Associations Between Weight Change and Meal Frequency, Breakfast Consumption, and Alcohol Intake in College Students

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ABSTRACT

Objective: To determine if weight gain in college subjects is associated with meal frequency, breakfast consumption, breakfast type, and alcohol intake over one year of college. Secondary aims were to determine whether BMI and body fat percent are associated with breakfast consumption and type as well as meal frequency.

Design: A longitudinal observational study. Health history, work schedule and sleep patterns were recorded. Subjects fasted overnight and height, weight, skin fold measurements, waist, and hip measurements were taken. Two seven day food and activity records were self recorded in September 2005 and in April of 2006.

Subjects: One-thousand fifty college students enrolled in freshman level foods and nutrition or personal health courses in fall 2005 were invited to participate in the study; 507 agreed to participate in the study.

Main Outcome Measures: Weight change, meal frequency, number of breakfasts per week, breakfast type, and amount of alcohol consumed were analyzed. Weight change by breakfast category was also analyzed.

Statistical analyses: Diet records were entered into Nutritionist Pro™ for nutrient analysis. Associations between weight change and meal frequency, breakfast consumption, and alcohol intake in college students were analyzed using independent t-test and analysis of variance (ANOVA).

Results: Two-hundred and thirty subjects completed the study. Subjects ate more breakfasts per week in September (148.5 ± 32.5) compared to April (149.6 ± 32.5, p > .05). Non-breakfast eaters gained slightly more weight than breakfast eaters (p = .099). Similar results were found for meal frequency and weight change. Those who consumed more meals per day gained less weight compared to those who ate 4 or fewer meals per day (p = .206). Non drinkers gained significantly more weight than heavy drinkers (p = .004).

Conclusion: Although significant associations between breakfast consumption, meal frequency and weight change were not found, results from this study suggest that increasing breakfast consumption as well as meal frequency may be beneficial in reducing the amount of weight gained over time. Although non-drinkers gained significantly more weight than heavy drinkers, more studies are warranted to investigate this finding.

Application: This study strengthens the literature on meal frequency and breakfast consumption as they are associated with changes in body weight. The study was also the first of our knowledge to assess these associations in a college setting. Based on these findings, more studies are warranted to determine whether the associations between weight changes and meal frequency as well as breakfast consumption and breakfast type

are strongly correlated when a larger and more diverse population base is used.

Attribution:

I have been honored to have the opportunity to work with Dr. Kathy Hosig throughout my undergraduate and graduate career. During this time she has taught me a wealth if information about nutrition that has prepared me well for my career in dietetics. Dr. Hosig received her B.S. in Human Nutrition, and Foods/Dietetics from Virginia Tech. She later completed a M.P.H. in Public Health Leadership from the University of North Carolina at Chapel Hill, and a Ph.D. in Foods and Nutrition from Purdue University. She has played an intricate part in my success at Virginia Tech and without her knowledge, guidance and support this experience would not have been possible.

I would also like to thank my committee members, Dr. Nickols-Richardson and Dr. Anderson for their time and thoughtful feedback. Dr. Sharon Nickols-Richardson received a B.S. in Food, Nutrition and Institutional Administration from Oklahoma State University and a M.S. and Ph.D. in Foods and Nutrition from the University of Georgia. She is now a full time professor at Penn State University and is missed greatly by the department here at Virginia Tech. Dr. Eileen Anderson received a B.A. in Psychology from UVA, a M.Ed. from James Madison University and an Ed.D. from Virginia Tech. Her expertise in the area of statistics played a significant role in giving me the guidance needed to analyze my data. Both Dr. Nickols-Richardson and Dr. Anderson's comments were invaluable to my research design and overall study.

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Chapter 1: Introduction

Obesity is defined as a markedly high amount of body fat or adipose tissue in relation to lean body mass. The distribution of body fat throughout the body and the size of the adipose tissue deposits are of concern. The more centrally located the fat distribution, the higher the risk for chronic diseases such as heart disease and diabetes (1).

