples of college freshmen over the course of their first semester [38], but other data have been reported that show some students actually lose weight during this period [39]. The mean weight change of all subjects in this study who completed the final measurement was 2.9 ± 4.7 pounds, which is in keeping with the previously reported data.

One aim of this study was to establish a time course of weight change over the course of the first semester of college. Among those subjects who lost weight in excess of one pound, mean weight loss at the final measurement (Week 15) was -2.3 ± 1.2 pounds. No significant difference from baseline was seen at Week 6 (the second measurement), but a significant difference was observed at both measurement three (Week 11) and measurement 4 (Week 15). The same pattern was seen among those subjects who gained greater than one pound over the course of the study. There was no significant change from baseline at Week 6, but at both Week 11 and Week 15, significant increases from baseline were observed, and subjects in this group gained an average of 6.0 ± 3.5 pounds over the course of the study. Among those whose weight changed by greater than one pound over the course of the study, our data show significant differences in fat mass and fat free mass only at the final measurement (Week 15). Among those who lost greater than one pound, the loss was seen to a greater extent in fat mass (-2.7 ± 1.2 pounds) than in fat free mass change (0.4 ± 0.6 pounds). This was different from what those who gained greater than one pound reported. In that group, the weight gain was seen primarily in the change in fat free mass (4.6 ± 5.1 pounds) rather than in fat mass (1.2 ± 4.0 pounds).

Previous data have shown no gender difference in weight gain trends among incoming freshmen during the first semester [7], and based on this, a gender effect was not expected. While males had a higher mean baseline weight (174.5 ± 47.2 lbs.) than females (136.0 ± 31.2), there was no difference in weight change over time between these two groups, which is in keeping with the previously reported data. Females in our study reported a mean weight change of 3.0 ± 4.1 pounds, which is comparable to a previous study of female college freshmen that showed an average baseline weight of 140.5 ± 25.0 lbs. and an increase to 142.0 ± 25.2 lbs. at five months [56].

Weight change analysis stratified subjects according to categorical variables describing baseline BMI status. Due to the small sample size, these categories were limited to "BMI <25" and "BMI ≥25" rather than "normal weight" (BMI = 18.5-24.9), "overweight" (BMI = 25-29.9) and "obese" (BMI ≥ 30) as was originally intended. A 15-year prospective study of young adults found that 73.9% increased their BMI, while 16.3% maintained their BMI and 9.8% experienced BMI fluctuations over the study period [57]. Higher baseline BMI categories were associated with a greater likelihood of increasing BMI, and it was hypothesized that a higher baseline BMI would correlate to greater increases in weight over the course of this study. Our sample did not show any significant differences in changes in weight, BMI, fat mass or fat free mass from baseline to the final measurement at Week 15. There were significant differences between groups in changes in fat mass (at Weeks 6 and 11) and fat free mass (Week 11), but these differences disappeared by the final measurement at Week 15 and were no longer significant.

Frequency of breakfast consumption has been associated with prevention of weight gain [58], and it was expected that frequency of breakfast consumption would correlate with weight change in this study. This is the first study to examine frequency of breakfast consumption among college-aged young adults using University-issued identification cards to track use of meal plans. Our study showed no association between frequency of breakfast consumption and weight change. This may be due to a number of factors in combination, most likely the small sample size, the small average weight change among all subjects (2.9 ± 4.7 lbs.), and the low average frequency of breakfast consumption (2.0 ± 1.4 breakfasts per week) over the course of the semester.

We also showed no difference in breakfast consumption based on baseline BMI category. This is contrary to previously reported data that showed those with healthy weight BMI values were more likely to consume breakfast than those in the overweight or obese categories [59]. Our data did not show any difference in the total number of breakfasts consumed throughout the semester based on BMI categories of "< 25.0 kg/m^2" (27.6 ± 20.1 breakfasts) or "≥ 25.0 kg/m^2" (33.2 ± 23.0, $p = 0.475$).

It has been shown that, compared to those who skipped breakfast, subjects who consumed breakfast had lower total cholesterol and LDL cholesterol [60]. It was hypothesized that lower total cholesterol and LDL cholesterol would be associated with increased frequency of breakfast consumption. Again, this was not shown in our study, possibly due to the small sample size and low frequency of breakfast consumption among subjects. Dividing subjects into two groups based on breakfasts consumed, "Low Frequency" and "High Frequency," there were no significant differences seen in changes from baseline in total cholesterol.

CHAPTER 4 DETERMINING THE ROLE OF EGGS IN HEALTH MAINTENANCE AND THEIR IMPACT ON CARDIOVASCULAR RISK IN YOUNG ADULTS

Introduction

An intervention was designed to assess the impact of breakfast type on long-term weight maintenance in college students. This study sought to determine the extent to which regular consumption of eggs at breakfast attenuates weight gain among college students compared to consumption of non-egg breakfasts over the course of the first college semester. A long-term intervention to assess the impact of egg consumption on attenuation of weight gain in young adults had not previously been conducted, and therefore the effects of long-term egg consumption on attenuation of weight gain and changes in biomarkers of cardiovascular disease were assessed.

The Specific Aims of this study were: 1) to document the extent to which regular consumption of eggs at breakfast impacts changes in body weight and body composition; 2) to document the extent to which the increased intake of dietary cholesterol from eggs at breakfast affects plasma lipid levels over time; and 3) to document whether the consumption of eggs is associated with other food choices at breakfast.

Materials and Methods

The study protocol was approved by the Human Investigation Committee of Wayne State University (HIC #: 032508MP2E, Protocol #: 0906007205).

The study was named The Freshmen Health Study and was advertised in several different ways. Announcements of the study with general details and relevant contact information were approved by Wayne State University's Human Investigation Committee and were included in packets distributed to all incoming freshmen residents on the day they moved into the residence halls. These were also posted on walls and bulletin boards throughout the residence halls. The lead researcher of the study was present at all move-in days to meet with prospective study subjects and their parents and explain specifics about the study and what participation would entail. An announcement of the study was also advertised electronically on Pipeline, the web-based gateway of services and information of Wayne State University.

Subjects were recruited by both active and passive methods. Subjects were recruited passively through direct response to study advertisements that were both distributed to students directly and posted in locations throughout the residence halls and undergraduate library. These passive methods resulted in no e-mailed inquiries and exactly one telephone inquiry, and this student was eventually enrolled in the study. Subjects were also recruited directly by a group of several research assistants trained by the lead researcher to provide information about the study to prospective subjects. This phase occurred during the move-in period but before the start of classes for the semester. During this phase, research assistants collected contact information from prospective subjects interested in participating and advised them they would be contacted via e-mail with further information and details pertaining to study enrollment.

Research assistants conducted this phase at all meal service times (breakfast, lunch and dinner), and they were positioned proximally to the dining hall entrance at a table with a Wayne State University Department of Nutrition and Food Science table cover. On the table were additional flyers advertising the study as well as an assortment of Department of Nutrition and Food Science pens and key chains that the students could take. Research assistants also entered the dining hall and talked to students during meal services. All interested students who provided contact information were given a card with the study name and contact information and were asked to contact the study's lead researcher or principal investigator for further information in the event they had specific questions regarding participation. Approximately 280 students indicated interest in the study and provided contact information during this collection.

A Wayne State University e-mail account was established for the study (healthstudy@wayne.edu), and this e-mail account was used for all investigator-to-subject electronic correspondence. E-mails were sent to all prospective study subjects who had given their contact information on the same day it was received. The e-mail contained details about the study including its purpose, duration, participation details including compensation paid to participants, as well as enrollment details. Prospective subjects were asked to reply to the e-mail (by using the "reply" function) to indicate their interest in enrolling in the study. The purpose of this 2-tired enrollment process was to eliminate those potential subjects who may have been initially attracted to the compensation offered to participants but who may not have been fully committed to participating in the entire study. As the study design was participation-intensive for an extended period of time, it was decided that having an active, "opt-in" style of enrollment might serve to reduce the drop-out rate.

Actual enrollment for the study was conducted over a period of three days at the first week of the semester (Wednesday, Thursday and Friday). These sessions were held in the same activity room (near the entrance to the dining hall) where recruitment had previously taken place. Sessions were held in conjunction with lunch service in the dining hall, which was determined to be a time where most potential subjects could most readily attend. Enrollment was also made available by appointment for those potential participants who could not attend the lunchtime sessions. Prospective participants filled out a screening questionnaire and read and signed the consent form. The lead researcher was present at all sessions to respond to any questions and explain the consent form and study details. Once a consent form was obtained, study subjects were given instructions as to how to participate in the first measurement collection session. A total of 73 subjects were enrolled in the study. These represent 26% of those who had originally indicated an interest in participating in the Freshmen Health Study.

Subjects to be included in the study were incoming freshmen students at Wayne State University, aged 17-20, who lived in the residence halls and were enrolled in the University meal plan (a requirement for all residence hall freshmen residents). Exclusion criteria included weight loss of greater than 5% in the three months prior to the study, current participation in any weight loss program, unstable cardiac conditions, major systemic illness, history of drug abuse or eating disorders, uncontrolled diabetes or hyperthyroidism, familial hyperlipidemias, any condition for which weight loss would be contraindicated including pregnancy, allergies to or dislike of eggs and participation in college athletics. A screening questionnaire was given to prospective subjects, and their responses were used to determine eligibility.

Participants were compensated for their time and inconvenience during study participation. Total compensation provided was up to $ 375.00, which was also intended to reimburse participating students for the breakfast portion of their pre-paid meal plans. Actual compensation paid was in proportion to each student's actual participation in the study.

Study participants were randomly assigned to either an Egg Breakfast diet (EB) or a Non-Egg Breakfast diet (NEB), and members of both groups were instructed to consume breakfasts in the residence hall dining facility 5 days per week. For the duration of the 14-week study period, EB subjects were instructed to include one "serving" of eggs (equivalent to 2 whole eggs) from the breakfast line for at least 5 days each week, while NEB subjects were instructed to exclude eggs from their breakfasts for at least 5 days each week. All study breakfasts were otherwise ad libitum and were consumed in the designated university dining facility during designated breakfast service times.

Compliance was assessed in two ways. Compliance with the instructed frequency of breakfast consumption was assessed by the tabulation of data acquired from participants' University-issued identification cards (One Cards), which are required for entry into University residence hall dining facilities.

Compliance to breakfast intervention group (eggs or no eggs for breakfast) was assessed by immediate written recall of breakfast items consumed. Subjects were asked to fill out "breakfast cards," a method of immediate recall for items consumed at breakfast, and this was done in the presence of research assistants. These were collected at five time points over the course of the study, at weeks 1, 4, 7, 10, and 13. For each time point, breakfast cards were collected for three days (Tuesday, Wednesday and Thursday mornings), ideally to obtain an average snapshot of consumption for each subject, but also to allow for the possibility that subjects might not be able to attend breakfast on a particular day. The purpose of the "breakfast cards" was to assess compliance to study group assignment as well as to provide an accurate assessment of the nutritional profile of breakfasts. Subjects were requested to fill out the breakfast cards immediately upon finishing breakfast and exiting the dining hall. A table was set up in the activity room immediately proximal to the entrance of the dining hall, and the Nutrition and Food Science table cover was used in addition to signage to indicate our presence. The lead researcher was present at all breakfast card collections and was available to answer any questions the subjects had regarding their completion of the cards. Subjects were instructed to write their ID number only and then to list the specific items and quantities they consumed for breakfast. Subjects were instructed to indicate if they ate only a partial serving of an item.

Breakfast cards were analyzed using the nutrition information provided by AVI Food Systems for the items made available at the breakfast buffet. All items available were of a standard, predetermined serving size, and self-serve items were served in utensils of known volume. Macronutrient, fiber and cholesterol quantities were determined using the nutrition information provided by AVI Food Systems through "nutriDATA," their online nutrition database (http://www.avifresh.com/nutrisource/nutridata.html). Individual breakfast items were also tallied for each subject for each day.

Food diaries were collected at two time points during the study. They were collected during the second week of the study (first full week of classes) and again at the final measurement collection session during the last week of the study (last full week of classes). Study participants were verbally instructed as to how to complete their food diaries by the lead researcher, and they were shown examples of food diaries showing the level of detail requested. Subjects were also given written instructions for completion of the food diaries, and they were given the opportunity to ask questions and have them answered by the lead researcher. Food diaries were analyzed using NAT Verson 2.0, an online database created and maintained by the University of Illinois Department of Food Science and Human Nutrition. The database is composed of the USDA Handbook #8 as well as data from various food companies, and it is a dietary assessment tool recommended by the USDA.

Subjects were asked to complete a series of five online food frequency questionnaires. The requested completion schedule for these was weeks 2, 5, 8, 11, and 14. A 124-question Block food frequency questionnaire was modified for online administration on Wayne State University's Blackboard online course administration system, and questions were included to explore demographic characteristics and lifestyle factors that are known to contribute to weight status. The first and the last food frequency questionnaire were analyzed and reported in this study.

Anthropometric measurements were taken in a residence hall activity room in the mornings prior to breakfast consumption at baseline and at weeks 4, 8, 11 and 14 of the study. Height and weight were measured with subjects wearing light clothing with all materials removed from pockets. Weight and body composition were assessed with a Tanita body composition analyzer (model TBF-300A, Arlington Heights, Illinois, U.S.A.).

Body mass index (BMI) was calculated as kg/m^2 and is reported as such. Current recommendations for defining BMI in children and adolescents aged 2 through 19 years are based on the relation of BMI to the 2000 Centers for Disease Control and Prevention (CDC) age- and sex-specific weight-for-recumbent-length growth charts [47]. Prevalence estimates of childhood overweight and obesity have been traditionally based on two cut-off values: the 85^{th} percentile to designate what has been termed "at risk for overweight" and the 95^{th} percentile to designate "overweight" categories. Recently, nomenclature describing these cut-off points has changed to "overweight" and "obese," respectively [48]. This now corresponds to adult BMI classification labels of 25.0 to 29.9 kg/m^2 as overweight and ≥ 30 kg/m^2 as obese. As "college students" and "college freshmen" are frequently referred to as "young adults," and their markers for risk of chronic disease are often compared to those of the adult population, BMI is typically reported for this special population in terms of the adult scale and nomenclature. BMI values reported in this study will follow that convention and are reported as BMI of 18.5 to 24.9 kg/m^2 as being "healthy weight," BMI of 25.0 to 29.9 kg/m^2 as "overweight" and BMI ≥ 30 kg/m^2 as "obese."

Fasting plasma lipids were assessed at weeks 2, 8 and 14 of the study. Subjects were asked to report to the activity room located inside of the residence hall at the entrance to the dining hall on the designated dates. Subjects were instructed to report to the blood draw sessions in a fasted state, having not consumed any food or drink after going to sleep the night before (no later than 10:00 PM was given as a guideline). Blood was drawn by trained phlebotomists from the Detroit Medical Center, and two were scheduled at each measurement session to limit the time subjects were required to wait in line. Subjects were seated, and blood was drawn into two 5-mL EDTA-containing vacutainer tubes, labeled with the subject's ID code, and kept on ice until transfer back to the laboratory for analysis.

Plasma was separated from whole blood through centrifugation. Total cholesterol, triglycerides and HDL-C were determined by enzymatic assay (Pointe Scientific, Canton, MI), and performed in duplicate. Values were calculated to represent mg/dL.

Fasting glucose measurements and plasma total cholesterol, HDL, LDL and triglycerides were taken from collected blood samples using Cholestech LDX mobile units (Hayward, California, U.S.A.) and Lipid Profile Plus Glucose cassettes. These cassettes were also used on subjects who either refused the venous blood draws or experienced unsuccessful attempts at drawing blood from a vein. Values obtained from this portable screening system were compared to lab-based enzymatic assays performed the same day of sample collection and showed high correlations.

All data were analyzed with SPSS version 17.0 statistical analysis software (Chicago, IL). Unless otherwise indicated, results are reported as means ± SD [44]. Independent and repeated measures t-tests were used to compare means between two groups. Analysis of variance (ANOVA) was used to compare means between three groups, and chi-square tests were used to compare proportions within categorical variables. All statistical tests were based on $\alpha \leq 0.05$ as a level of significance.

Results

At baseline, 46 females and 27 males completed anthropometric measurements. Table 28 (p. 96) shows the results of baseline measurements for all subjects and by gender. Significant differences were observed between genders in mean height (female = 1.67 ± 0.01 meters, males = 1.80 ± 0.02, $p< 00001$) but not in mean weight. A significant difference was observed between genders in mean BMI at baseline (female = 27.2 ± 1.3, male = 23.9 ± 1.2, $p= 0.05$) and in body fat percentage (female = 31.9 ± 1.9%, male = 15.9 ± 2.1%, $p<0.0001$). Chi-square analysis of the proportion of each gender in baseline BMI categories of <25 kg/m^2 (50% of all females and 70% of all males) and ≥25 kg/m^2

(50% of all females and 30% of all males) revealed a trend toward significance (Chi-square (1) = 3.640, p=0.056). No significant differences in the proportions of each gender in the BMI health categories (Underweight, Healthy Weight, Overweight and Obese) or plasma lipids or glucose were observed.