In 2000 more than 17% of deaths in the US were attributed to overweight or obesity (2). Obesity is one of the leading causes of morbidity and mortality in the nation today (1). According to data from the National Center for Health Statistics, 30% of US adults 20 years of age and older (over 60 million people) are obese (3). This is a significant increase from 1980 when only 13% of men and 17% of women were classified as obese (4). The condition affects adults and adolescents alike. It is estimated that one in three adults are obese and 16% of children are overweight and 31% are at risk of overweight (5). In addition, new evidence suggests that children who are overweight have a greater chance of remaining overweight as adults (6). Older adolescents and young adults may be particularly susceptible to weight gain. The National Longitudinal Study of Adolescent Health tracked adolescents transitioning into young adulthood for 5 years. Only 14.7% of obese adolescents ceased to be obese young adults. In addition, 12.7% of non-obese adolescents became obese as young adults. The incidence of overweight and obesity was higher during this five year period compared to the incidence of overweight and obesity in later adulthood. Thus, adolescent obesity appears to be a strong predictor of adult obesity (7). The number of children who are overweight has doubled in the last 2 to 3 decades (8).

Obesity is associated with chronic diseases such as heart disease, diabetes, and stroke. In 2000, the total cost of obesity in the United States was estimated to be $117 billion (3). Approximately $61 billion was for direct medical costs, and $56 billion was for indirect costs. Children and adolescents' annual hospital costs related to obesity accounted for $127 million during 1997–1999, up from $35 million during 1979–1981. The compounding trend in weight gain as well as the health problems associated with obesity are alarming and show the necessity of preventive interventions to stop the spread of obesity.

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Chapter 2: Review of Literature

Dietary characteristics including meal frequency, breakfast consumption, and alcohol consumption have been associated with greater risk of obesity. Meal frequency, breakfast consumption, and alcohol consumption therefore may be important components to include in interventions that aim to decrease the development of obesity.

Meal Frequency

Several studies have shown an inverse relationship between number of eating episodes and risk of obesity. Increased daily meal frequency may play a protective role against obesity (1,2).

A cross sectional study conducted with 4,370 children ages 5 and 6 years found that the prevalence of obesity decreased by number of meals per day (1). Parents of the children volunteered to complete a questionnaire on risk factors for obesity. Children's meal frequencies were assessed by asking parents how many meals per day their child consumed. Daily frequency of meals was measured by asking: How many meals per day does your child consume? Potential answers were 1/2/3/4/5/>5 and do not know. A meal was defined with examples (i.e., breakfast, lunch, dinner). These examples characterized meals that were normally served on a plate. Stature and weight measures of children in light clothes and no shoes were taken by trained nurses. Increased number of meals was associated with higher daily kcal intake. Grazers consumed fewer potatoes, pastries, candy, and cola but more pasta, fresh salad, and fresh fruits and vegetables ($p<.05$). Children that consumed 3 meals or less per day had a 4.2% incidence of obesity; 4 meals, 2.8%; and incidence of obesity was only 1.7% with 5 meals or more per day. Obesity at school entry was most strongly associated with parental obesity followed by little physical activity, TV viewing, smoking at pregnancy, and snacking in front of the TV. Adjustment for these variables did not explain the effect of meal frequency on overweight and obesity (1).

Meal frequency in adults has also been associated with risk of obesity. Farshchi et al. examined the metabolic effects of meal frequency on dietary thermogenesis, insulin sensitivity, and fasting lipid profiles in healthy obese women (2). Ten women ages 32-47 who were not pregnant or lactating and who did not have any self-reported history of high cholesterol, hyperglycemia, or serious medical conditions participated in the randomized crossover trial. Subjects were screened for depression using the Beck Depression Inventory and dieting attitudes were assessed using the Eating Attitudes Test: (EAT). Those who scored greater than 10 on the depression test, and 30 on the EAT were excluded from the study. Subjects kept food diaries on 2 week days and 1 weekend day prior to the start of the intervention. There were two intervention phases with a 14-day washout period in between. During phase one, women were asked to eat a normal diet consuming foods and beverages on six occasions with regular intervals (regular meal pattern), or follow a chaotic pattern. The chaotic meal pattern consisted of 3 to 9 meals a day. Day one through 14 on the chaotic diet followed as such: 7,4,9,3,5,8,6,5,9,8,3,4,7, and 6 meals per day. Meals were defined as food or snack (solid or liquid) containing an unspecified amount of energy with an interval of 1 hour between two occasions. Food intake for the 3rd, 11th, and 14th days of both the regular (defined as either 6 meals or snacks) and irregular meal (defined as eating 3 to 9 meals on a given day) patterns was also recorded. Laboratory and anthropometric data were collected on the first and last days of each phase. Data collection included height, weight, and waist and hip circumference measurements as well as fasting blood samples. Insulin sensitivity and lipid profile tests were also given. Although only 10 women participated in the study, results showed that eating 6 regular meals per day vs. eating irregularly significantly improved fasting lipid levels, postprandial insulin profiles and thermogenesis. Irregular meals lead to significant decreased postprandial energy expenditure, impaired thermic effect of food, higher total LDL cholesterol levels and lower insulin sensitivity (2).

Breakfast Consumption

Breakfast in particular may be an important meal for body weight regulation. Skipping meals, especially breakfast, has been associated with increased body weight (3). Overweight children and adolescents were more likely to skip breakfast than their thin counterparts (4).

Cho et al. analyzed data from 16,452 white, African American or Hispanic individuals over the age of 18 in the NHANES III database. The relationship between breakfast type, energy intake and body mass index (BMI) was investigated. Foods consumed at breakfast were initially categorized based on the USDA food-coding scheme in order to categorize all possible foods consumed. Categories included: “Skippers," "Dairy," "Meat and Eggs," "Fruits and Vegetables," "Ready-to-eat cereal (RTEC)," "Cooked cereal," "Breads," "Quick Breads," "Fats and Sweets" and "Beverages.". The adjusted mean BMI and daily calorie intake of the different groups were compared using analysis of covariance. Results indicated that subjects who ate cooked cereal, RTEC, or quick breads had significantly lower BMI compared to skippers and meat and egg eaters ($p \leq 0.01$). Breakfast skippers and fruit/vegetable eaters had the lowest daily caloric intake. The meat and eggs eaters had higher daily energy intake and higher BMI (27.04(SE 0.19)) compared to cooked cereal eaters (BMI 25.46 (SE 0.22)). These results indicate that skipping breakfast is not beneficial in weight management. Eating cereal (ready-to-eat or cooked cereal) or quick breads for breakfast is associated with lower BMI compared to eating meats and/or eggs or skipping breakfast (5).

An additional study examined breakfast consumption as being a common behavior for people who succeed in achieving and maintaining weight loss over the long-term (6). Subjects were 2959 members of the National Weight Control Registry (NWCR) who were long-term obese-reduced individuals: 2350 were women (79.5%) and 607 were men

(20.5%). Individuals had to be ≥18 years old, had to have lost more than 13.6 kg (30 lb), and had to maintain the weight loss for more than a year to participate. Subjects were asked to give their maximum adult weight, total weight loss, current body weight, and current height. This information was used to find current and maximum body mass index (BMI). At the beginning of the study, subjects were asked how many days in a 7-day week they ate breakfast. Breakfast eaters were defined as those reporting eating breakfast four or more times per week. Only 114 (3.9%) of subjects reported that they never eat breakfast, and 78.3% (n = 2313) reported eating breakfast every day of the week. Nearly 90% reported eating breakfast 4 days or more. At follow up, 94.8% of subjects (n = 1796) reported eating breakfast in the last 3 months. Men reported that they did not eat breakfast 7.6% of the time and women reported not eating breakfast 4.6% of the time. Using these criteria, 314 subjects were non-breakfast eaters and 2645 were breakfast eaters. Breakfast eaters engaged in slightly more physical activity than non-breakfast eaters. Researchers concluded that regular breakfast eating may be useful in weight-loss maintenance because it may reduce hunger seen later in the day that may in turn lead to overeating. Differences in energy intake between groups were not found. These data suggest that skipping breakfast is a very uncommon behavior among individuals successful at long-term weight-loss maintenance (6).

Breakfast Consumption and Meal Frequency

Breakfast consumption and meal frequency have been shown to be associated (7). Bertone et al. conducted a study on 499 free living US adults between the ages of 20 and 70 to determine associations between meal frequency and obesity (8). Every 3 months for a year blood samples were taken and body weight was measured. Three 24-hour recalls (2 weekdays and 1 weekend) were also completed using Nutrition Data System Data Entry and Nutrient Database Software and diet was assessed. Height in meters was taken at baseline and body mass index (BMI) was calculated (wt in kg / ht (m) squared). Eating episodes were defined as an eating event that provided at least 50 kcals with a minimum time period of 15 minutes. On average, subjects ate 3.92 (SD .8) times/day. Average energy intake per day was 2,259 (SD 540) for men and 1,641 kcal (SD 363) for women. The risk of obesity was estimated using logistic regression analysis with SAS. Findings suggested that the frequency of eating episodes was inversely related to obesity. Those who reported 4 or more eating episodes daily had a 33% reduced risk of being overweight and a 45% lower risk of becoming obese compared to those who ate 3 meals or less. In addition, eating breakfast and dinner away from home was positively related to obesity risk as was skipping breakfast. Those who skipped breakfast 75% of the days measured were at 4.5 times the risk of becoming obese as those who were breakfast eaters. Those who self-reported skipping breakfast once out of the twelve 24 hour recalls completed, had a 1.34 time greater risk of obesity. Total energy intake was also found to be higher on days that subject's skipped breakfast (8).