Table 28: Baseline Measurements All Subjects and By Gender

	All Subjects	Females	Males	p=
n=	73	46	27	
Mean Height (m)	1.72 ± 0.1	1.67 ± 0.01	1.80 ± 0.02	<0.0001
Mean Weight (kg)	77.4 ± 26.2	77.0 ± 4.3	77.3 ± 4.1	NS
Mean BMI (kg/m^2)	26.0 ± 8.0	27.2 ± 1.3	23.9 ± 1.2	0.05
BMI <25 kg/m^2	42 (58%)	23 (50%)	19 (70%)	NS
BMI ≥25 kg/m^2	31 (42%)	23 (50%)	8 (30%)	NS
Underweight	10 (14%)	6 (13%)	4 (15%)	NS
Healthy Weight	32 (44%)	17 (37%)	15 (56%)	NS
Overweight	11 (15%)	9 (20%)	2 (7%)	NS
Obese	20 (27%)	14 (30%)	6 (22%)	NS
Mean % Fat	25.9 ± 14.2	31. 9 ± 1.9	15.9 ± 2.1	< 0.0001
Total Cholesterol (mg/dL)	145 ± 24	150 ± 26	139 ± 18	NS
Triglycerides (mg/dL)	87 ± 37	92 ± 38	79 ± 35	NS
LDL Cholesterol (mg/dL)	83 ± 20	84 ± 22	80 ± 16	NS
HDL Cholesterol (mg/dL)	49 ± 13	51 ± 14	45 ± 11	NS
Glucose (mg/dL)	87 ± 8	86 ± 6	89 ± 10	NS

Means are reported ± SD. Significant differences in means between gender groups were determined using independent samples t-tests. Significant differences in mean height and mean % body fat were observed between gender groups. No significant differences in proportions between groups were determined using Chi-square analysis, Chi-square (3) = 3.995, p=0.262.

Results of baseline measurements were analyzed by grouping subjects into categories based on body mass index, and these are detailed in Table 29 (p. 98). As expected, there were significant differences in mean weight, BMI and percent body fat between those with baseline BMI of <25 kg/m^2 and those with baseline BMI of ≥25 kg/m^2. However, there were no significant differences between BMI status groups in any plasma lipid or glucose parameter.

Subjects were randomized into intervention groups based on type of breakfast to consume for the course of the semester. Subjects in the Egg Breakfast (EB) group were instructed to consume one serving of eggs (equivalent to two whole eggs) for 5 days each week at breakfast in the residence hall dining facility. Subjects assigned to the Non-egg Breakfast (NEB) group were instructed to exclude eggs for breakfast for 5 days each week. These subjects were permitted to consume eggs for breakfast on the weekend if they wished.

Thirty-nine subjects in the Egg Breakfast (EB) group (23 female, 16 male) and 34 subjects in the Non-egg Breakfast (NEB) group (23 female, 11 male) completed baseline measurements (Table 30, p. 99). There was no significant difference between intervention groups in proportions of gender representation (Chi-square (1)=0.891, p=0.461). Significant differences between intervention groups at baseline were observed in mean weight (EB = 83.9 ± 5.1 kg, NEB = 70.6 ± 2.6 kg, p=0.029) and mean BMI (EB = 27.8 ± 1.5 kg/m^2, NEB = 24.1 ± 5.2). However, there was no significant difference between intervention groups in

Table 29: Baseline Measurements By Baseline BMI Status

	BMI < 25 kg/m^2	BMI ≥ 25 kg/m^2	p=
n=	42	31	
Female	23 (50%)	23 (50%)	NS
Male	19 (70%)	8 (30%)	NS
Mean Height (m)	1.72 ± 0.10	1.72 ± 0.10	NS
Mean Weight (kg)	61.5 ± 9.2	99.8 ± 26.0	< 0.0001
Mean BMI (kg/m^2)	20.7 ± 1.9	33.5 ± 7.1	< 0.0001
Mean % Fat	16.3 ± 8.0	39.4 ± 9.0	< 0.0001
Total Cholesterol (mg/dL)	143 ± 21	149 ± 28	NS
Triglycerides (mg/dL)	85 ± 36	90 ± 39	NS
LDL Cholesterol (mg/dL)	80 ± 18	85 ± 22	NS
HDL Cholesterol (mg/dL)	50 ± 12	46 ± 14	NS
Glucose (mg/dL)	85 ± 5	91 ± 10	0.011

Means are reported ± SD. Significant differences in means between groups were determined using independent samples t-tests. Significant differences in proportions between groups were determined using Chi-square analysis.

[a] No significant difference in proportions of females and males were found between breakfast groups, Chi-square(1)=0.891, p=0.461.

[b] A significant difference in proportions of subjects with baseline BMI <25 and those with baseline BMI ≥ 25 between breakfast groups, Chi-square(1)=5.193, p=0.031.

[c] No significant difference in proportions of subjects in BMI health categories were found between breakfast groups, Chi-square(3)=6.799, p=0.079.

Table 30: Baseline Measurements By Breakfast Group

	Egg Group	Non-Egg Group	p=
n=	39	34	
Female	23 (59%)	23 (68%)	NS[a]
Male	16 (31%)	11 (32%)	NS
Mean Height (m)	1.73 ± 0.02	1.71 ± 0.02	0.4
Mean Weight (kg)	83.9 ± 5.1 *	70.6 ± 2.6 *	0.029
Mean BMI (kg/m^2)	27.8 ± 1.5 *	24.1 ± 5.2 *	0.046
BMI <25 kg/m^2	18 (46%)	24 (71%)	0.031[b]
BMI ≥25 kg/m^2	21 (54%)	10 (29%)	0.031
Underweight	6 (15%)	4 (12%)	NS[c]
Healthy Weight	12 (31%)	20 (59%)	NS
Overweight	8 (21%)	3 (9%)	NS
Obese	13 (33%)	7 (21%)	NS
Mean % Fat	28.0 ± 15.4	23.7 ± 12.4	NS
Total Cholesterol (mg/dL)	145 ± 22	147 ± 27	NS
Triglycerides (mg/dL)	83 ± 36	92 ± 38	NS
LDL Cholesterol (mg/dL)	82 ± 19	83 ± 21	NS
HDL Cholesterol (mg/dL)	49 ± 12	49 ± 14	NS
Glucose (mg/dL)	89 ± 8	86 ± 7	NS

Means are reported ± SD. Significant differences in means between groups were determined using independent samples t-tests. Significant differences in proportions between groups were determined using Chi-square analysis.

[a] No significant difference in proportions of females and males were found between breakfast groups, Chi-square(1)=0.891, p=0.461.

[b] A significant difference in proportions of subjects with baseline BMI <25 and those with baseline BMI ≥ 25 between breakfast groups, Chi-square(1)=5.193, p=0.031.

[c] No significant difference in proportions of subjects in BMI health categories were found between breakfast groups, Chi-square(3)=6.799, p=0.079.

baseline mean body fat percentage, and there were no correlations between baseline weight or BMI status in any differences in outcome measures.

Fifty-seven subjects (78%) completed the final measurement, which is a comparable retention to similar, previously reported studies. There was no significant difference in baseline anthropometric or fasting plasma cholesterol and glucose measures between those who completed final measurement of the study and those who did not (Table 31, p. 101).

The mean frequencies of breakfast consumption each week were determined by analyzing One Card data provided by the University. Each time students enter a dining facility, their University-issued identification cards (One Cards) are swiped through an electronic reader, and this information is collected from all vending outlets accepting One Cards for payment. To determine frequencies of breakfasts consumed each week, data files for residence hall dining facilities were obtained from the University, and data pertaining only to study subjects was extracted by study researchers. Data for each subject from each residence hall was combined for analysis. Changes in frequency of attendance of dining hall breakfasts over the course of the semester were assessed. A general time effect was observed for all subjects with breakfast frequency increasing from Week 1 (2.5 ± 1.9) over the course of the semester ($p<0.0001$), and no significant difference between genders was observed ($p=0.719$). Repeated measures analysis for all subjects shows no significant mean changes from baseline in breakfast attendance frequency until Week 4,

Table 31: Baseline Measurements By Final Measurement Completion Status

	Completed Last Anthropometric Measurement	Did Not Complete Last Anthropometric Measurement	p=
n=	57	16	
Female	35	11	NS[a]
Male	22	4	NS
Mean Weight (lbs.)	165.3 ± 51.0	189.5 ± 77.4	NS
Mean BMI (kg/m^2)	25.1 ± 7.2	29.5 ± 9.9	NS
BMI <25 kg/m^2	36	6	NS[b]
BMI ≥25 kg/m^2	21	9	NS
Mean % Fat	24.6 ± 13.4	30.9 ± 16.5	NS
Total Cholesterol	145 ± 25	148 ± 20	NS
Triglycerides	85 ± 38	92 ± 35	NS
LDL Cholesterol	81 ± 20	87 ± 19	NS
HDL Cholesterol	50 ± 13	44 ± 13	NS
Glucose	87 ± 8	86 ± 8	NS
Egg Group	32	7	NS[c]
Non-egg Group	25	9	NS

Means are reported ± SD. Significant differences in means between groups were determined using independent samples t-tests. Significant differences in proportions between groups were determined using Chi-square analysis.

[a] No significant difference in completion of final measurement was seen between proportions of females and males, Chi-square(1)=0.733, p=0.093.

[b] No significant difference in completion of final measurement was seen between baseline BMI categories, Chi-square(1)=2.620, p=0.301.

[c] No significant difference in completion of final measurement was seen between breakfast groups, Chi-square(1)=0.771, p=0.380.

where a mean increase from baseline is seen (0.5 ± 1.8, p=0.031) and then again at Week 8 (2.1 ± 3.4, p<0.0001). No significant changes from baseline are seen again (with the exception of Week 11, which corresponds to the Thanksgiving holiday break) until a significant decline in breakfast attendance frequency is seen at Week 13 (-0.5 ± 2.1, p=0.038) and at Week 14 (-1.9 ± 2.0, p<0.0001).

Reported means of dining hall breakfast frequency for all subjects and by intervention group for each week are found in Table 32 (p. 104). The mean weekly breakfast attendance frequency for all subjects for the entire semester was 3.8 ± 1.4 breakfasts per week. There was no significant difference between breakfast intervention groups in the average of total number of breakfasts consumed per week (EB = 3.7 ± 1.4, NEB = 3.8 ± 1.5, p=0.731). The relatively high frequency of overall average frequency of breakfasts consumed per week indicates good level of compliance to study requirements of breakfast consumption. There was no significant difference in mean weekly breakfast frequency seen between intervention groups.

Comparisons of weekly mean frequencies of breakfast consumption by study completion category are reported in Table 33 (p. 105). There was a significant difference between those who completed the study and those who did not complete the study in the total breakfasts consumed (57.5 ± 16.8 and 34.7 ± 20.8, p<0.0001) as well as the average number of breakfasts consumed per week (4.1 ± 1.2 and 2.5 ± 1.5, p<0.0001). There was no significant difference in mean frequencies of breakfast consumption in weeks 1, 3 or 5 of the study, however from week 7 through the end of the study, those who did not complete the final measurement showed a significantly lower mean frequency of breakfast consumption each week. This indicates that among those who did not complete

Table 32: Mean Weekly Breakfast Frequency All Subjects and By Breakfast Group

	All Subjects	Egg Group (n=39)	Non-egg Group (n=34)	p=
Week 1	2.5 ± 1.9	2.8 ± 1.8	2.5 ± 2.0	NS
Week 2	4.0 ± 1.7	4.2 ± 1.8	3.8 ± 1.5	NS
Week 3	4.4 ± 1.7	4.3 ± 1.5	4.5 ± 1.8	NS
Week 4	4.4 ± 1.8	4.4 ± 1.4	4.7 ± 1.9	NS
Week 5	4.1 ± 2.0	3.9 ± 1.9	4.2 ± 2.1	NS
Week 6	4.2 ± 1.9	4.3 ± 2.0	4.4 ± 1.7	NS
Week 7	4.0 ± 1.8	4.1 ± 2.0	4.0 ± 1.7	NS
Week 8	6.0 ± 3.5	6.6 ± 4.0	5.9 ± 3.0	NS
Week 9	4.2 ± 2.2	4.1 ± 2.0	4.4 ± 2.2	NS
Week 10	4.0 ± 2.2	3.9 ± 2.2	4.4 ± 2.3	NS
Week 11	1.6 ± 1.2	1.4 ± 1.3	1.8 ± 1.3	NS
Week 12	3.8 ± 2.1	4.0 ± 2.1	3.8 ± 1.3	NS
Week 13	3.4 ± 1.7	3.4 ± 1.7	3.6 ± 1.9	NS
Week 14	2.1 ± 1.4	2.1 ± 1.4	2.1 ± 1.5	NS

Weekly mean breakfast frequency is reported ± SD, and significant differences between groups were determined by independent samples t-tests. There were no significant differences in mean breakfast attendance frequency between study groups. Both groups showed a steady rate of compliance with breakfast attendance for the duration of the study. Week 8 is the week of Halloween, where many students stayed on campus through the weekend rather than go home, which may explain the increase in frequency during this week. Week 11 is the week of Thanksgiving.

Table 33: Mean Weekly Breakfast Frequency By Study Completion Status

	Completed Final Measure (n=57)	Did Not Complete Final Measure (n=16)	p=
Week 1	2.6 ± 1.8	2.2 ± 2.0	NS
Week 2	4.3 ± 1.6	7.7 ± 1.6	0.001
Week 3	4.5 ± 1.5	4.0 ± 2.4	NS
Week 4	4.7 ± 1.6	3.6 ± 2.0	0.040
Week 5	4.2 ± 1.6	3.6 ± 2.3	NS
Week 6	4.4 ± 1.7	3.3 ± 2.4	0.053
Week 7	4.5 ± 1.5	2.5 ± 2.1	<0.0001
Week 8	6.2 ± 3.2	2.9 ± 2.9	<0.0001
Week 9	4.8 ± 1.9	2.2 ± 2.1	<0.0001
Week 10	4.6 ± 1.9	1.7 ± 2.0	<0.0001
Week 11	1.9 ± 1.2	0.6 ± 0.7	<0.0001
Week 12	4.2 ± 2.0	2.1 ± 1.9	<0.0001
Week 13	3.8 ± 1.5	2.0 ± 1.7	<0.0001
Week 14	4.1 ± 1.2	2.5 ± 1.3	0.006

Weekly mean breakfast frequency is reported ± SD, and significant differences between groups were determined by independent samples t-tests.

Subjects who did not complete the final anthropometric measurement session showed a significantly lower mean breakfast frequency at weeks 2, 4, and 7 to 14. This pattern indicates lower participation in the study began mid-semester. Week 8 is the week of Halloween, where many students stayed on campus through the weekend rather than go home, which may explain the increase in frequency during this week. Week 11 is the week of Thanksgiving.

the final study measurement, participation in the study in terms of actual breakfast attendance started to decline midway through the semester.

Composition of breakfasts was determined throughout the study period. At five time points during the study (Weeks 1, 4, 4, 7, 10 and 13), subjects were asked to complete immediate recall of the items consumed at breakfast for three days in the week (Tuesday, Wednesday and Thursday). These "breakfast cards" were completed by subjects immediately upon leaving the dining hall under the supervision of a study researcher. Subjects were instructed to list all items consumed at breakfast and the number of servings of each item.