Weight Gain, Meal Frequency and Breakfast Consumption in College Students

Body weight and obesity increase with age (3). In addition, there appears to be a propensity toward significant weight gain between adolescence and adulthood (9). Potential for weight gain in early adulthood may be compounded by adjustment to new social and physical environment of college. The transition period from high school to college can be challenging in terms of developing or maintaining positive health behaviors (9). Vending machines offering junk food can be found with little or no effort. Lack of sleep, demanding class schedules, and time constraints may make it challenging to not only eat a balanced meal, but to have scheduled meals (breakfast, lunch, dinner, and snacks (10). Campus dining halls are not making this task easier; meal plans cater to those who skip meals and like to make up for it in one sitting. Approximately 98% of freshmen choose flex meal plans that emphasize the convenience of fast food rather than healthier food choices (11). Seventy six percent of college students report eating the same foods day after day (12). Healthy food choices are especially important with repetitive eating behaviors. In addition, fast food franchises are dispersed conveniently around campus making unhealthy foods even more accessible. Habits such as staying up late to either party or cram for an exam can also have a major impact on dietary habits.

There is evidence that the freshman 15 is real and can continue throughout one's collegiate career (12). These changes in lifestyle amongst college students seem to be one of the major underlying factors of the "freshman 15" phenomenon (13).

Although not all college freshmen gain weight their first year, one study reported a mean weight gain of 8 pounds during the freshman year (14). Levitsky studied 60 college freshmen during their first 12 weeks at Cornell University. The students were weighed during the first week of school and again after 12 weeks. They were also given a questionnaire to fill out concerning their dietary behavior during the study. Mean weight gain after 12 weeks was 1.9 kg. This was attributed to increased snacking, high fat snack foods, and all you can eat dining halls.

Butler et al studied eating and exercise patterns of 54 freshman women upon college entry and five months later (15). Height was measured to the nearest quarter inch and weight to the nearest quarter pound using a Detecto balance beam scale. Body mass Index (BMI) was calculated by kg/m2. A Harpenden skin fold caliper was used to estimate body fat percentage using 3 skin fold sites, tricep, suprailiac, and abdomen (16). The Block Food Frequency Questionnaire was used to assess dietary intake. Deficiency was defined as being significantly lower in means from pre to post in food groups. Eighty percent of participants did not eat enough grains, 81.7% were deficient in fruits and vegetables, 83.3% were deficient in the dairy category, and 35.5% in the meat group. There were significant increases in percent fat (p=.05) and alcohol (p=.05) consumed per day when follow up food frequency was compared to baseline. Total caloric intake was less at the post-test (1856 kcal ±680) than at the pre-test (2205 kcal ± 877). Total activity from baseline decreased. Fat mass increased which could be related to increased alcohol consumption. Body fat percentage and BMI increased significantly in freshmen females after 20 weeks in college. These findings suggest that as freshmen begin college weight gain occurs primarily because of reduction in physical activity. No studies have reported meal frequency and breakfast consumption in college students. A study addressing these topics is therefore warranted.

Alcohol and Weight:

One drink per day for women and two per day for men has been defined as drinking in moderation (17). According to The National Institute on Alcohol Abuse and Alcoholism (NIAAA), binge drinking is defined as four or more drinks for women and five or more drinks for men with in a 2 hour time period (18). Although moderate amounts of alcohol can be beneficial to health, over-consumption can affect digestion, storage, utilization, and excretion of nutrients.

A study conducted by Heliovaara et al. examined associations between obesity and alcohol intake (19). Independent cross-sectional surveys were conducted in 1982, 1987, 1992, and 1997. Participants in the survey included 24,604 men and women who were randomly selected from 3 regions in Finland. Weight and height were measured and BMI was calculated. Alcohol consumption was assessed via questions about the frequency and type of alcohol consumption during the previous week (beer, wine, liquor). An alcohol index was then determined representing the intake of alcohol in grams. Women who abstained from alcohol use and men who reported drinking 10 servings were at higher risk for obesity than those who consumed alcohol in moderation. BMI increased with increasing alcohol intake in men but decreased in women (19).