Mean daily frequencies of the consumption of specific breakfast items were determined for each breakfast card collection time point (Eggs, Ready-to-Eat Cereals, Hot Cereals, Pancakes, Meats, Potatoes, Toast, Pastries, Juice, Milk, Fruit, Yogurt). This was calculated for each subject as the sum of the number of servings of each item on each day a breakfast card was completed, divided by the number of breakfast occasions (defined as the number of breakfast cards the subject turned in for a particular week). Independent samples t-tests were used to assess differences between breakfast intervention groups in mean weekly servings of each breakfast item, and these results are reported in Table 34 (p. 107). As expected, those in the egg group consumed more average servings of eggs at every time point than those in the non-egg group. Other differences were seen only sporadically, starting at Week 10, where a difference in mean servings of Ready-to-eat cereal was seen (EB = 0.10 ± 0.27, NEB =

Table 34: Mean Daily Frequency of Breakfast Item Servings Consumed By Breakfast Group

		Egg Group	Non-egg Group	p=
Eggs	W1	(n=32) 0.98 ± 0.08	(n=30) 0.56 ± 0.21	<0.0001
	W4	(n=30) 1.00 ± 0.06	(n=29) 0.03 ± 0.18	<0.0001
	W7	(n=28) 1.00 ± 0.00	(n=28) 0.07 ± 0.26	<0.0001
	W10	(n=28) 0.95 ± 0.20	(n=27) 0.04 ± 0.19	<0.0001
	W13	(n=25) 0.97 ± 0.12	(n=28) 0.07 ± 0.26	<0.0001
Ready-to-eat Cereal	W1	0.21 ± 0.33	0.24 ± 0.32	NS
	W4	0.23 ± 0.40	0.34 ± 0.42	NS
	W7	0.21 ± 0.36	0.26 ± 0.35	NS
	W10	0.09 ± 0.27	0.38 ± 0.41	0.004
	W13	0.15 ± 0	0.30 ± 0.38	NS
Hot Cereal	W1	0.06 ± 0.21	0.13 ± 0.29	NS
	W4	0.12 ± 0.31	0.14 ± 0.33	NS
	W7	0.10 ± 0.24	0.10 ± 0.24	NS
	W10	0.11 ± 0.29	0.07 ± 0.27	NS
	W13	0.06 ± 0.22	0.10 ± 0.28	NS
Pancakes	W1	0.21 ± 34	0.38 ± 0.48	NS
	W4	0.38 ± 0.49	0.45 ± 0.45	NS
	W7	0.21 ± 0.33	0.40 ± 0.46	NS
	W10	0.30 ± 0.40	0.51 ± 0.43	NS
	W13	0.15 ± 0.31	0.48 ± 0.47	0.005
Breakfast Meats	W1	0.41 ± 0.40	0.36 ± 0.44	NS
	W4	0.49 ± 0.54	0.36 ± 0.47	NS
	W7	0.51 ± 0.46	0.42 ± 0.41	NS
	W10	0.53 ± 0.50	0.40 ± 0.53	NS
	W13	0.50 ± 0.44	0.36 ± 0.41	NS
Potatoes	W1	0.40 ± 0.43	0.38 ± 0.45	NS
	W4	0.37 ± 0.42	0.49 ± 0.48	NS
	W7	0.51 ± 0.45	0.41 ± 0.45	NS
	W10	0.54 ± 0.43	0.59 ± 0.49	NS
	W13	0.57 ± 0.47	0.45 ± 0.45	NS
Toast	W1	0.14 ± 0.28	0.28 ± 0.38	NS
	W4	0.12 ± 0.24	0.21 0.33	NS
	W7	0.19 ± 0.36	0.31 ± 0.38	NS
	W10	0.07 ± 0.21	0.26 ± 0.40	0.031
	W13	0.14 ± 0.31	0.27 ± 0.39	NS
Pastries	W1	0.08 ± 0.17	0.18 ± 0.34	NS
	W4	0.13 ± 0.28	0.28 ± 0.64	NS
	W7	0.17 ± 0.29	0.16 ± 0.30	NS
	W10	0.15 ± 0.30	0.28 ± 0.48	NS
	W13	0.12 ± 0.26	0.20 ± 0.36	NS
Juice	W1	0.61 ± 0.50	0.76 ± 0.55	NS
	W4	0.59 ± 0.57	0.92 ± 0.79	NS
	W7	0.72 ± 0.47	0.70 ± 0.48	NS

W10	0.56 ± 0.48	0.85 ± 0.70	NS
W13	0.52 ± 0.47	0.73 ± 0.43	NS
Milk W1	0.28 ± 0.41	0.31 ± 0.38	NS
W4	0.32 ± 0.42	0.36 ± 0.42	NS
W7	0.30 ± 0.47	0.36 ± 0.39	NS
W10	0.21 ± 0.38	0.40 ± 0.43	NS
W13	0.30 ± 0.46	0.33 ± 0.42	NS
Fruit W1	0.56 ± 0.58	0.70 ± 0.67	NS
W4	0.23 ± 0.43	0.24 ± 0.47	NS
W7	0.39 ± 0.42	0.60 ± 0.61	NS
W10	0.14 ± 0.36	0.23 ± 0.37	NS
W13	0.27 ± 0.33	0.60 ± 0.64	0.027
Yogurt W1	0.21 ± 0.36	0.25 ± 0.40	NS
W4	0.21 ± 0.45	0.20 ± 0.34	NS
W7	0.24 ± 0.41	0.25 ± 0.42	NS
W10	0.22 ± 0.43	0.17 ± 0.34	NS
W13	0.16 ± 0.29	0.27 ± 0.39	NS

Table shows mean number of daily servings of each food ± SD. "One serving" is defined as: Eggs = 2 whole eggs; RTE Cereal = 3/4 cup; Hot Cereal = 3/4 cup; Pancakes = 2 small pancakes; Breakfast Meats = 1.5 ounces; Potatoes = 4 ounces; Toast = 2 slices or 1 bagel; Pastries = 2 small; Juice = 8 ounces; Milk = 8 ounces; Fruit = 1/2 cup; Yogurt = 4 ounces.

0.38 ± 0.41, p = 0.004), and a difference in mean servings of toast was also seen (EB = 0.07 ± 0.21, NEB = 0.26 ± 0.40, p = 0.031). At Week 13, differences between the intervention groups were seen in consumed servings of pancakes (EB = 0.15 ± 0.30, NEB = 0.48 ± 0.47, p = 0.005) and fruit (EB = 0.27 ± 0.33, NEB = 0.59 ± 0.64, p = 0.027).

When analyzed by gender (Please see supplementary data, Appendix X), the only significant differences seen were in consumption of servings of toast at Week 7 (F = 0.18 ± 0.32, M = 0.39 ± 0.44, p = 0.041) and fruit at Week 4 (F = 0.10 ± 0.23, M = 0.29 ± 0.47, p = 0.049). When analyzed by final weight change category, significant differences between these groups were seen only sporadically, and these were in the frequency of consumption meats (at Weeks 1 and 7) and juice (Weeks 4 and 7).

Analysis of breakfast nutrient composition for breakfast intervention groups is presented in Table 35 (p. 110). At baseline, there were no significant differences observed between intervention groups in Calories consumed at breakfast (EB = 615 ± 130, NEB = 591 ± 197, p=0.998) or Calories per kilogram body weight (EB = 8.3 ± 2.9, NEB = 8.9 ± 3.9, p=0.893). At baseline, subjects in the Egg Breakfast group showed significantly higher mean breakfast consumption of fat (EB = 217 ± 59 kcals, NEB = 127 ± 64 kcals, p<0.0001), saturated fat (EB = 56 ± 17 kcals, NEB = 32 ± 16 kcals, p<0.0001), cholesterol (EB = 414 ± 41 mg, NEB = 63 ± 96 mg, p<0.0001) and protein (EB = 95 ± 28 kcals, NEB = 69 ± 30 kcals, p=0.001), while NEB subjects reported higher

Table 35: Changes in Breakfast Nutrient Composition By Breakfast Group

		Egg Group	Non-Egg Group	p=
Total Calories	W1	(n=32) 615 ± 130	(n=30) 591 ± 197	NS
	W4	(n=30) 680 ± 212	(n=29) 633 ± 244	NS
	W7	(n=28) 686 ± 176	(n=28) 611 ± 197	NS
	W10	(n=28) 633 ± 189	(n=27) 679 ± 241	NS
	W13	(n=25) 601 ± 167	(n=28) 641 ± 180	NS
Calories/kg Body Weight	W1	8.3 ± 2.9	8.9 ± 3.9	NS
	W4	9.3 ± 3.4	9.6 ± 4.9	NS
	W7	9.3 ± 3.2	9.2 ± 3.5	NS
	W10	8.4 ± 3.5	10.4 ± 4.7	NS
	W13	8.4 ± 3.7	9.7 ± 3.6	NS
Calories from Carbohydrates	W1	301 ± 96	402 ± 139	0.002
	W4	325 ± 154	418 ± 144	0.002
	W7	335 ± 125	400 ± 134	NS
	W10	284 ± 113	440 ± 129	<0.0001
	W13	265 ± 106	427 ± 129	<0.0001
Calories from Protein	W1	95 ± 28	69 ± 30	0.001
	W4	111 ± 37	75 ± 36	<0.0001
	W7	106 ± 27	76 ± 34	0.001
	W10	102 ± 38	84 ± 34	NS
	W13	97 ± 30	77 ± 29	0.014
Calories from Total Fat	W1	217 ± 59	127 ± 64	<0.0001
	W4	241 ± 75	127 ± 64	<0.0001
	W7	243 ± 63	142 ± 64	<0.0001
	W10	243 ± 83	163 ± 91	0.001
	W13	235 ± 68	144 ± 59	<0.0001
Calories from Saturated Fat	W1	56 ± 17	32 ± 16	<0.0001
	W4	60 ± 23	33 ± 16	<0.0001
	W7	61 ± 17	36 ± 18	<0.0001
	W10	60 ± 22	35 ± 18	<0.0001
	W13	60 ± 16	33 ± 15	<0.0001
Cholesterol (mg)	W1	414 ± 41	63 ± 96	<0.0001
	W4	422 ± 27	46 ± 81	<0.0001
	W7	418 ± 14	76 ± 119	<0.0001
	W10	417 ± 18	49 ± 79	<0.0001
	W13	404 ± 52	68 ± 114	<0.0001

Means are reported ± SD. Breakfast cards were collected at Weeks 1, 4, 7, 10 and 13.

mean carbohydrate intake at breakfast (EB = 301 ± 96 kcals, NEB = 402 ± 139 kcals, p=0.002). These results illustrate the expected differences in meal composition between egg-based breakfasts and non-egg-based breakfasts.

Analysis of breakfast nutrient composition by baseline BMI groups is presented in Table 36 (p. 112). While there was no significant difference between baseline BMI groups in total Calories consumed at breakfast, interestingly, those with baseline BMI <25 consumed significantly more Calories per kilogram body weight at breakfast (9.9 ± 3.6 kcals/kg) compared to those with baseline BMI of ≥25 (6.7 ± 1.8 kcals/kg, p=0.001), and this was maintained throughout the study. There were no significant differences observed between baseline BMI groups in other variables.

When breakfast nutrient composition was analyzed by gender (Table 37, p. 113), no significant differences were seen between groups except in protein at Week 10. When data were analyzed by weight change status (Table 38, p. 114), significant differences were seen between who lost >1 pound or gained >1 pound over the course of the study in total Calories consumed at breakfast at every time point except baseline, where those who gained weight reported greater mean intakes of energy at breakfast. Significant differences were also seen in Calories per kilogram consumed, with those gaining greater than one pound reporting higher mean Calories consumed per kilogram body weight at Weeks 4, 7 and 10. Those who gained more than one pound also consumed significantly more energy from carbohydrates at Weeks 4 and 7, and they consumed significantly more energy from protein at baseline.

Table 36: Changes in Breakfast Nutrient Composition By Baseline BMI Category

		BMI < 25	BMI ≥ 25	p=
Total Calories	W1	(n=36) 597 ± 183	(n=25) 625 ± 126	NS
	W4	(n=37) 632 ± 234	(n=21) 696 ± 220	NS
	W7	(n=33) 641 ± 234	(n=22) 676 ± 182	NS
	W10	(n=34) 653 ± 237	(n=20) 654 ± 184	NS
	W13	(n=33) 626 ± 169	(n=19) 633 ± 177	NS
Calories/kg Body Weight	W1	9.9 ± 3.6	6.7 ± 1.8	<0.0001
	W4	10.5 ± 4.5	7.6 ± 1.8	0.008
	W7	10.5 ± 3.5	7.4 ± 2.0	<0.0001
	W10	10.8 ± 4.5	6.9 ± 2.2	0.001
	W13	10.4 ± 3.6	6.8 ± 2.5	<0.0001
Calories from Carbohydrates	W1	353 ± 149	354 ± 88	NS
	W4	373 ± 161	364 ± 152	NS
	W7	373 ± 141	370 ± 115	NS
	W10	374 ± 174	333 ± 123	NS
	W13	354 ± 146	356 ± 138	NS
Calories from Protein	W1	81 ± 33	86 ± 29	NS
	W4	87 ± 41	104 ± 39	NS
	W7	88 ± 35	98 ± 32	NS
	W10	91 ± 38	96 ± 35	NS
	W13	85 ± 32	91 ± 28	NS
Calories from Total Fat	W1	166 ± 85	186 ± 59	NS
	W4	174 ± 99	225 ± 83	0.047
	W7	184 ± 89	209 ± 66	NS
	W10	191 ± 102	223 ± 83	NS
	W13	188 ± 85	189 ± 64	NS
Calories from Saturated Fat	W1	43 ± 23	50 ± 15	NS
	W4	44 ± 24	53 ± 24	NS
	W7	48 ± 24	53 ± 17	NS
	W10	46 ± 24	53 ± 23	NS
	W13	45 ± 24	49 ± 15	NS
Cholesterol (mg)	W1	245 ± 192	327 ±161	NS
	W4	227 ± 203	307 ± 180	NS
	W7	251 ± 194	321 ± 169	NS
	W10	212 ± 196	315 ± 174	NS
	W13	247 ± 195	269 ± 182	NS

Means are reported ± SD. Breakfast cards were collected at Weeks 1, 4, 7, 10 and 13.

Table 37: Changes in Breakfast Nutrient Composition By Gender

	Females	Males	p=
Total Calories W1	(n=40) 596 ± 170	(n=21) 632 ± 144	NS
W4	(n=36) 621 ± 203	(n=22) 709 ± 262	NS
W7	(n=35) 635 ± 189	(n=20) 690 ± 176	NS
W10	(n=34) 613 ± 190	(n=20) 722 ± 246	NS
W13	(n=33) 626 ± 186	(n=19) 632 ± 141	NS
Calories/kg Body Weight W1	8.6 ± 3.8	8.6 ± 2.6	NS
W4	9.5 ± 4.4	9.4 ± 3.8	NS
W7	9.2 ± 3.4	9.4 ± 3.3	NS
W10	9.3 ± 4.4	9.5 ± 3.9	NS
W13	9.3 ± 4.1	8.6 ± 2.5	NS
Calories from Carbohydrates W1	351 ± 135	357 ± 112	NS
W4	347 ± 153	407 ± 158	NS
W7	358 ± 132	396 ± 128	NS
W10	338 ± 145	395 ± 173	NS
W13	357 ± 158	351 ± 111	NS
Calories from Protein W1	79 ± 28	91 ± 37	NS
W4	89 ± 33	102 ± 51	NS
W7	88 ± 32	98 ± 37	NS
W10	84 ± 29	106 ± 45	0.035
W13	85 ± 28	90 ± 35	NS
Calories from Total Fat W1	168 ± 71	188 ± 85	NS
W4	186 ± 82	205 ± 117	NS
W7	191 ± 80	200 ± 84	NS
W10	190 ± 81	185 ± 74	NS
W13	185 ± 74	194 ± 86	NS
Calories from Saturated Fat W1	43 ± 17	51 ± 25	NS
W4	44 ± 21	54 ± 29	NS
W7	48 ± 19	53 ± 25	NS
W10	43 ± 20	57 ± 28	NS
W13	45 ± 19	49 ± 24	NS
Cholesterol (mg) W1	256 ± 186	328 ± 170	NS
W4	244 ± 194	286 ± 203	NS
W7	258 ± 190	325 ± 172	NS
W10	240 ± 194	273 ± 195	NS
W13	226 ± 189	315 ± 177	NS

Means are reported ± SD. Breakfast cards were collected at Weeks 1, 4, 7, 10 and 13.

Table 38: Changes in Breakfast Nutrient Composition By Weight Change Status

		Lost > 1 Lb.	Gained > 1 Lb.	p=
Total Calories	W1	(n=16) 558 ± 136	(n=26) 630 ± 169	NS
	W4	(n=15) 564 ± 138	(n=27) 717 ± 229	0.023
	W7	(n=14) 571 ± 174	(n=24) 689 ± 164	0.044
	W10	(n=14) 525 ± 125	(n=26) 712 ± 227	0.007
	W13	(n=15) 537 ± 185	(N=23) 650 ± 151	0.046
Calories/kg Body Weight	W1	7.8 ± 3.1	9.5 ± 3.9	NS
	W4	7.9 ± 3.1	9.5 ± 3.9	0.034
	W7	7.9 ± 2.8	10.3 ± 3.5	0.036
	W10	7.1 ± 2.3	10.6 ± 4.5	0.012
	W13	7.5 ± 4.2	9.7 ± 3.8	NS
Calories from Carbohydrates	W1	332 ± 123	348 ± 134	NS
	W4	304 ± 102	415 ± 162	0.021
	W7	328 ± 137	378 ± 121	NS
	W10	267 ± 94	407 ± 167	0.006
	W13	290 ± 147	352 ± 125	NS
Calories from Protein	W1	76 ± 24	86 ± 35	0.021
	W4	87 ± 28	98 ± 45	NS
	W7	80 ± 30	97 ± 33	NS
	W10	77 ± 25	96 ± 41	NS
	W13	76 ± 28	93 ± 30	NS
Calories from Total Fat	W1	152 ± 57	196 ± 84	NS
	W4	174 ± 83	206 ± 98	NS
	W7	165 ± 75	215 ± 80	NS
	W10	179 ± 84	211 ± 101	NS
	W13	171 ± 80	206 ± 82	NS
Calories from Saturated Fat	W1	40 ± 18	50 ± 23	NS
	W4	43 ± 24	49 ± 26	NS
	W7	43 ± 21	55 ± 22	NS
	W10	43 ± 23	48 ± 25	NS
	W13	43 ± 22	52 ± 21	NS
Cholesterol (mg)	W1	350 ± 139	283 ± 185	NS
	W4	348 ± 150	268 ± 201	NS
	W7	343 ± 148	299 ± 183	NS
	W10	316 ± 169	256 ± 197	NS
	W13	323 ± 150	278 ± 192	NS

Means are reported ± SD. Breakfast cards were collected at Weeks 1, 4, 7, 10 and 13.

Three-day food diaries were collected at two time points during the study, during the second week of the study (first full week of classes) and again at the final measurement collection session during the last week of the study (last full week of classes). Thirty-three subjects completed and turned in 3-day food records for the first collection. This represents 45% of the original study sample.

Comparative results of the changes in nutrient intake as assessed by food diary nutrient analysis by breakfast intervention group are presented in Table 39 (p. 117). There were no significant differences between groups in mean energy intake at either time point. Those in the egg breakfast group showed a higher mean intake of saturated fat Calories at baseline (EB = 242 ± 85, NEB = 180 ± 94, $p = 0.05$), but this difference was not apparent at the end of the semester. Subjects in the egg breakfast group showed a higher mean intake of cholesterol at baseline (EB = 451 ± 196, NEB = 142 ± 108, $p < 0.0001$), but there was no significant difference seen between intervention groups in cholesterol intake at the end of the semester. Repeated measures analysis reveals a significant mean decrease in cholesterol intake among those in the egg breakfast group (-52 ± 77 mg, $p = 0.024$) as well as a significant increase in cholesterol intake among those in the non-egg breakfast group (109 ± 129 mg, $p = 0.025$).

Analysis of 3-day food diaries by gender is presented in Table 40 (p. 118). As expected, males consumed significantly more Calories (2329 ± 649) than females (1800 ± 701, $p=0.045$) at the beginning of the semester, and this difference remained significant at the end of the semester (M = 2839 ± 817, F = 1898 ± 860, $p = 0.018$). At baseline, males also consumed more cholesterol (456

± 30 mg) than did females (238 ± 128, p=0.006), but this difference was maintained at the end of the semester. While there were no significant differences in energy intake from carbohydrates or protein at the beginning of the semester, males reported higher mean intakes of energy from carbohydrates (M = 1566 ± 799, F = 942 ± 480, p = 0.025) and protein (M = 400 ± 139, F = 287 ± 106, p = 0.037) at the end of the semester.

Table 39: Changes in 3-Day Average Nutrient Intake By Breakfast Group

	Egg Group W2 n=18 W14 n=14	Non-Egg Group W2 n=15 W14 n=10	p=
Total Kcals (W2)	2076 ± 715	1790 ± 731	NS
(W14)	2417 ± 946	1925 ± 910	NS
Carbohydrate Kcals (W2)	1054 ± 450	1069 ± 379	NS
(W14)	1306 ± 714	932 ± 534	NS
Protein Kcals (W2)	338 ± 146	277 ± 231	NS
(W14)	337 ± 149	308 ± 92	NS
Total Fat Kcals (W2)	704 ± 294	553 ± 216	NS
(W14)	791 ± 447	729 ± 382	NS
Saturated Fat Kcals (W2)	242 ± 85	180 ± 94	0.05
(W14)	299 ± 199	219 ± 120	NS
Fiber (g) (W2)	16 ± 15	15 ± 8	NS
(W14)	17 ± 7	13 ± 4	NS
Cholesterol (mg) (W2)	451 ± 196	142 ± 108	0.0001
(W14)	379 ± 162	258 ± 185	NS
% Kcals Carbohydrate (W2)	50 ± 7	58 ± 7	0.003
(W14)	54 ± 15	48 ± 10	NS
% Kcals Protein (W2)	16 ± 3	14 ± 5	NS
(W14)	14 ± 3	17 ± 5	NS
% Kcals Fat (W2)	34 ± 9	30 ± 7	NS
(W14)	33 ± 13	37 ± 13	NS
% Kcals Saturated Fat (W2)	12 ± 3	10 ± 4	0.049
(W14)	12 ± 5	11 ± 3	NS

Table 40: Changes in 3-Day Average Nutrient Intake By Gender

	Females W2 = 22 W14 = 16	Males W2 = 11 W14 = 8	p=
Total Kcals (W2)	1801 ± 701	2329 ± 649	0.045
(W14)	1898 ± 860	2839 ± 817	0.018
Carbohydrate Kcals (W2)	982 ± 396	1219 ± 417	NS
(W14)	942 ± 480	1566 ± 799	0.025
Protein Kcals (W2)	272 ± 206	388 ± 122	NS
(W14)	287 ± 106	400 ± 139	0.037
Total Fat Kcals (W2)	577 ± 213	754 ± 335	NS
(W14)	710 ± 380	874 ± 481	NS
Saturated Fat Kcals (W2)	198 ± 74	246 ± 121	NS
(W14)	224 ± 127	350 ± 225	NS
Fiber (g) (W2)	15 ± 13	17 ± 12	NS
(W14)	15 ± 7	16 ± 5	NS
Cholesterol (mg) (W2)	239 ± 128	456 ± 301	0.006
(W14)	282 ± 155	423 ± 196	NS
% Kcals Carbohydrate (W2)	54 ± 6	53 ± 11	NS
(W14)	50 ± 11	55 ± 18	NS
% Kcals Protein (W2)	14 ± 4.4	17 ± 3	NS
(W14)	16 ± 5	14 ± 4	NS
% Kcals Fat (W2)	33 ± 8	32 ± 10	NS
(W14)	37 ± 10	30 ± 13	NS
% Kcals Saturated Fat (W2)	11 ± 3	10 ± 4	NS
(W14)	11 ± 3	12 ± 6	NS

When 3-day average food diaries were analyzed by baseline BMI category, no significant differences were observed. These data are reported in Table 41 (p. 120).

Analysis of 3-day food diaries by final weight change group is presented in Table 42 (p. 121). There were no significant differences in any variable between those who lost >1 pound and those who gained >1 pound over the course of the study.

Data from analysis of 3-day food records were used to assess subjects' adherence to the 2010 Dietary Guidelines recommendations for fat, saturated fat and fiber. Results are shown in Table 43 (p. 122). Of those completing and turning in the first 3-day food diary (n=33, 45% of enrolled subjects), only 42% were within the desirable range of fat intake. Of the 58% of subjects whose intakes of fat fell outside of the guidelines, 12% consumed less than 20% of total Calories from fat, and 46% consumed more than 35% of their total Calories from fat. Only 36% of food diary respondents met the intake guidelines for saturated fat of ≤10% total energy. Further, only 9% had fiber intakes of ≥25 grams per day.

Table 41: Changes in 3-Day Average Nutrient Intake By Baseline BMI Category

	BMI < 25 W2 n=20 W14 n=13	BMI ≥ 25 W2 = n=13 W14 n=11	p=
Total Kcals (W2)	2060 ± 769	1850 ± 646	NS
(W14)	2414 ± 1067	1973 ± 753	NS
Carbohydrate Kcals (W2)	1136 ± 460	946 ± 308	NS
(W14)	1304 ± 820	969 ± 357	NS
Protein Kcals (W2)	323 ± 221	291 ± 130	NS
(W14)	360 ± 135	284 ± 108	NS
Total Fat Kcals (W2)	629 ± 248	645 ± 307	NS
(W14)	813 ± 467	709 ± 353	NS
Saturated Fat Kcals (W2)	214 ± 91	214 ± 100	NS
(W14)	259 ± 159	274 ± 194	NS
Fiber (g) (W2)	18 ± 15	11 ± 5	NS
(W14)	17 ± 7	13 ± 4	NS
Cholesterol (mg) (W2)	279 ± 201	361 ± 254	NS
(W14)	307 ± 152	355 ± 212	NS
% Kcals Carbohydrate (W2)	55 ± 8	52 ± 9	NS
(W14)	53 ± 15	50 ± 12	NS
% Kcals Protein (W2)	15 ± 5	15 ± 3	NS
(W14)	16 ± 5	15 ± 4	NS
% Kcals Fat (W2)	31 ± 9	35 ± 8	NS
(W14)	34 ± 12	35 ± 12	NS
% Kcals Saturated Fat (W2)	11 ± 4	12 ± 3	NS
(W14)	10 ± 4	13 ± 5	NS

Table 42: Changes in 3-Day Average Nutrient Intake By Weight Change Group

	Lost > 1 Lb. W2 n=11 W14 n=9	Gained > 1 Lb. W2 n=14 W14 n=11	p=
Total Kcals (W2)	2004 ± 1007	2117 ± 620	NS
(W14)	2138 ± 1156	2475 ± 874	NS
Carbohydrate Kcals (W2)	1078 ± 570	1093 ± 382	NS
(W14)	1116 ± 625	1273 ± 791	NS
Protein Kcals (W2)	366 ± 284	310 ± 133	NS
(W14)	272 ± 107	386 ± 134	NS
Total Fat Kcals (W2)	593 ± 269	741 ± 279	NS
(W14)	770 ± 450	853 ± 407	NS
Saturated Fat Kcals (W2)	215 ± 101	248 ± 89	NS
(W14)	278 ± 186	299 ± 196	NS
Fiber (g) (W2)	20 ± 17	14 ± 10	NS
(W14)	16 ± 6	17 ± 6	NS
Cholesterol (mg) (W2)	324 ± 153	362 ± 277	NS
(W14)	326 ± 183	356 ± 207	NS
% Kcals Carbohydrate (W2)	53 ± 7	52 ± 8	NS
(W14)	53 ± 7	50 ± 16	NS
% Kcals Protein (W2)	17 ± 5	14 ± 4	NS
(W14)	14 ± 4	16 ± 5	NS
% Kcals Fat (W2)	31 ± 10	35 ± 7	NS
(W14)	36 ± 9	36 ± 11	NS
% Kcals Saturated Fat (W2)	12 ± 4	12 ± 2	NS
(W14)	12 ± 4	12 ± 5	NS

Table 43: Comparison of Selected Nutrient Intakes to 2010 Dietary Guidelines

	Proportion of Subjects at Baseline (n=33)	Proportion of Subjects at Week 14 (n=24)
Percentage of Energy as Total Fat		
< 20%	12%	12%
20-35%	42%	21%
> 35%	46%	67%
Percentage of Energy as Total Sat Fat		
≤ 10%	36%	25%
> 10%	64%	75%
Grams of Dietary Fiber		
< 25 g/day	91%	92%
≥ 25 g/day	9%	8%

Data are derived from 3-day food diary records (n=33). Chi-square analyses revealed no significant differences in any variables by breakfast group, gender, baseline BMI category or final weight change category. The Dietary Guidelines for fiber intake are 25 g/day for women and 38 g/day for men. The value of 25 g/day was used here, because no subject met the 38 g/day threshold.

Among all subjects who completed the final measurement collection (n=57, 78% of enrolled subjects), a mean weight change of 1.6 ± 5.3 pounds was observed. Among these subjects, only one lost greater than 5% of their baseline body weight, and six (11%) experienced weight change of greater than 5% of their baseline body weight. Among subjects completing the final measurement, 28% lost weight (n=16), 53% gained weight (n=30), and 19% (n=11) did not experience a weight change of greater than one pound over the course of the study.

Mean changes in body composition by breakfast intervention group are reported in Table 44 (p. 124). Subjects in the EB group showed a significantly higher mean baseline weight (EB = 184.6 ± 69.9, NEB = 153.4 ± 32.2, $p<0.0001$) and mean baseline fat mass (EB = 59.6 ± 52.9, NEB = 38.8 ± 27.7, $p=0.017$). No significant difference between intervention groups was observed in mean baseline fat free mass or mean fat free mass changes at any time point. A mixed between-within analysis of variance was conducted to assess the impact of breakfast intervention type on changes in weight and percentage of body fat variables over time. There was a large main effect for time that was significant for weight change (Wilks Lambda = 0.692, F = 4.345, $p<0.005$, partial eta squared = 0.308) and for percent body fat (Wilks Lambda =0.720, F = 3.697, $p=0.012$, partial eta squared = 0.280). There was no significant interaction effect seen for time and breakfast intervention type on either weight or percentage body fat.

Table 45 (p. 125) shows mean differences in body composition changes over the course of the study by final weight change categories of "Lost Weight"

Table 44: Mean Body Composition Changes By Breakfast Intervention Group

	Egg Group	Non-Egg Group	p=
Baseline Weight (lbs.)	184.6 ± 69.9 (n=39)	153.4 ± 32.2 (n=33)	<0.0001
Weight Δ 2-1	2.1 ± 3.0 (n=32)	2.2 ± 3.5 (n=30)	NS
Weight Δ 3-1	1.1 ± 4.5 (n=31)	1.3 ± 3.5 (n=28)	NS
Weight Δ 4-1	2.3 ± 4.7 (n=28)	1.5 ± 2.8 (n=23)	NS
Weight Δ 5-1	1.3 ± 6.1 (n=32)*	2.2 ± 4.5 (n=25)*	NS
Baseline Fat Mass (lbs.)	59.6 ± 52.9	38.8 ± 27.7	0.017
Fat Mass Δ 2-1	1.8 ± 3.5	1.5 ± 3.6	NS
Fat Mass Δ 3-1	1.2 ± 5.0	0.7 ± 2.4	NS
Fat Mass Δ 4-1	1.9 ± 4.6	0.8 ± 2.7	NS
Fat Mass Δ 5-1	2.5 ± 6.8	1.5 ± 4.1	NS
Baseline Fat Free Mass (lbs.)	125.1 ± 28.4	114.6 ± 18.9	NS
Fat Free Mass Δ 2-1	0.3 ± 2.9	0.9 ± 2.8	NS
Fat Free Mass Δ 3-1	0.1 ± 3.7	0.6 ± 2.9	NS
Fat Free Mass Δ 4-1	0.3 ± 3.0	0.7 ± 2.2	NS
Fat Free Mass Δ 5-1	-1.2 ± 4.0**	0.7 ± 2.2**	NS

Means are reported ± SD. Significance between groups was assessed using independent measures t-tests at p≤0.05.

Table 45: Mean Body Composition Changes By Final Weight Change Category

	Lost Weight	Gained Weight	p=
Mean Baseline Weight	178.0 ± 65.3 (n=16)	161.9 ± 49.0 (n=30)	NS
Weight Δ 2-1 (lbs.)	0.4 ± 2.1 (n=14)	3.4 ± 3.1 (n=29)	0.003
Weight Δ 3-1	-1.7 ± 3.8 (n=15)	3.1 ± 2.9 (n=29)	<0.0001
Weight Δ 4-1	-1.9 ± 2.5 (n=14)	4.3 ± 3.5 (n=26)	<0.0001
Weight Δ 5-1	-4.1 ± 3.7 (n=16)	5.2 ± 3.9 (n=30)	<0.0001
Mean Baseline Fat Mass	58.1 ± 47.3	38.8 ± 32.8	NS
Fat Mass Δ 2-1 (lbs.)	-0.3 ± 1.2	2.9 ± 3.4	0.002
Fat Mass Δ 3-1	-1.6 ± 2.6	2.4 ± 4.5	0.003
Fat Mass Δ 4-1	-1.3 ± 1.8	3.3 ± 4.4	0.001
Fat Mass Δ 5-1	-1.8 ± 3.8	4.7 ± 6.1	<0.0001
Mean Baseline Fat Free Mass	120.0 ± 29.0	123.0 ± 27.4	NS
Fat Free Mass Δ 2-1 (lbs.)	0.6 ± 2.5	0.6 ± 2.7	NS
Fat Free Mass Δ 3-1	0.0 ± 3.0	0.7 ± 3.3	NS
Fat Free Mass Δ 4-1	-0.5 ± 2.3	1.1 ± 3.0	NS
Fat Free Mass Δ 5-1	-2.2 ± 1.7	0.5 ± 4.2	0.015

Timing of measurements is defined as: Time 1 (Baseline) = Week 1, Time 2 = Week 4, Time 3 = Week 8, Time 4 = Week 11, Time 5 = Week 14. Changes were calculated as the change from baseline at each particular time point.

Means are reported ± SD. Significance between groups was assessed using independent measures t-tests at a significance level of $p \leq 0.05$.

(n=16) and "Gained Weight" (n=30), defined as a change at the final measurement of greater than one pound from baseline weight. Eleven subjects experienced no weight change in excess of one pound from baseline to the final measurement. There was no significant difference in baseline anthropometric measurement variables between those who lost weight and those who gained weight as observed at the final measurement. Among those who lost weight in excess of one pound, the average weight loss was 4.1±3.7 pounds, and among those who gained in excess of one pound, the average weight gain was 5.2±3.9 pounds ($p<0.0001$). Mean differences in weight changes from baseline were significant between groups at every time point. Subjects who lost weight lost an average of 1.8 ± 3.8 pounds of body fat by the final measurement, and subjects who gained weight gained an average of 4.7 ± 6.1 pounds of body fat, and these differences were significant ($p<0.0001$). Significant differences in mean fat mass change were observed between weight change groups at every time point. No significant differences in mean change in fat free mass were observed between weight change groups at any time point until the final measurement. At the final measurement, subjects who had lost weight showed a reduction in fat free mass of 2.2 ± 1.7 pounds, while those who gained weight showed a statistically different change of an increase of 0.5 ± 4.2 pounds ($p=0.015$). Taken together, the results of the fat mass changes and fat free mass changes indicate weight change in subjects was primarily due to changes in fat mass.