A crossover study that included 12 male subjects showed that individuals tend to over eat when they were given alcohol in combination with a high fat appetizer versus a low fat appetizer without alcohol (20). Subjects were given an isocaloric breakfast and 4.5 hours later were given wine with a high fat food. They were then instructed to eat ad libitium their lunch and dinner. During this time kcal intake was measured. After a five day washout period subjects were fed the same isocaloric breakfast and 4.5 hours later were given an alcohol free (vegetable juice), low fat appetizer and told to do the same. When the high fat appetizer with alcohol was given, subjects consumed 812 more kcals compared to subjects given the low fat appetizer with vegetable juice ($P < .01$). The authors concluded that satiety is decreased when there is free access to foods after a high fat, alcohol containing appetizer is given (20).

A supporting study from Bouchard et al. measured body fatness in those who followed public health guidelines for fat and alcohol intake as well as physical activity and those who did not. Body fat, alcohol intake and physical activity of 358 men were analyzed to determine if there was a link between weight distribution and dietary and exercise regimens. Subjects who reported a healthy lifestyle defined by common public health guidelines reported eating 31% of total calories from dietary fat and 1.3% of calories from alcohol intake. They also reported regular physical activity of more than 2.5 hours per day. The group with less favorable health behaviors ate 38% of their calories from fat, 10% of total calories from alcohol and exercised only 15 minutes on average. While the effect of alcohol consumption was not measured separately, the difference between these groups was significant (p .0001). Conclusions can be made that a lifestyle characterized by high-fat and alcohol intake as well as lack of exercise promotes fat gain (21).

Wannamethee et al. studied 3327 men aged 60 to 79 years old to investigate the effects of quantity, type of drink, and timing related to meals in regard to adiposity (22). Body mass index (BMI), waist circumference (WC), body fat percent (BF%), and waist to hip ratio (WHR) were measured to determine whether alcohol intake was associated with weight and fat distribution based on the type of alcoholic beverage and whether or not alcohol was consumed with a meal. Subjects reported their current drinking frequency and estimated how many drinks they consumed in an average week. Heavy drinking was defined as > 35 drinks/week. Men were asked to specify what kind of alcohol they consumed and whether or not they consumed these drinks before, during, or after a meal.

Data was analyzed by analysis of covariance and regression. Standardised regression coefficients (regression coefficient/s.d. of the adiposity measure) were measured to compare the strength of association between alcohol and the adiposity measures. Results showed an average BMI of 26.8, WC of 96.8, WHR of .945, and mean BF% of 34.8. Increased alcohol consumption was positively correlated with increased kcal consumption. There was also a positive relationship between BMI and total alcohol intake (P=.02). Light drinkers or wine drinkers were more likely to drink with their meal, while heavy drinkers were less likely to do so. Men who drank with meals tended to consume fewer calories, ate less fat, and had lower BMI and WHR than men who drank separately. Number of drinks consumed was significantly correlated with weight and BMI. Those who drank more than 21 drinks/week had higher central adiposity and %BF than light drinkers. The largest weight difference was seen in beer drinkers, however was not significant. Weight gain occurred regardless of beverage type; ($p<0.001$)).

A similar study by Wannamethee et al. was conducted with middle aged men over a five year period (23). Men ages 40 to 59 years (n= 7608) were asked to complete a food frequency questionnaire at base line. Questions included smoking habits, alcohol intake, and medical history. Height and weight were measured, and BMI was calculated. Five years later a follow up questionnaire was administered and measurements were retaken. A weight change was defined as a loss or gain of 3.0 kg. Results showed that greater than 30g of alcohol/day contributed to weight gain and obesity regardless of alcohol type.

BMI significantly increased with increased alcohol intake (those who drank spirits had the greatest increase in BMI).