Changes in body composition by gender are reported in Table 46 (p. 127). There was no difference between genders in baseline weight or at the final

Table 46: Mean Body Composition Changes By Gender

	Females	Males	p=
Baseline Weight (lbs.)	169.5 ± 64.2 (n=46)	171.8 ± 45.1 (n=26)	NS
Weight Δ 2-1	1.8 ± 3.4 (n=37)	2.9 ± 2.7 (n=25)	NS
Weight Δ 3-1	0.6 ± 4.5 (n=36)	2.1 ± 3.0 (n=23)	NS
Weight Δ 4-1	1.1 ± 3.8 (n=33)	3.5 ± 3.8 (n=18)	0.037
Weight Δ 5-1	0.5 ± 5.7 (n=35)	3.2 ± 4.4 (n=22)	NS
Baseline Fat Mass (lbs.)	61.3 ± 47.9	30.1 ± 27.7	0.003
Fat Mass Δ 2-1	1.6 ± 3.2	2.0 ± 3.7	NS
Fat Mass Δ 3-1	0.4 ± 3.1	1.7 ± 5.0	NS
Fat Mass Δ 4-1	1.2 ± 2.9	1.9 ± 5.3	NS
Fat Mass Δ 5-1	1.0 ± 4.6	3.5 ± 6.9	NS
Baseline Fat Free Mass (lbs.)	108.2 ± 16.8	141.6 ± 22.6	<0.0001
Fat Free Mass Δ 2-1	0.2 ± 2.7	1.0 ± 3.0	NS
Fat Free Mass Δ 3-1	0.2 ± 3.1	0.8 ± 3.7	NS
Fat Free Mass Δ 4-1	-0.1 ± 2.3	1.6 ± 3.0	0.027
Fat Free Mass Δ 5-1	-0.5 ± 2.2	-0.3±4.8	NS

Timing of measurements is defined as: Time 1 (Baseline) = Week 1, Time 2 = Week 4, Time 3 = Week 8, Time 4 = Week 11, Time 5 = Week 14. Changes were calculated as the change from baseline at each particular time point.

Means are reported ± SD. Significance between groups was assessed using independent measures t-tests at a significance level of $p \leq 0.05$.

measurement, however, females showed a significant difference from males in weight change at time point 4 (female = 1.1 ± 3.8 lbs., male 3.5 ± 3.8 lbs., p=0.037). There was a significant difference between genders in baseline fat mass (female = 61.3 ± 47.9, male = 30.1 ± 27.7, p=0.003), but there were no significant differences in mean change in fat mass seen at any other time point. There was a significant difference between genders in baseline fat free mass (female = 108.2 ± 16.8 lbs., males 141.6 ± 22.6, p≤0.0001). While there was no significant difference in change from baseline seen at the final measurement, males showed a significant increase in fat free mass compared to females at time point 4 (female = -0.1 ± 2.3 lbs., male 1.6 ± 3.0 lbs., p=0.037). A mixed between-within analysis of variance was conducted to assess the impact of gender on changes in weight and percentage of body fat variables over time. There was a large main effect for time that was significant for weight change (Wilks Lambda = 0.614, F = 6.119, p<0.001, partial eta squared = 0.386) and for percent body fat (Wilks Lambda = 0.678, F = 4.521, p=0.004, partial eta squared = 0.322). There was no significant interaction effect seen for time and gender on either weight or percentage of body fat.

Mean changes in body composition by baseline BMI category are reported in Table 47 (p. 129). Subjects in these categories showed significantly different measurements at baseline, but no significant differences in changes in any of these variables were seen at any time point. A mixed between-within analysis of variance was conducted to assess the impact of baseline BMI on changes in weight and percentage of body fat variables over time. There was a large main

Table 47: Mean Body Composition Changes By Baseline BMI Category

	Baseline BMI <25	Baseline BMI ≥25	p=
Mean Baseline Weight	135.2 ± 20.3 (n=42)	219.4 ± 57.3 (n=30)	<0.0001
Weight Δ 2-1 (lbs.)	2.2 ± 2.6 (n=40)	2.4 ± 4.0 (n=22)	NS
Weight Δ 3-1	1.4 ± 2.4 (n=37)	0.8 ± 5.9 (n=22)	NS
Weight Δ 4-1	2.0 ± 2.9 (n=33)	1.7 ± 5.4 (n=18)	NS
Weight Δ 5-1	1.3 ± 3.5 (n=36)	2.0 ± 7.6 (n=21)	NS
Mean Baseline Fat Mass	22.1 ± 11.9	89.1 ± 43.1	<0.0001
Fat Mass Δ 2-1 (lbs.)	1.6 ± 2.9	2.1 ± 4.1	NS
Fat Mass Δ 3-1	1.0 ± 2.5	0.8 ± 5.7	NS
Fat Mass Δ 4-1	1.4 ± 2.9	1.5 ± 5.2	NS
Fat Mass Δ 5-1	1.0 ± 3.0	3.6 ± 8.4	NS
Mean Baseline Fat Free Mass	113.1 ± 20.5	130.2 ± 27.3	<0.003
Fat Free Mass Δ 2-1 (lbs.)	0.6 ± 2.5	0.4 ± 3.4	NS
Fat Free Mass Δ 3-1	0.5 ± 2.2	0.2 ± 4.8	NS
Fat Free Mass Δ 4-1	0.6 ± 2.2	0.2 ± 3.3	NS
Fat Free Mass Δ 5-1	0.2 ± 2.5	-1.5 ± 4.5	NS

Timing of measurements is defined as: Time 1 (Baseline) = Week 1, Time 2 = Week 4, Time 3 = Week 8, Time 4 = Week 11, Time 5 = Week 14. Changes were calculated as the change from baseline at each particular time point.

Means are reported ± SD. Significance between groups was assessed using independent measures t-tests at a significance level of $p \leq 0.05$.

effect for time that was significant for weight change (Wilks Lambda = 0.750, F = 3.256, p<0.021, partial eta squared = 0.250) and for percent body fat (Wilks Lambda = 0.688, F = 4.300, p=0.006, partial eta squared = 0.312). There was no significant interaction effect seen for time and baseline BMI category on weight, but a significant interaction effect was seen for time and baseline BMI category on percentage of body fat (Wilks Lambda = 0.759, F = 3.011, p=0.030, partial eta squared = 0.241).

Fasting plasma cholesterol measurements were taken at weeks 2, 8 and 14 of the study period, and these measurements were taken two different ways. Cholestech LDX lipid screening units were used in the residence halls for subjects with unsuccessful attempts at drawing blood intravenously. For the remaining subjects, a sample of blood was extracted from EDTA-containing tubes upon return to the lab from the residence hall and subjected to analysis with Cholestech LDX panels. The other cholesterol assessment method employed a series of standard laboratory-based enzymatic assays using rendered plasma from the collected samples of whole blood. Correlative analysis was done to compare these two measurement techniques. A strong and significant correlation was observed for all variables. In the interest of uniformity of reporting in line with the previous residence hall pilot study, results of measurements of cholesterol variables will use those obtained from the Cholestech screening devices.

Results from measurements of fasting plasma lipid and glucose taken at the three time points and analyzed by breakfast intervention group are presented in Table 48 (p. 132). There were no significant differences between intervention groups in any variables at any time point. A mixed between-within analysis of variance was conducted to assess the impact of breakfast group on changes in fasting plasma cholesterol variables. There was a large main effect for time that was significant for Total Cholesterol (Wilks Lambda = 0.523, F = 17.812, p<0.0001, partial eta squared = 0.477), Triglycerides (Wilks Lambda = 0.716, F = 5.548, p=0.009, partial eta squared = 0.284) and LDL (Wilks Lambda = 0.667, F = 7.000, p=0.003, partial eta squared = 0.333), but not for HDL. There was no significant interaction between intervention type (EB versus NEB) and time on any measured fasting plasma cholesterol parameters.

Analysis of cholesterol variables by baseline BMI category is presented in Table 49 (p. 133). A significant difference between baseline BMI categories was seen only in triglycerides and only at the Week 8 measurement point, where those with a baseline BMI <25 showed lower mean fasting triglycerides (79 ± 5 mg/dL) than those with a baseline BMI of ≥25 (99 ± 9, p=0.047), however this difference was not maintained at Week 14. A mixed between-within analysis of variance was conducted to assess the impact of baseline BMI category on changes in fasting plasma cholesterol variables. There was a large main effect for time that was significant for Total Cholesterol (Wilks Lambda = 0.543, F = 16.4, p<0.0001, partial eta squared = 0.457), Triglycerides (Wilks Lambda = 0.727, F = 5.251, p=0.12, partial eta squared = 0.273) and LDL (Wilks Lambda = 0.654, F = 7.417, p=0.003, partial eta squared = 0.346), but not for HDL. There

Table 48: Time Course of Changes in Fasting Plasma Cholesterol and Glucose By Breakfast Group

	Week 2		Week 8		Week 14	
	EB	NEB	EB	NEB	EB	NEB
Total Cholesterol (mg/dL)	145 ± 22 (n=34)	146 ± 27 (n=28)	152 ± 26 (n=27)	147 ± 26 (n=24)	168 ± 28 (=27)	164 ± 32 (n=21)
Triglycerides (mg/dL)	83 ± 36 (n=32)	92 ± 38 (n=25)	83 ± 27 (n=23)	91 ± 39 (n=20)	96 ± 41 (n=22)	108 ± 51 (n=18)
LDL Cholesterol (mg/dL)	82 ± 19 (n=30)	83 ± 21 (n=23)	86 ± 22 (n=22)	81 ± 18 (n=20)	97 ± 26 (n=22)	93 ± 23 (n=18)
HDL Cholesterol (mg/dL)	48 ± 12 (n=35)	49 ± 14 (n=32)	52 ± 13 (n=28)	51 ± 14 (n=24)	56 ± 13 (n=28)	54 ± 18 (n=22)
TC / HDL Ratio	3.2 ± 1.0 (n=33)	3.1 ± 1.0 (n=28)	3.0 ± 0.7 (n=27)	3.1 ± 0.9 (n=24)	3.1 ± 0.8 (n=27)	3.3 ± 1.3 (n=21)
Glucose (mg/dL)	89 ± 8 (n=20)	86 ± 7 (n=24)	91 ± 11 (n=27)	94 ± 12 (n=24)	105 ± 42 (n=28)	97 ± 9 (n=22)

Cholesterol measurements were taken at weeks 2, 8 and 14 of the study period. Independent samples t-tests revealed no significant differences between study groups in mean TC, LDL, TG and HDL concentrations at any time point.

A mixed between-within analysis of variance was conducted to assess the impact of breakfast group on changes in fasting plasma cholesterol variables. There was a large main effect for time that was significant for Total Cholesterol (Wilks Lambda = 0.523, F = 17.812, p<0.0001, partial eta squared = 0.477), Triglycerides (Wilks Lambda = 0.716, F = 5.548, p=0.009, partial eta squared = 0.284) and LDL (Wilks Lambda = 0.667, F = 7.000, p=0.003, partial eta squared = 0.333), but not for HDL. There was no significant interaction between intervention type (EB versus NEB) and time on any measured fasting plasma cholesterol parameters.

Table 49: Time Course of Changes in Fasting Plasma Cholesterol and Glucose By Baseline BMI Category

	Week 2		Week 8		Week 14	
	BMI <25	BMI ≥25	BMI <25	BMI ≥25	BMI <25	BMI ≥25
Total Cholesterol (mg/dL)	143 ± 21 (n=36)	149 ± 28 (n=26)	149 ± 24 (n=33)	151 ± 30 (n=18)	163 ± 25 (n=30)	172 ± 36 (n=18)
Triglycerides (mg/dL)	85 ± 36 (n=31)	90 ± 39 (n=26)	79 ± 28 [a] (n=26)	99 ± 38 [a] (n=17)	100 ± 56 (n=22)	104 ± 31 (n=18)
LDL Cholesterol (mg/dL)	80 ± 18 (n=28)	85 ± 22 (n=25)	84 ± 18 (n=25)	84 ± 23 (n=17)	94 ± 18 (n=22)	97 ±31 (n=18)
HDL Cholesterol (mg/dL)	50 ± 12 (n=40)	46 ± 14 (n=27)	53 ± 13 (n=34)	49 ± 12 (n=18)	55 ± 15 (n=32)	54 ± 16 (n=18)
TC / HDL Ratio	3.0 ± 0.8 (n=35)	3.4 ± 1.1 (n=26)	2.9 ± 0.8 (n=33)	3.2 ± 0.9 (n=18)	3.2 ± 1.2 (n=30)	3.3 ± 1.0 (n=18)
Glucose mg/dL	85 ± 5 (n=30)	91 ± 10 (n=14)	90 ± 9 (n=33)	97 ± 14 (n=18)	103 ± 40 (n=32)	99 ± 13 (n=18)

[a] Independent samples t-test revealed a significant difference between groups (p=0.047).

A mixed between-within analysis of variance was conducted to assess the impact of baseline BMI category on changes in fasting plasma cholesterol variables. There was a large main effect for time that was significant for Total Cholesterol (Wilks Lambda = 0.543, *F* = 16.4, p<0.0001, partial eta squared = 0.457), Triglycerides (Wilks Lambda = 0.727, *F* = 5.251, p=0.12, partial eta squared = 0.273) and LDL (Wilks Lambda = 0.654, *F* = 7.417, p=0.003, partial eta squared = 0.346), but not for HDL. There was no significant interaction between baseline BMI and time on fasting plasma cholesterol parameters.

Table 50: Time Course of Changes in Fasting Plasma Cholesterol and Glucose by Gender

	Week 2		Week 8		Week 14	
	Female	Male	Female	Male	Female	Male
Total Cholesterol (mg/dL)	150 ± 26 (n=40)	139 ± 18 (n=22)	153 ± 28 (n=30)	145 ± 22 (n=21)	171 ± 32 (n=31)	160 ± 23 (n=17)
Triglycerides (mg/dL)	92 ± 38 (n=36)	79 ± 35 (n=21)	87 ± 38 (n=27)	86 ± 24 (n=16)	106 ± 44 (n=26)	93 ± 49 (n=14)
LDL Cholesterol (mg/dL)	84 ± 22 (n=34)	80 ± 16 (n=19)	84 ± 21 (n=27)	84 ± 18 (n=15)	97 ± 26 (n=26)	92 ± 23 (n=14)
HDL Cholesterol (mg/dL)	51 ± 14 (n=42)	45 ± 11 (n=25)	54 ± 13 (n=30)	48 ± 10 (n=22)	57 ± 17 (n=31)	51 ± 11 (n=19)
TC / HDL Ratio	3.1 ± 1.0 (n=39)	3.2 ± 0.9 (n=22)	3.0 ± 1.0 (n=30)	3.0 ± 0.6 (n=21)	3.2 ± 1.1 (n=31)	3.2 ± 1.1 (n=17)
Glucose mg/dL	86 ± 6 (n=28)	89 ± 10 (n=16)	90 ± 11 (n=29)	95 ± 11 (n=22)	102 ± 40 (n=31)	100 ± 13 (n=19)

Independent samples t-tests revealed no significant differences by gender.

was no significant interaction between baseline BMI and time on fasting plasma cholesterol parameters.

When data were analyzed by gender (Table 50, p. XX), no significant differences were observed.

Discussion

A previous study showed that students living on campus had no significant differences in nutrient or energy intakes compared to students living off campus [49], so the results of this work may be generalized to the entire student population of incoming freshmen.

Forty-six females and 27 males participated in baseline anthropometric measurements. We found significant differences in baseline BMI (females = 27.2 ± 1.3, males = 23.9 ± 1.2), which is inconsistent with previously reported data from Economos and colleagues that showed a sample of freshmen women with mean BMI of 21.5 ± 2.6 and males of 22.7 ± 3.2 [39]. For example, previous data have shown no gender difference in weight gain trends among incoming freshmen during the first semester [7], and based on this, a gender effect was not expected. A significant change from baseline was seen between genders in our sample at Week 11 in both weight change and change in fat free mass (males showed greater positive change), but these differences were no longer evident at Week 14.