Another study assessed the effects on calorie intake of an aperitif (wine or beer) compared to 3 fruit juice appetizers (containing one of the following; fat, carbohydrate, or protein) and a water appetizer (24). Fifty-two men and women aged 20 to 45 participated in the study. Eating restraint was determined, anthropometric measurements were taken, height and weight were measured, and BMI calculated (kg/m2). Subjects were randomly given either 340 ml alcohol, a protein fruit juice, grape juice, water, or no preload. Thirty minutes after this, subjects were offered a lunch. This was done for 5 consecutive weeks. An appetite profile was recorded before and after the preload and lunch, 2 and 4 hrs after lunch, before and after dinner, and 2 and 4 hours after dinner. Energy consumption was significantly greater after the alcohol preloads than after the carbohydrate, protein, or fat pre load in both men and women. Energy consumption at lunch did not significantly differ after the 3 preloads in either sex. Total energy consumption was higher on the days that an alcohol preload was consumed compared to water or no preload (24). On days when preloads other than alcohol were consumed, participants consumed fewer kcals when compared to alcohol and more when compared to water or no preload, however, this was not significant. Eating rate and meal duration was greater after the alcohol preloads in women and men. Satiation began to increase later with alcohol preloads when compared to other macronutrient preloads (24).

Alcohol Consumption and College Students:

There have been limited studies conducted on alcohol consumption and weight gain in college students, most likely because of the legal age barrier. A recent study surveyed students from 119 colleges and reported alcohol to be easily attained even if students were underage, and that the primary reason for drinking was to get drunk (25). In addition, several national studies reported that two out of five college students are binge drinkers (26-29). Alcoholic drinks were heavily promoted on and around campuses. Kegs and other alcoholic packages were also heavily advertised. It is estimated that 90% of college students drink alcohol, with 25% to 50% of these students being classified as heavy drinkers (25).

Anding et al. measured dietary intake, body mass index, exercise, and alcohol consumption in 103 college women (average age 21 +/- 4.6 years) to determine whether the women were following dietary guidelines for Americans (30). Sixty of the women completed 3-day food records that were appropriate for analysis. According to these records, only 13 percent of participants reported drinking alcohol. The alcohol consumed provided only 1% of their average kcal intake. Two of the participants reported drinking more than the recommended amount (one drink per day for women). The authors suggested that since 57% of participants were under the age of 21, they most likely did not report their true alcohol intake. Another study investigated eating habits of adolescents (age 16 and 17) in relation to body fatness and gender. Questionnaires were used to gather dietary intake and meal frequency, body fat percent was taken using a BodPod. A positive correlation between consumption of alcohol and weight gain in both male and females was found (31). Additional studies are needed to gather accurate information on the correlation between alcohol consumption and weight gain in college students.

Specific Aims:

The primary aim of this study was to determine whether alcohol consumption, meal frequency and breakfast consumption among college students are associated with weight gain during college. Secondary aims were to determine whether weight gain, and baseline body fat, and baseline BMI were associated with breakfast and meal frequency categories.

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Chapter 3: Associations Between Weight Change and Meal Frequency, Breakfast Consumption, and Alcohol Intake in College Students

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Associations Between Weight Change and Meal Frequency, Breakfast Consumption, and Alcohol Intake in College Students

Abstract:

Objective: To determine if weight gain in college subjects is associated with meal frequency, breakfast consumption, breakfast type, and alcohol intake over one year of college. Secondary aims were to determine whether BMI and body fat percent are associated with breakfast consumption and type as well as meal frequency.

Design: A longitudinal observational study. Health history, work schedule and sleep patterns were recorded. Subjects fasted overnight and height, weight, skin fold measurements, waist, and hip measurements were taken. Two seven day food and activity records were self recorded in September 2005 and in April of 2006.

Subjects: One-thousand fifty college students enrolled in freshman level foods and nutrition or personal health courses in fall 2005 were invited to participate in the study; 507 agreed to participate in the study.

Main Outcome Measures: Weight change, meal frequency, number of breakfasts per week, breakfast type, and amount of alcohol consumed were analyzed. Weight change by breakfast category was also analyzed.

Statistical analyses: Diet records were entered into Nutritionist Pro™ for nutrient analysis. Associations between weight change and meal frequency, breakfast consumption, and alcohol intake in college students were analyzed using independent t-test and analysis of variance (ANOVA).

Results: Two-hundred and thirty subjects completed the study. Subjects ate more breakfasts per week in September (148.5 ± 32.5) compared to April (149.6 ± 32.5, $p >$

.05). Non-breakfast eaters gained slightly more weight than breakfast eaters (p = .099). Similar results were found for meal frequency and weight change. Those who consumed more meals per day gained less weight compared to those who ate 4 or fewer meals per day (p = .206). Non drinkers gained significantly more weight than heavy drinkers (p = .004).

Conclusion: Although significant associations between breakfast consumption, meal frequency and weight change were not found, results from this study suggest that increasing breakfast consumption as well as meal frequency may be beneficial in reducing the amount of weight gained over time. Although non-drinkers gained significantly more weight than heavy drinkers, more studies are warranted to investigate this finding.

Application: This study strengthens the literature on meal frequency and breakfast consumption as they are associated with changes in body weight. The study was also the first of our knowledge to assess these associations in a college setting. Based on these findings, more studies are warranted to determine whether the associations between weight changes and meal frequency as well as breakfast consumption and breakfast type are strongly correlated when a larger and more diverse population base is used.

Introduction:

Seventeen percent of deaths in the United States were attributed to being overweight or obese in 2000 (1). Obesity has become one of the leading causes of morbidity and mortality in the United States today (2). It affects both adults and adolescents, in fact it is estimated that 16% of children are currently overweight (3). Adolescents between the ages of 18 and 19 as well as young adults may be particularly susceptible to weight gain. There appears to be a tendency for significant weight gain between late adolescence and adulthood (4). Potential for weight gain in early adulthood may be exacerbated by adjustment to new social and physical environment of college. The transition period from high school to college can be taxing in terms of developing or maintaining sound health behaviors (5).

Dietary characteristics including meal frequency, breakfast consumption, breakfast type, and alcohol consumption have been associated with greater risk of obesity (6-11). These dietary factors therefore may be important components to include in interventions that aim to decrease the development of obesity.

Few studies have examined the relationship between breakfast consumption, alcohol intake, and meal frequency as associated with weight gain in college students; therefore the aim of the present study is to measure these relationships. The primary aim of this study was to determine whether alcohol consumption, meal frequency and breakfast consumption amongst college students are associated with weight gain. In addition, weight gain, body fat percent, and BMI were also analyzed to determine their association with breakfast and meal frequency categories. Secondary aims were to determine whether there is an association between alcohol consumption and meal frequency as well as breakfast consumption and meal frequency in college students. Subjects who reported regular breakfast consumption, higher meal frequency and lower alcohol consumption were expected to have lower baseline BMI and percent body fat and gain less weight over one academic year. Subjects who ate cooked cereal, ready to eat cereal (RTEC), and or quick breads were expected to gain less weight than those who ate other types of breakfast foods. Numbers of alcoholic drinks per day and total daily alcohol intake were expected to be positively correlated with body weight.

Methods:

Design:

A longitudinal observational study investigated the relationship between breakfast consumption, alcohol intake, and meal frequency as associated with weight gain over one academic year of college (September 2005 to April 2006).

Subjects:

Approximately 1050 college students enrolled in freshman level foods and nutrition or personal health courses in the fall of 2005 were invited to participate in the study. There were no exclusion criteria or limits on number of student participants. Bonus points (with 1% of course credit) were offered in fall; $30 or course credit (~20% course credit) in a special one-credit research course were offered for participation in Spring. The study was approved by the University's Institutional Review Board and informed consent was obtained from each subject before participation in the study.

Data Collection:

Data collected included demographic information, anthropometric measurements, 7-day food records and 7-day physical activity records.

Demographics:

Subjects reported general information about themselves including age, gender, race, major, and reason for taking foods and nutrition or personal health courses. A health history form was included to rule out any pre-existing conditions and to identify current medications and/or health conditions. Work schedule and sleep patterns were included.

Diet:

Subjects completed a 7 day food record in September and again in April. This included time of each meal, snack, and/or drink, the foods/drinks eaten in detail, and the amount of food/drink consumed. Instructions including portion sizes, and examples were provided.

Anthropometric measurements:

Subjects fasted overnight and consumed no more than 1 cup of liquid the morning of measurements. Subjects were measured between the hours of 7 am and noon without shoes and in light clothing; outer layers of clothing were removed. Anthropometric data were collected including waist and hip measurements, height (in inches, to the nearest 0.25 inch), weight (in pounds, to the nearest 0.25 pound), and skin fold measurements using 3 sites: abdomen, suprailiac, and tricep (Lange, Beta Technology, Santa Cruz, CA). Percent body fat was calculated (12). Weight and height were obtained using a calibrated balance beam scale with stadiometer (Seca, Hanover, MD).

Data Analysis:

Data Management:

Food records:

Seven day food records were analyzed for nutrient content by Nutritionist Pro™ (version 2.4.1 diet analysis software, Axxya Systems, Stafford, Tx, 2005). Mean daily calories, carbohydrate (grams), protein (grams), and fat (grams), fiber (grams), sugar (grams), and alcohol (grams) were recorded from nutrient analysis. Breakfast consumption, meal frequency, number of drinks per week, and percent of calories from alcohol were recorded from food records.