Weight change analysis stratified subjects according to categorical variables describing baseline BMI status. Due to the small sample size of 57

Table 50: Time Course of Changes in Fasting Plasma Cholesterol By Gender

	Week 2		Week 8		Week 14	
	Females	Males	Females	Males	Females	Males
Total Cholesterol (mg/dL)	149 ± 26 (n=40)	139 ± 18 (n=22)	153 ± 28 (n=30)	145 ± 23 (n=21)	171 ± 32 (n=31)	159 ± 23 (n=17)
Triglycerides (mg/dL)	92 ± 38 (n=36)	79 ± 35 (n=21)	87 ± 38 (n=27)	86 ± 24 (n=16)	106 ± 44 (n=26)	93 ± 49 (n=14)
LDL Cholesterol (mg/dL)	84 ± 22 (n=34)	80 ± 35 (n=19)	84 ± 21 (n=27)	84 ± 18 (n=15)	97 ± 26 (n=26)	92 ± 23 (n=16)
HDL Cholesterol (mg/dL)	51 ± 13 (n=42)	45 ± 11 (n=25)	54 ± 15 (n=30)	48 ± 10 (n=22)	57 ± 17 (n=31)	51 ± 11 (n=19)
TC / HDL Ratio	3.1 ± 1.0 (n=39)	3.2 ± 0.9 (n=22)	3.0 ± 1.0 (n=30)	3.0 ± 0.6 (n=21)	3.2 ± 1.1 (n=31)	3.2 ± 1.1 (n=17)
Glucose mg/dL	86 ± 29 (n=28)	87 ± 10 (n=16)	90 ± 11 (n=29)	95 ± 11 (n=22)	102 ± 40 (n=31)	100 ± 12 (n=19)

Independent samples t-tests revealed no significant differences between groups.

A mixed between-within analysis of variance was conducted to assess the impact of gender on changes in fasting plasma cholesterol variables. There was a large main effect for time that was significant for Total Cholesterol (Wilks Lambda = 0.543, F = 16.4, p<0.0001, partial eta squared = 0.457), Triglycerides (Wilks Lambda = 0.727, F = 5.251, p=0.12, partial eta squared = 0.273) and LDL (Wilks Lambda = 0.654, F = 7.417, p=0.003, partial eta squared = 0.346), but not for HDL. There was no significant interaction between baseline BMI and time on fasting plasma cholesterol parameters.

subjects completing the final measurement at Week 14, these categories were limited to "BMI <25" and "BMI ≥25" rather than "normal weight" (BMI = 18.5-24.9), "overweight" (BMI = 25-29.9) and "obese" (BMI ≥ 30) as was originally intended. A 15-year prospective study of young adults found that 73.9% increased their BMI, while 16.3% maintained their BMI and 9.8% experienced BMI fluctuations over the study period [57]. Higher baseline BMI categories were associated with a greater likelihood of increasing BMI, and it was hypothesized that a higher baseline BMI would correlate to greater increases in weight over the course of this study. Our results showed no differences in weight or body composition change among those with baseline BMI of < 25 or ≥ 25, which is likely due to the relatively short time duration of this study.

Upon enrollment into the study, subjects were randomized into either the Egg Breakfast (EB) group or the Non-egg Breakfast (NEB) group. Randomization was done using the computerized randomization feature in Blackboard, the online course portal used to disburse the study communications and online materials. All subjects were added to the Blackboard "course" and then the randomization function was used to assign the groups. Because of the randomization method used, the subjects were not weight or BMI matched between groups. Baseline measurements revealed significant differences in the mean weight and BMI of the intervention groups. The egg group had a higher mean weight (31 pounds higher) and mean BMI, and a larger proportion of those in the egg group had baseline BMI values ≥ 25 compared to the non-egg group.

These weight and BMI discrepancies between the groups could have potentially confounded the results, however it should be noted that there were no differences between groups in baseline fasting plasma cholesterol or glucose values.

We consistently observed, however, that the baseline anthropometric differences between intervention groups did not lead to significantly different outcomes. There was no difference between intervention groups in the frequency of breakfasts consumed at dining halls at any time point. There was no significant difference seen between groups in average Calories consumed as assessed by 3-day food records at either baseline or the final collection at Week 14. There was also no difference in body composition changes between the intervention groups at any time point.

In the pilot study, those who did not complete the final anthropometric measurement were found to have higher baseline weights and BMIs. We did not find that to be the case in this study. No significant differences in baseline anthropometric or blood measurements were found between those who attended the final measurement and those who did not. However, those who did not complete the final anthropometric measurement showed a significantly lower mean frequency of breakfast attendance at Week 4 and then from Week 7 onward. This indicates subjects may have decided to reduce or stop participation in the study midway through the semester, which could be due to a variety of reasons. While only one subject formally withdrew from the pilot study, the reason of increased time constraints and increased workload were cited as reasons. This may be one explanation relevant here, as the timing of drop off in breakfast attendance is concurrent with mid-term exams.

Based on the data collected from the pilot study showing mean frequency of breakfast attendance of 2.0 ± 1.4 breakfasts per week, compliance to the requested 5 breakfasts per week was seen as one obstacle to overcome by researchers. Reminders were sent throughout the study in an attempt to keep students participating at a consistent rate throughout the semester. Further, the collection of breakfast cards throughout the study was another means to facilitate consistent attendance at breakfasts. The mean breakfast frequency for all subjects for the entire 14 weeks was 3.8 ± 1.4 breakfasts per week, which is substantially higher than the 2008 pilot reported. This showed good overall compliance with the study instructions. No significant differences in frequency of breakfast attendance were observed between EB or NEB groups at any week during the study. This indicates compliance was consistent between groups.

Conflicting data exist with respect to breakfast consumption and BMI. In children and adolescents, breakfast consumption is associated with a better overall nutritional profile as well as a reduced risk of overweight and obesity, despite greater daily energy intake, compared to those not consuming breakfast [22]. In adults, breakfast consumption is generally but not consistently associated with a decreased risk of overweight [40] [41].Frequency of breakfast consumption has been associated with prevention of weight gain [58], and it was expected that frequency of breakfast consumption would correlate with weight change in this study. It has been shown in a population of adolescents, no differences are found between genders in likelihood to consume breakfast [61]. Consistent with this, we found no significant differences between genders in frequency of breakfasts attended throughout the semester.

We documented frequencies of consumption of specific breakfast items by collecting immediate recalls of breakfast items consumed. This was done in part as another layer of compliance assessment. We found those in the EB group consumed an average of one serving of eggs per day at every collection point (5 throughout the study), which indicated consistent compliance to the study protocol. This was significantly different from the mean egg consumption frequency for the NEB group. It should be noted that at the first collection, the NEB group consumed an average of 0.56 ± 0.21 servings of eggs that week, which was the result of confusion of group assignments. This was immediately rectified, and from each point onward, the mean daily frequency of egg consumption in the NEB group was under 0.1 serving.

Participants were instructed to either consume eggs or not to consume eggs at breakfast. No instructions were given as to what other items to include or what amounts to consume, which was intended to mimic as close as possible a real life scenario. The next question the breakfast cards allowed us to address was whether those who consumed eggs for breakfast were also more likely to choose other items compared to the NEB group. A previous study linked egg consumption to increased body weight [42], but a likely confounder of this data was the combination of eggs with breakfast meats into one categorical variable. We found that subjects in the EB group were no more likely to consume breakfast meats than those in the NEB group. We found only sporadic significant differences in frequencies of item consumption between groups, and no distinct pattern of consumption was apparent between groups. For example, at Week 10, those in the EB group were less likely to consume ready to eat cereal and toast, at Week 13 they were less likely to consume pancakes and fruit. Other than these, no significant differences in item frequencies were reported.

It has been reported that milk, ready to eat cereals and juices are the most readily consumed breakfast items by children and adolescents [11]. We found our data supported this observation. In order of frequency among all subjects, we found juice to be the most frequently consumed item, however, milk and ready to eat cereals were consumed with lower frequency than fruit, potatoes and breakfast meats.

Participants in the National Weight Control Registry, which consists of over 2,900 formerly obese subjects who have maintained weight loss of at least 30 pounds for one year or more, have provided data about breakfast item choices [15]. These subjects report frequent consumption of fruit (not juice) and ready to eat cereal. When analyzing breakfast item frequency data by those who had lost or gained over one pound over the course of the study, no pattern of differences emerged. Instead, only sporadic differences were seen in consumption of breakfast meats at two time points and the consumption of juice at two time points. While it is tempting to conclude that weight change is not associated with any distinct pattern of choice of breakfast items, it is necessary to consider the very limited change in mean weight that was reported by all subjects. It is possible that the sample size is too small to allow for detection of a pattern associated with weight change.

Consumption of ready-to-eat cereal at breakfast has been shown to be associated with a reduced risk of overweight and obesity, while egg consumption has been associated with a greater risk [42]. However, a potential confounding variable in this study is the categorical inclusion of eggs into a "meat/eggs" group, which masks the contributory effects on weight gain to consumption of common breakfast meats such as sausage or bacon, which are more energy dense than eggs. We saw no correlation between frequency of consumption of ready to eat cereals and either baseline BMI or weight change among our sample.

Breakfast cards were also used to quantify nutrient compositions of breakfasts. At baseline, no difference between intervention groups was seen in either Calories consumed or Calories per kilogram consumed, and no significant changes in these variables were seen over time. Subjects consumed an average of 615 Calories (EB) or 591 Calories (NEB) at breakfast, which is comparable to the higher range of breakfast energy intake reported from a sample of 5-18 year old subjects, who reported breakfast energy intakes of 275-669 Calories [11]. Macronutrient composition was different between groups, with those in the egg breakfast group consuming higher amounts of fat, saturated fat, cholesterol and protein. This is in keeping with the nutrient analysis of meals, which were assessed using nutrient information provided by AVI FoodSystems. One serving of scrambled eggs contained 170 Calories, 12 grams of fat, 3.5 grams of saturated fat and 385 mg of cholesterol. Most common breakfast choices for those in the NEB group were pancakes, which had 370 Calories per serving but only 8 grams of fat, no saturated fat and no cholesterol, and ready to eat cereal, which had approximately 115 Calories per serving (depending on the type of cereal), one gram fat, no saturated fat and no cholesterol.

It has been reported that boys tend to have higher intakes of total Calories, carbohydrate, fat and protein intakes at breakfast [11]. When our data were analyzed by gender, no significant differences were seen for any of these variables with the exception of Week 10 where boys consumed more protein. One possible explanation for this difference may be due to the differences in ages of the respective samples. Rampersaud and colleagues report from a sample of 5 to 18 year olds, and data on nutrient intake were not separated by age group. In a sample of Spanish children, it was shown that there was no difference in macronutrient intake between males and females aged 18-24 years old [62].

When breakfast nutrient data was analyzed by baseline BMI status, we found those in the BMI < 25 category consumed significantly more Calories per kilogram body weight compared to those in the BMI ≥ 25 category, and this difference was maintained throughout the study. Interestingly, we saw no difference in average daily Calorie intake between these two groups in analysis of 3-day food records. Further, no differences were seen between these two groups in body composition changes over the course of the semester.

Some studies have reported significant associations between body weight and breakfast intake [59] [63], but this association is not consistent among all reported data [64]. Our study showed those who gained greater than one pound over the course of the 14-week study consumed more Calories at breakfast on average and more Calories per kilogram body weight at three of the five time points (Weeks 4, 7 and 10). These differences in energy intake were not seen in results from analysis of 3-day diet records however, and no significant differences in mean daily energy intake were seen between these groups. This result is likely due to the inadequate sensitivity of an averaged, self- reported 3-day food record to detect the small differences in Calorie intake that could result in the narrow delimiter of weight change category designations. Similar results showing a failure to account for small differences in weight change have been reported elsewhere. Use of three-day food records to assess changes in energy intake and weight changes showed significant decreases in energy intake among both female freshmen who lost weight and those who gained weight over the course of a one year period [65].

Analysis of three-day food records showed significant differences between intervention groups, with EB subjects reporting higher mean intakes of saturated fat and cholesterol and NEB subjects reporting higher mean intakes of carbohydrates at baseline, but these differences were not apparent at the final food diary collection at week 14. This result may be due to the lack of sensitivity of a three-day averaged food record to detect slight differences in intake over time. Further, the quality of food diaries collected was highly variable. While subjects were uniformly instructed as to how to maintain food records and shown examples of the types of information to include, these efforts did not yield uniformly meticulous records from subjects. It has been shown that younger subjects are less likely to underreport energy intake than older subjects and that those with higher BMI values tend to underreport energy intake in 4-day averaged food records [66].

There is much disagreement in the literature surrounding weight change among incoming college freshmen [38], with reported studies varying widely in sample sizes, timing of measurements and measurement collection techniques. A significant mean weight change of 1.6 ± 5.3 pounds was observed for all subjects in this study who completed the final anthropometric measurement at Week 14 of the study. This is somewhat lower than what we observed in the pilot study conducted the previous year showing a mean weight change of 2.9 ± 4.6 pounds. Because the lower mean weight change was seen in the breakfast intervention study where subjects consumed breakfast with higher mean frequency than students in the previous year's observation study, it is tempting to conclude that breakfast attendance may be a contributing factor to the lower mean weight change seen in the intervention study. However, these results should be interpreted with caution, as we saw no significant correlation between breakfast consumption frequency and weight change among either the observation pilot sample or the breakfast intervention sample.

Among studies reporting weight change after only one semester, the mean weight change reported by subjects in this study are similar but comparatively low. Anderson and colleagues reported a mean weight change of 2.86 pounds among a sample of 135 males and females [7]. Other studies reported only changes in body weight among female subjects. Hovell and colleagues reported a mean weight gain of 2.9 pounds among females after one semester [67]. Higher mean weight gains among samples of freshmen women have been reported by Levitsky (4.2 pounds) [68] and Matvienko (3.96 pounds) [45].

Reported data regarding BMI status and weight change is inconsistent. It has been previously shown that a higher baseline BMI was associated with greater weight gain in a among college freshmen. Those subjects with baseline BMI values < 25 kg/m^2 gained an average of six pounds compared to those with baseline BMI values ≥ 25 kg/m^2 who gained an average of 10 pounds over a one year period [8]. Another study showed those with higher starting BMIs maintained their weight, while those with lower baseline BMIs gained weight [69]. In another study examining changes in body mass over the course of the freshmen year, no difference in weight change was seen among baseline BMI categories [70]. We saw no association between baseline BMI status and weight change in our sample.

While most published data regarding weight change in the freshmen year uses female subjects, and only one study including men in the sample found a difference between genders in weight change, although measurements were self-reported [71]. We observed no significant differences between genders in weight or body composition changes from baseline to the end of the 14-week study period.

Because increases in weight in and of itself are do not necessarily increase risk for chronic disease, it is necessary to look at changes in body composition as well. Increases in fat mass and decreases in fat free mass are patterns most associated with increased risk of chronic disease over time, and we used bioelectrical impedance to assess changes in fat mass and fat free mass over the course of the study period. It has been previously reported that in a sample of female freshmen, among those who gained weight, this was seen in increased percentage of body fat, and those who lost weight showed a decreased percentage of body fat [65]. In a sample of men and women, of those who gained weight, the increase was seen in both fat mass and fat free mass [7]. Our data are inconsistent with these findings in that only a significant increase from baseline in fat mass was seen in subjects who gained weight. Among those who lost weight, decreases in both fat mass and fat free mass were observed, with a larger change in the fat free mass.

This study aimed to assess differences in weight change between those who consumed eggs regularly at breakfast and those who did not. It was intended to build on previous data that showed eggs to be associated with reduced energy intake and weight loss. In a sample of overweight and obese subjects, an egg breakfast resulted in increased satiety and lower energy intake at lunch as well as at 24 hours and 36 hours compared to an isocaloric bagel breakfast [21]. In a follow-up study conducted over eight weeks, it was shown that the egg breakfast in combination with energy restriction resulted in a 65% greater weight loss compared to an isocaloric bagel breakfast in combination with energy restriction.

In this study, logistical constraints prevented feeding subjects in each intervention group identical breakfasts. Instead, the study design intended to document the "real life" effects of including eggs with breakfast or not including them. Despite these relatively unrestricted instructions, no differences in energy intake per kilogram body weight were seen between intervention groups.

One aim of this study was to document changes in fasting plasma cholesterol and glucose variables and determine any changes that may result from the increase in dietary cholesterol from the egg breakfast intervention. Previous evidence shows consumption of dietary cholesterol by healthy adults does not have a deleterious effect on biomarkers of CVD risk and may serve to promote a cardioprotective lipoprotein profile [43]. Eggs are a source of cholesterol in the American diet, and one egg contains approximately 212-300 mg of cholesterol [23]. Because of their high cholesterol content, eggs were quickly maligned as contributors to heart disease as a result of the "diet-heart hypothesis" in the early 1960's. This was based on the observations that dietary cholesterol increased circulating plasma cholesterol and that diets higher in cholesterol were associated with greater risk of heart disease, although there was a distinct absence of quality empirical data supporting this at the time [72].

As early as 1985, a review of the data to that time failed to show an association between either dietary cholesterol or egg consumption with serum cholesterol or heart disease outcomes [23]. Dawber and colleagues report no differences in serum cholesterol between all subjects and those whose mean daily dietary cholesterol intake was greater than 300 mg/day. At that time, mean egg consumption for men was 5.9 eggs per week 3.8 eggs per week for women. Despite the lack of evidence supporting the association between egg consumption and increased plasma cholesterol or increased heart disease risk, the recommendation to reduce egg consumption continued [73].

In 2000, Song and colleagues showed no increase in heart disease risk due to egg consumption. In fact, they reported a negative association between egg consumption and plasma cholesterol concentrations. They showed that those subjects consuming more than four eggs per week had lower mean plasma cholesterol than those eating one or fewer than one egg per week [74]. In a review of evidence published in 2000, McNamara calculated the predicted effect of the reduction in yearly egg consumption from 231 eggs in 1960 to 235 eggs in 1995 on total plasma cholesterol levels would be 1.1 mg/dL [75]. Further, the potential effects on LDL and HDL cholesterol were estimated. Adding one egg per day to the diet was estimated to increase LDL by 4.1 mg/dL increase HDL by 0.9 mg/dL.

In accordance with previously published literature, it was hypothesized that subjects in the egg breakfast group would not exhibit deleterious changes in plasma cholesterol during the study period. In our study comparing those who consumed eggs for breakfast and those who did not consume eggs for breakfast, there were no differences seen in any plasma cholesterol variable at baseline or at Week 8 or Week 14 of the study period.

Weight loss has been associated with decreases in plasma cholesterol, and it has been shown that mean weight loss of 9.5 pounds in women and 10.3 pounds in men was associated with 3% and 14% reductions in total cholesterol and 3% and 13% reductions in LDL cholesterol among these respective gender groups [76]. No significant difference in any fasting plasma cholesterol parameter was observed among those subjects who lost greater than one pound. This is likely due to the small change in weight seen over the course of the semester.

Young adulthood is a critical life stage and point at which an intervention to attenuate weight gain could be most effective. Curbing weight gain in an ethnically diverse young adult population through an intervention of an egg breakfast could have significant implications on public health. It has been shown that higher BMI values throughout life are associated with substantially higher Medicare expenditures in later life [5], which illustrates the urgency in reducing the increasing healthcare burden posed by obesity. While it is now known that dietary cholesterol does not negatively impact CVD risk in healthy populations, the unwarranted stigma on eggs remains. Per capita consumption of shell eggs has exhibited a negative trend over the past 30 years[74], which parallels previous dietary recommendations to limit cholesterol intake. Eggs are an economic, convenient and nutrient-dense food choice. As a firmly established breakfast tradition [74], eggs represent an ideal dietary intervention to curb weight gain. Despite the positive nutritional attributes of eggs, their consumption at breakfast is lowest among 18 to 40 year olds [77]. Reintroducing eggs as an integral part of a healthy, long-term weight maintenance strategy as has been done here, should serve be a positive step toward reestablishing eggs as the hallmark of a healthy breakfast as well as a healthy lifestyle.

Appendix A: Supplementary Breakfast Item Frequency Data Gender

Mean Daily Frequency of Breakfast Item Servings Consumed by Gender

	Gender	N	Mean	Std. Deviation
Eggs1	Female	40	0.52	0.50
	Male	21	0.60	0.49
RTEcereal1	Female	40	0.28	0.34
	Male	21	0.13	0.28
HOTcereal1	Female	40	0.11	0.29
	Male	21	0.07	0.19
Pancakes1	Female	40	0.30	0.45
	Male	21	0.30	0.36
Meats1	Female	40	0.37	0.43
	Male	21	0.38	0.41
Potatoes1	Female	40	0.38	0.44
	Male	21	0.43	0.44
Toast1	Female	40	0.17	0.30
	Male	21	0.30	0.39
Pastries1	Female	40	0.11	0.23
	Male	21	0.17	0.33
Juice1	Female	40	0.75	0.55
	Male	21	0.59	0.47
Milk1	Female	40	0.27	0.37
	Male	21	0.37	0.44
Fruit1	Female	40	0.63	0.62
	Male	21	0.57	0.61
Yogurt1	Female	40	0.20	0.36
	Male	21	0.29	0.41
Eggs2	Female	36	0.53	0.51
	Male	22	0.56	0.53
RTEcereal2	Female	36	0.29	0.42
	Male	22	0.29	0.40
HOTcereal2	Female	36	0.13	0.31
	Male	22	0.13	0.31
Pancakes2	Female	36	0.37	0.47
	Male	22	0.47	0.47
Meats2	Female	36	0.37	0.47
	Male	22	0.50	0.57
Potatoes2	Female	36	0.46	0.45
	Male	22	0.36	0.44
Toast2	Female	36	0.16	0.31
	Male	22	0.19	0.27
Pastries2	Female	36	0.24	0.58
	Male	22	0.15	0.32
Juice2	Female	36	0.71	0.71
	Male	22	0.87	0.70
Milk2	Female	36	0.33	0.41
	Male	22	0.36	0.44

Fruit2	Female	36	0.14	0.31
	Male	22	0.36	0.58
Yogurt2	Female	36	0.16	0.32
	Male	22	0.28	0.50
Eggs3	Female	35	0.51	0.51
	Male	20	0.60	0.50
RTEcereal3	Female	35	0.29	0.37
	Male	20	0.17	0.33
HOTcereal3	Female	35	0.10	0.24
	Male	20	0.11	0.26
Pancakes3	Female	35	0.31	0.45
	Male	20	0.32	0.35
Meats3	Female	35	0.50	0.44
	Male	20	0.38	0.42
Potatoes3	Female	35	0.44	0.43
	Male	20	0.52	0.48
Toast3	Female	35	0.18	0.32
	Male	20	0.39	0.44
Pastries3	Female	35	0.20	0.31
	Male	20	0.12	0.27
Juice3	Female	35	0.74	0.51
	Male	20	0.68	0.38
Milk3	Female	35	0.29	0.39
	Male	20	0.43	0.49
Fruit3	Female	35	0.47	0.52
	Male	20	0.48	0.52
Yogurt3	Female	35	0.20	0.38
	Male	20	0.33	0.47
Eggs4	Female	34	0.49	0.50
	Male	20	0.55	0.51
RTEcereal4	Female	34	0.24	0.38
	Male	20	0.24	0.38
HOTcereal4	Female	34	0.09	0.29
	Male	20	0.11	0.28
Pancakes4	Female	34	0.35	0.40
	Male	20	0.48	0.45
Meats4	Female	34	0.36	0.43
	Male	20	0.62	0.64
Potatoes4	Female	34	0.60	0.48
	Male	20	0.49	0.43
Toast4	Female	34	0.16	0.33
	Male	20	0.18	0.33
Pastries4	Female	34	0.23	0.44
	Male	20	0.19	0.33
Juice4	Female	34	0.69	0.68
	Male	20	0.76	0.49
Milk4	Female	34	0.31	0.42
	Male	20	0.31	0.41
Fruit4	Female	34	0.10	0.24

	Male	20	0.29	0.47
Yogurt4	Female	34	0.16	0.29
	Male	20	0.27	0.52
Eggs5	Female	34	1.49	0.71
	Male	20	1.65	0.75
RTEcereal5	Female	34	0.44	0.45
	Male	20	0.65	0.44
HOTcereal5	Female	34	0.42	0.38
	Male	20	0.44	0.38
Pancakes5	Female	34	0.56	0.53
	Male	20	0.91	0.80
Meats5	Female	34	1.26	1.12
	Male	20	1.44	0.94
Potatoes5	Female	34	0.25	0.33
	Male	20	0.25	0.28
Toast5	Female	34	0.38	0.43
	Male	20	0.64	0.65
Pastries5	Female	34	0.50	0.51
	Male	20	0.60	0.45
Juice5	Female	34	1.26	0.29
	Male	20	1.38	0.47
Milk5	Female	34	0.42	0.52
	Male	20	0.49	0.34
Fruit5	Female	34	0.66	0.55
	Male	20	0.91	0.73
Yogurt5	Female	34	0.51	0.56
	Male	20	0.64	0.48

** Independent samples t-tests revealed significant differences, $p<0.05$.

Appendix B: Supplementary Breakfast Item Frequency Data Weight Change Group

Mean Daily Frequency of Breakfast Item Servings Consumed by Weight Change Group

	Wt. Ch. Grp.	N	Mean	Std. Deviation
Eggs1	Lost Weight	16	0.69	0.48
	Gained Weight	26	0.60	0.49
RTEcereal1	Lost Weight	16	0.19	0.27
	Gained Weight	26	0.25	0.34
HOTcereal1	Lost Weight	16	0.15	0.34
	Gained Weight	26	0.06	0.17
Pancakes1	Lost Weight	16	0.24	0.36
	Gained Weight	26	0.22	0.29
Meats1	Lost Weight	16	0.16	0.31
	Gained Weight	26	0.47	0.42
Potatoes1	Lost Weight	16	0.26	0.42
	Gained Weight	26	0.51	0.45
Toast1	Lost Weight	16	0.24	0.38
	Gained Weight	26	0.15	0.28
Pastries1	Lost Weight	16	0.17	0.30
	Gained Weight	26	0.18	0.32
Juice1	Lost Weight	16	0.53	0.44
	Gained Weight	26	0.75	0.52
Milk1	Lost Weight	16	0.28	0.37
	Gained Weight	26	0.32	0.41
Fruit1	Lost Weight	16	0.78	0.69
	Gained Weight	26	0.54	0.55
Yogurt1	Lost Weight	16	0.29	0.42
	Gained Weight	26	0.33	0.41
Eggs2	Lost Weight	15	0.67	0.49
	Gained Weight	27	0.57	0.52
RTEcereal2	Lost Weight	15	0.18	0.38
	Gained Weight	27	0.31	0.41
HOTcereal2	Lost Weight	15	0.17	0.36
	Gained Weight	27	0.10	0.28
Pancakes2	Lost Weight	15	0.34	0.42

	Gained Weight	27	0.51	0.50
Meats2	Lost Weight	15	0.23	0.42
	Gained Weight	27	0.41	0.53
Potatoes2	Lost Weight	15	0.29	0.42
	Gained Weight	27	0.49	0.44
Toast2	Lost Weight	15	0.22	0.37
	Gained Weight	27	0.12	0.17
Pastries2	Lost Weight	15	0.37	0.78
	Gained Weight	27	0.16	0.39
Juice2	Lost Weight	15	0.42	0.52
	Gained Weight	27	0.89	0.73
Milk2	Lost Weight	15	0.28	0.43
	Gained Weight	27	0.31	0.42
Fruit2	Lost Weight	15	0.13	0.35
	Gained Weight	27	0.33	0.53
Yogurt2	Lost Weight	15	0.19	0.36
	Gained Weight	27	0.24	0.47
Eggs3	Lost Weight	14	0.64	0.50
	Gained Weight	24	0.63	0.49
RTEcereal3	Lost Weight	14	0.20	0.32
	Gained Weight	24	0.23	0.34
HOTcereal3	Lost Weight	14	0.07	0.19
	Gained Weight	24	0.09	0.24
Pancakes3	Lost Weight	14	0.26	0.40
	Gained Weight	24	0.26	0.30
Meats3	Lost Weight	14	0.24	0.35
	Gained Weight	24	0.51	0.42
Potatoes3	Lost Weight	14	0.35	0.42
	Gained Weight	24	0.57	0.47
Toast3	Lost Weight	14	0.23	0.39
	Gained Weight	24	0.23	0.37
Pastries3	Lost Weight	14	0.24	0.32
	Gained Weight	24	0.19	0.30
Juice3	Lost Weight	14	0.50	0.50
	Gained	24	0.81	0.37

	Weight			
Milk3	Lost Weight	14	0.27	0.40
	Gained Weight	24	0.40	0.46
Fruit3	Lost Weight	14	0.56	0.59
	Gained Weight	24	0.44	0.46
Yogurt3	Lost Weight	14	0.37	0.46
	Gained Weight	24	0.31	0.45
Eggs4	Lost Weight	14	0.64	0.50
	Gained Weight	26	0.53	0.50
RTEcereal4	Lost Weight	14	0.13	0.29
	Gained Weight	26	0.26	0.38
HOTcereal4	Lost Weight	14	0.14	0.36
	Gained Weight	26	0.08	0.25
Pancakes4	Lost Weight	14	0.23	0.27
	Gained Weight	26	0.48	0.44
Meats4	Lost Weight	14	0.29	0.43
	Gained Weight	26	0.45	0.50
Potatoes4	Lost Weight	14	0.50	0.44
	Gained Weight	26	0.60	0.47
Toast4	Lost Weight	14	0.13	0.29
	Gained Weight	26	0.14	0.25
Pastries4	Lost Weight	14	0.26	0.46
	Gained Weight	26	0.22	0.42
Juice4	Lost Weight	14	0.55	0.54
	Gained Weight	26	0.88	0.71
Milk4	Lost Weight	14	0.23	0.39
	Gained Weight	26	0.26	0.36
Fruit4	Lost Weight	14	0.04	0.13
	Gained Weight	26	0.22	0.40
Yogurt4	Lost Weight	14	0.15	0.30
	Gained Weight	26	0.27	0.48
Eggs5	Lost Weight	14	1.55	0.71
	Gained Weight	26	1.66	0.76
RTEcereal5	Lost Weight	14	0.43	0.39
	Gained Weight	26	0.56	0.45

HOTcereal5	Lost Weight	14	0.45	0.45
	Gained Weight	26	0.37	0.32
Pancakes5	Lost Weight	14	0.42	0.32
	Gained Weight	26	0.77	0.64
Meats5	Lost Weight	14	1.62	0.94
	Gained Weight	26	1.35	1.05
Potatoes5	Lost Weight	14	0.32	0.41
	Gained Weight	26	0.25	0.30
Toast5	Lost Weight	14	0.40	0.35
	Gained Weight	26	0.49	0.45
Pastries5	Lost Weight	14	0.54	0.34
	Gained Weight	26	0.64	0.59
Juice5	Lost Weight	14	1.40	0.28
	Gained Weight	26	1.26	0.35
Milk5	Lost Weight	14	0.49	0.26
	Gained Weight	26	0.48	0.60
Fruit5	Lost Weight	14	0.50	0.36
	Gained Weight	26	0.76	0.50
Yogurt5	Lost Weight	14	0.43	0.38
	Gained Weight	26	0.64	0.65

** Independent samples t-tests revealed significant differences, $p<0.05$.

Appendix C: Modified Block Food Frequency Questionnaire Administered Online

1. Please type your Wayne State Access ID (xx1234) in the space below.

Answer:

2. How many days last week did you eat PANCAKES, WAFFLES or POP TARTS?

 a. None
 b. 1 day
 c. 2 days
 d. 3-4 days
 e. 5-6 days
 f. Every day

3. In ONE DAY, how many PANCAKES, WAFFLES or POP TARTS did you eat?

 a. 1/2
 b. 1
 c. 2
 d. 3
 e. 4 or more
 f. None

4. How many days last week did you eat GRANOLA BARS or BREAKFAST BARS?

 a. None
 b. 1 day
 c. 2 days
 d. 3-4 days
 e. 5-6 days
 f. Every day

5. In ONE DAY, how many GRANOLA BARS or BREAKFAST BARS did you eat?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more
f. None

6. How many days last week did you eat EGGS or BREAKFAST SANDWICHES LIKE EGG McMUFFINS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

7. How many EGGS do you usually eat in 1 day?

a. Just a bite
b. 1 egg
c. 2 eggs
d. 3 eggs
e. Zero eggs

8. How many days last week did you eat BACON or SAUSAGE?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

9. How many days last week did you eat COOKED CEREAL like OATMEAL or GRITS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

10. How many days last week did you eat COLD CEREAL like Corn Flakes, Frosted Flakes, or any other kind?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

11. When you ate sweet cereal, which kind did you eat? (Mark the one you ate the MOST of.)

a. Sweet cereals like Frosted Flakes or Froot Loops
b. Plain cereals like Corn Flakes, Cheerios or Rice Krispies
c. Fiber cereals like Raisin Bran or Shredded Wheat
d. Fortified cereals like Total or Product 19
e. Granola cereals
f. I do not eat sweet cereals.

12. How often do you have milk on cereals?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

13. How many days last week did you eat BANANAS

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

14. How many BANANAS do you usually have in 1 day?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more
f. None

15. How many days last week did you eat APPLES or PEARS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

16. How many APPLES or PEARS do you usually have in 1 day?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more
f. None

17. How many days last week did you eat ORANGES or TANGERINES? (DO NOT count juices.)

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

18. How many ORANGES or TANGERINES do you eat in 1 day?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more
f. None

19. How many days last week did you eat STRAWBERRIES or OTHER BERRIES?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

20. How many days last week did you eat APPLESAUCE, FRUIT COCKTAIL, or PINEAPPLE SLICES?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

21. How many days last week did you eat ANY OTHER FRUIT like GRAPES, PEACHES, WATERMELON, CANTALOUPE, or FRUIT ROLL-UPS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

22. How many days last week did you eat HAMBURGERS or CHEESEBURGERS, at home or from a fast food restaurant?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

23. In ONE DAY, how many HAMBURGERS or CHEESEBURGERS do you usually eat?

a. 1/2 of a small burger
b. 1 small burger
c. 1 large burger
d. 2 large burgers
e. None

24. Which kind do you usually eat? (Choose the one you eat most often.)

a. Hamburgers
b. Cheeseburgers
c. None

25. How many days last week did you eat TACOS, BURRITOS, or ENCHALADAS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

26. In ONE DAY, how many TACOS, BURRITOS, or ENCHILADAS do you usually eat?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more
f. None

27. Which kind of TACOS, BURRITOS, or ENCHALADAS to you usually eat? (Choose the one you eat most often.)

a. With meat or chicken
b. Without meat or chicken

28. How many days last week did you eat HOT POCKETS, MEATBALL SUBS, or SLOPPY JOES?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

29. How many days last week did you eat ROAST BEEF or STEAK?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

30. How many days last week did you eat HAMBURGER HELPER, BEEF & NOODLES, BEEF STEW, or any other BEEF dishes?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

31. How many days last week did you eat PORK CHOPS, RIBS, or COOKED HAM?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

32. How many days last week did you eat FRIED CHICKEN, including CHICKEN NUGGETS, from home of from a restaurant like KFC?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

33. How many days last week did you eat any other kind of CHICKEN, like ROASTED CHICKEN, CHICKEN STEW, or CHICKEN HELPER?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

34. How many days last week did you eat any kind of FISH, like FISH SANDWICH, FISH STICKS, or SHRIMP or TUNA?

a. None
b. 1 day
c. 2 days

d. 3-4 days
e. 5-6 days
f. Every day

35. How many days last week did you eat SPAGHETTI, RAVIOLI, or LASAGNA WITH TOMATO SAUCE?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

36. How many days last week did you eat MACARONI & CHEESE?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

37. How many days last week did you eat PIZZA or PIZZA POCKETS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

38. In ONE DAY, how many slices of PIZZA did you usually eat?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more
f. None

39. How many days last week did you eat HOT DOGS or CORN DOGS?

a. None
b. 1 day
c. 2 days

d. 3-4 days
e. 5-6 days
f. Every day

40. In ONE DAY, how many HOT DOGS or CORN DOGS did you usually eat?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more

41. How many days last week did you eat LUNCH MEAT, like sliced BOLOGNA, CHICKEN, HAM? (Remember sandwiches and Lunchables.)

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

42. In ONE DAY, how many slices of LUNCH MEAT did you usually eat?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more
f. None

43. How many days last week did you eat REFRIED BEANS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

44. How many days last week did you eat VEGETABLE SOUP, BEEF or CHICKEN VEGETABLE SOUP, or TOMATO SOUP?

a. None
b. 1 day
c. 2 days

d. 3-4 days
e. 5-6 days
f. Every day

45. How many days last week did you eat ANY OTHER SOUP like CHICKEN NOODLE, Cup-A-Soup, RAMEN NOODLES, or MENUDO, POSOLE?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

46. How many days last week did you eat BISCUITS or MUFFINS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

47. In ONE DAY, how many BISCUITS or MUFFINS did you usually eat?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more
f. None

48. How many days last week did you eat <u>WHOLE WHEAT</u> BREAD or <u>WHOLE WHEAT</u> ROLLS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

49. In ONE DAY, how many slices of WHOLE WHEAT BREAD or how many WHOLE WHEAT ROLLS did you usually eat?

a. 1

b. 2
c. 3-4
d. 5 or more
e. None

50. How many days last week did you eat WHITE BREAD, TOAST or ROLLS, including SANDWICHES or BAGLES?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

51. In ONE DAY, how many slices of WHITE BREAD, TOAST or ROLLS did you usually eat?

a. 1
b. 2
c. 3-4
d. 5 or more

52. How many days last week did you eat TORTILLAS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

53. In ONE DAY, how many TORTILLAS do you usually eat?

a. 1
b. 2
c. 3-4
d. 5 or more
e. None

54. How many days last week did you eat MARGARINE or BUTTER, like on bread, or on pancakes, or on potatoes?

a. None
b. 1 day
c. 2 days

d. 3-4 days
e. 5-6 days
f. Every day

55. How many days last week did you eat CHEESE? (Remember cheese in sandwiches, on pizza.)

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

56. On average, how many slices of CHEESE did you eat each day?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more
f. None

57. How many days last week did you eat MAYONNAISE or SANDWICH SPREAD?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

58. How many days last week did you eat a PEANUT BUTTER SANDWICH?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

59. On the days you ate a PEANUT BUTTER SANDWICH, how many did you eat?

a. 1/2

b. 1
c. 2
d. 3
e. 4 or more
f. I did not eat a peanut butter sandwich.

60. How many days last week did you eat JELLY or JAM?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

61. How many days last week did you eat SUNFLOWER SEEDS, PEANUTS or NUTS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

62. How many days last week did you eat SALAD with LETTUCE, a GREEN SALAD?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

63. How many days last week did you eat SALAD DRESSING?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

64. How many days last week did you eat GREEN BEANS, STRING BEANS, or PEAS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

65. How many days last week did you eat PINTO BEANS, BLACK BEANS, CHILI with BEANS, or BEAN BURRITOS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

66. How many days last week did you eat CORN or CORN ON THE COB?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

67. How many days last week did you eat TIOMATOES, including on salad?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

68. In ONE DAY, how many TOMATOES did you usually eat?

a. 1/2
b. 1
c. 2
d. 3
e. None

69. How many days last week did you eat GREENS, like COLLARDS, MUSTARD GREENS or SPINACH?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

70. How many days last week did you eat BROCCOLI?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

71. How many days last week did you eat CARROTS, CARROT STICKS, or COOKED CARROTS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

72. How many days last week did you eat SWEET POTATOES or SWEET POTATO PIE?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

73. How many days last week did you eat FRENCH FRIES, TATOR TOTS, HASH BROWNS, or HOME FRIES?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

74. How many days last week did you eat ANY OTHER KIND OF POTATOES, like MASHED, BAKED or BOILED?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

75. How many days last week did you eat ANY OTHER VEGETABLES, like SQUASH, CAULIFLOWER, or GREEN or RED PEPPERS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

76. How many days last week did you eat RICE, including FRIED RICE, SPANISH RICE, RICE & BEANS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

77. How many days last week did you eat KETCHUP, SALSA, or BARBEQUE SAUCE?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

78. How many days last week did you eat SNACK CHIPS, like POTATO CHIPS, TORTILLA CHIPS, POPCORN, or BUGLES?

a. None
b. 1 day

c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

79. How many days last week did you eat CRACKERS, including SNACK CRACKERS like CHEEZ-ITS, RITZ BITZ, or GOLDFISH?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

80. How many days last week did you eat NACHOS WITH CHEESE?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

81. How many days last week did you eat ICE CREAM, ICE CREAM BARS, or FROZEN YOGURT?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

82. How many days last week did you eat COOKIES?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

83. In ONE DAY, how many cookies did you usually eat?

a. 1

b. 2-3
c. 4-5
d. 6
e. None

84. How many days last week did you eat DONUTS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

85. In ONE DAY, how many DONUTS did you usually eat?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more
f. None

86. How many days last week did you eat CAKE, CUPCAKES, HO-HO's, TWINKIES?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

87. In ONE DAY, how many pieces of CAKE, HO-HO's or TWINKIES did you usually eat?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more
f. None

88. How many days last week did you eat PIE, FRUIT PIE, FRUIT CRISP, COBBLER?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

89. In ONE DAY, how many pieces of PIE, FRUIT PIE, FRUIT CRISP or COBBLER did you usually eat?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more
f. None

90. How many days last week did you eat CHOCOLATE CANDY BARS?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

91. In ONE DAY, how many CHOCOLATE CANDY BARS did you usually eat?

a. 1 small
b. 1 medium
c. 1 large
d. 2 large
e. 3 or more
f. None

92. How many days last week did you eat ANY OTHER CANDY (NOT CHOCOLATE), like SKITTLES, STARBURST, LIFESAVERS or GUM?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

93. In ONE DAY, how many PACKAGES of OTHER CANDY (NOT CHOCOLATE) did you usually eat?

a. 1/4
b. 1/2
c. 1
d. 2
e. None

94. How many days last week did you drink CHOCOLATE MILK, HOT CHOCOLATE, or COCOA?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

95. How many glasses of CHOCOLATE MILK, HOT CHOCOLATE or COCOA did you usually drink EACH DAY?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more
f. None

96. How many days last week did you drink MILK (not chocolate)? (DO NOT count milk on cereal.)

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

97. How many glasses of MILK (not chocolate) did you usually drink EACH DAY?

a. 1/2
b. 1
c. 2
d. 3
e. 4 or more

f. None

98. What kind of MILK do you usually drink?

a. Whole milk
b. Reduced fat (2%) milk
c. Low-fat (1%) milk
d. Non-fat milk
e. Lactaid milk
f. Soy Milk
g. Rice milk
h. Don't know
i. I don't drink milk.

99. How many days last week did you drink SODAS like COKE, DR. PEPPER, 7-UP, SPRITE, SUNKIST, or ORANGE CRUSH? (DO NOT count diet sodas.)

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

100. How many CANS or BOTTLES of SODA POP did you usually drink in ONE DAY?

a. 1/2
b. 1
c. 2
d. 3-4
e. 5 or more
f. Zero

101. What size SODA POP do you usually drink?

a. 12 ounce can
b. 20 ounce bottle
c. more than 20 ounces

102. How many days last week did you eat SLURPEES, SNO-CONES, POPSICLES?

a. None
b. 1 day
c. 2 days

d. 3-4 days
e. 5-6 days
f. Every day

103. How many days last week did you drink , HAWAIIAN PUNCH, KOOL-AID, SUNNY DELIGHT, GATORADE, ICED TEA, or SNAPPLE?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

104. In ONE DAY, how many glasses of HAWAIIAN PUNCH, KOOL-AID, SUNNY DELIGHT, GATORADE, ICED TEA, or SNAPPLE did you usually drink?

a. 1
b. 2
c. 3
d. 4
e. Zero

105. How many days last week did you drink HI-C, TANG, TAMPICO, or MR. JUICY?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

106. In ONE DAY, how many glasses of HI-C, TANG, TAMPICO, or MR. JUICY did you usually drink?

a. 1
b. 2
c. 3
d. 4
e. Zero

107. How many days last week did you drink REAL ORANGE JUICE? (DO NOT count SUNKIST or other orange beverages.)

a. None

b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

108. In ONE DAY, how many glasses of REAL ORANGE JUICE did you usually drink?

a. 1
b. 2
c. 3
d. 4
e. Zero

109. How many days last week did you drink ANY OTHER REAL FRUIT JUICES, like APPLE JUICE or GRAPE JUICE?

a. None
b. 1 day
c. 2 days
d. 3-4 days
e. 5-6 days
f. Every day

110. In ONE DAY, how many glasses of ANY OTHER REAL JUICE did you usually drink?

a. 1
b. 2
c. 3
d. 4

111. How many days last week did you consume alcoholic beverages?

a. None
b. One day
c. Two days
d. 3-4 days
e. 5-6 days
f. Every day

112. In ONE DAY, how many alcoholic beverages do you usually drink?

a. 1
b. 2

c. 3-4
d. 5-6
e. 7 or more
f. Zero

113. In the past week, did you take any VITAMIN PILLS, like ONE-A-DAY or CENTRUM?

a. Yes
b. No

114. If you took VITAMIN PILLS in the last week, on how many days did you take one?

a. 1-2
b. 3-4
c. 5-6
d. 7

115. During the PAST 7 DAYS, on how many days were you physically active for a total of at least 60 minutes? (Add up all the time you spend in any kind of physical activity that increases your heart rate and makes you breathe hard some of the time.)

a. 0 days
b. 1 day
c. 2 days
d. 3 days
e. 4 days
f. 5 days
g. 6 days
h. 7 days

116. On an average WEEK DAY, how many hours do you watch TV?

a. I do not watch TV during the week.
b. less than 1 hour per week
c. 1 hour per day
d. 2 hours per day
e. 3 hours per day
f. 4 hours per day
g. 5 or more hours per day

117. On an average WEEK DAY, how many hours do you play video or computer games or use a computer for something that is not school or work related?

(Include activities such as Nintendo,Game Boy, PlayStation, Xbox, computer games, and the Internet.)

a. I do not play video or computer games or use a computer for something that is not school or work related.
b. less than one hour per day
c. 1 hour per day
d. 2 hours per day
e. 3 hours per day
f. 4 hours per day
g. 5 or more hours per day

118. During the past 12 months, on how many organized sports teams did you play?

a. 0 teams
b. 1 team
c. 2 teams
d. 3 or more teams

119. How do you describe your weight?

a. very underweight
b. slightly underweight
c. about the right weight
d. slightly overweight
e. very overweight

120. Which of the following are you trying to do about your weight?

a. lose weight
b. gain weight
c. stay the same weight
d. I am not trying to do anything about my weight.

121. How do you describe yourself?

a. White, non-Hispanic
b. Black or African American, non-Hispanic
c. Hispanic
d. Asian
e. South Asian
f. Other

122. What is your gender?

a. male
b. female

123. What is your age?

a. 17
b. 18
c. 19

124. What is your current employment status?

a. working full-time
b. working part-time
c. with a job, but on medical leave, vacation or strike
d. unemployed, temporarily laid off or looking for work
e. retired
f. homemaker
g. in school and working full or part-time
h. in school, not working for pay

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ABSTRACT

DEVELOPMENT OF INTERVENTIONS AIMED AT REDUCING OBESITY AND CARDIOVASCULAR DISEASE RISK IN A DIVERSE POPULATION OF COLLEGE-AGE YOUNG ADULTS

by

JANICE MARIE WHINTER RUEDA

May 2011

Advisor: Dr. Pramod Khosla

Major: Nutrition & Food Science

Degree: Doctor of Philosophy

Obesity in the United States has increased dramatically over the past 30 years, and the country has fallen far short of the stated objective of Healthy People 2010 of reducing the prevalence of adult obesity to 15%. Among children, obesity has increased most significantly in the 12-19 year old age group. It is well established that obesity is associated with markers of metabolic dysfunction that increase the risk of development of chronic diseases including type 2 diabetes and cardiovascular disease (CVD), and these risk factors have been reported in college students. Transition from high school to college is characterized by changes in lifestyle and dietary habits that are associated with weight gain, and patterns established at this critical life stage can affect long-term weight management and development of CVD risk. The goal of this project was to identify potential interventions aimed at reducing obesity and associated risk factors for CVD in a diverse population of young adults.

AUTOBIOGRAPHICAL STATEMENT

JANICE MARIE WHINTER RUEDA

EDUCATION

University of Michigan, Dearborn, Michigan, U.S.A.: April 1998
Bachelor of General Studies "With High Distinction"
Double Major: History, Political Science

Wayne State University, Detroit, Michigan, U.S.A.: December 2004
Master of Arts
Major: Nutrition & Food Science
"Effects of moderate alcohol consumption on reduction of risk factors of cardiovascular disease"

Wayne State University, Detroit, Michigan, U.S.A.: May 2011
Doctor of Philosophy
Major: Nutrition & Food Science Minor: Community Medicine
"Development of interventions aimed at reducing obesity and cardiovascular disease risk in a diverse population of college-age young adults"

SERVICE: Wayne State University
Committee Assignments

1. Graduate Student Research Day, Steering Committee, 2005, 2006
2. College of Liberal Arts & Science Faculty Awards Committee, 2006
3. Wayne State University Alcohol Awareness Week, Steering Committee, 2006
4. Southeastern Michigan Junior Science and Humanities Symposium Judge, 2008, 2009, 2010
5. Department of Nutrition & Food Science Chair Review Committee, 2008
6. DEW Student-Run Diabetes Clinic, Faculty Representative, 2009-2010

Textbook/Course Material Review Service

1. Wiley's *iProfile, Version 1.0* nutrition analysis software, 2006
2. Sizer/Whitney's *Nutrition: Concepts and Controversies*, 12th Edition, 2009
3. Wiley's *Visualizing Nutrition: Everyday Choices,* 2nd Edition, 2010

External Service, Invited and Sponsored Talks

1. WSU Residence Hall Nutrition Lecture Series (4 lectures), Fall 2006
2. WSU Alcohol Awareness Week, Fall 2006
3. WSU Residence Hall Nutrition Lecture Series (4 lectures), Fall 2007
4. La Sed Senior Community Center, Healthy Foods for Diabetes, Detroit, Winter 2008
5. Detroit Public Schools, Science of Nutrition seminar, Winter 2009
6. Detroit Public Schools, Science of Nutrition Series (3 seminars), Winter 2010
7. C.S. Mott Foundation and Michigan State University, April, 2010
   - Developed and implemented assessment plan for evaluation of U.S.D.A. Fresh Fruit and Vegetable Program for Detroit Public Schools
   - Composed written report detailing findings of FFVP assessment, including recommendations for program implementation and evaluation