Variables Defined:

Breakfast was defined as consuming at least 50 kcals (not including sugar sweetened beverages) between 5 am and 10am. Breakfast consumption was expressed as number of breakfasts per week. High-breakfast eaters (eating breakfast less than 4 times/week) and low-breakfast eaters (eating breakfast greater than 4 times/week) were based on frequency data such that 50% of subjects were in either category. Breakfast type was categorized based on a previous study as: 0) none; 1) dairy; 2) meat and eggs; 3) fruits and vegetables; 4) ready to eat cereal (RTEC); 5) cooked cereal; 6) breads; 7) quick breads; 8) fats/sweets; 9) beverages; 10) bars; 11) shakes, meal replacements; 12) mixed groups (7).

Meals were defined as greater than 50 calories excluding sugar sweetened beverages that were consumed within 15 minutes of the time the meal began and were recorded directly from food records. Meal frequency was expressed as meals per day. Meal frequency was categorized as low (4 or fewer meals/day) or high frequency (> 4 meals/day) using frequency data such that approximately 50% of subjects were in each category.

Alcohol consumption was expressed as number of drinks per day based on food records. One drink was defined as 12 oz of beer, 5 oz of wine, or 1.5 oz of liquor. Based on frequency data such that 50% of subjects fell into the non-drinking category and 50% fell into the drinking category, non drinkers were defined as having zero drinks/day and drinkers were defined as consuming more than one drink/day. Percentage of calories from alcohol was recorded from the nutrient analysis print out from Nutritionist Pro™.

Body Measurements:

Height and weight were used to determine BMI (kg/m^2). Weight change from September to April was calculated. Weight change was categorized as either loss/maintain (within one pound of baseline) or gain (> 1 pound) based on frequency data such that approximately half of subjects were in each category. Subjects who gained more than 25 pounds were excluded from data analysis.

Descriptive Analysis:

Class and major (nutrition related or non-nutrition related) were expressed as frequencies. Baseline age, BMI, body fat percent, percent kcal from fat, kcal/day, and grams of fiber/day were expressed as mean plus or minus standard deviation.

Statistical analysis:

Breakfast consumption

Weight change for breakfast eaters versus non-breakfast eaters was analyzed via independent t-test ($p<.05$) as was the number of breakfasts per week for subjects who lost/maintained or gained weight. Weight change, percent body fat and BMI were analyzed by breakfast category (0-12) via one-way analysis of variance (ANOVA $p<.05$).

Meal Frequency

Weight gain by meal frequency category (lower, greater) was analyzed by independent t-test ($p<.05$). The number of meals per day for subjects that lost/maintained or gained weight were analyzed by independent t-test ($p < 0.05$).

Alcohol consumption

Average kcals/kg/day for drinkers versus non-drinkers was compared by t-test ($p<.05$). Mean drinks per day by weight change category (lost/maintained or gained) were analyzed by independent t-test ($p < 0.05$). One-way ANOVA was used to analyze weight change by drinking status (non, moderate, heavy). One-way ANOVA was used to analyze grams of fiber, milligrams calcium, total kcal per kg per day, and percent kcals from fat by drinking status.

Results:

<u>Study Population:</u>

Of the 1050 students in the foods and nutrition or personal health courses invited to participate in the study, 507 (48.6%) agreed to participate. Forty-five percent (n =231) of the subjects who began the study in September completed the study in April (22% of students enrolled in either class) and were included in the final analysis. Descriptive information about the subjects is summarized in Table 1. Subsequent analyses were based on dietary variables from September (baseline).

Mean weight in September was 148.5 ± 31.0 compared to April where mean weight increased to 149.6 ± 32.5 (paired t test; $t = -2.198$, $p = .029$). Most of the subjects were Caucasian females who were between 19 and 24 years of age. The majority of the subjects were normal weight based on BMI (18.5-24.9 kg/m^2) with a small percentage who were underweight (BMI<18.5) or overweight (BMI≥25.0) (Table 2). BMI for women was significantly different from men (Table 3). Body fat percentage was greater for women than for men. Average body fat percentage was 22.2 ± 7.6. Women ate breakfasts and meals more frequently than men (Table 3). Men consumed more alcoholic beverages per day compared to women (Table 3).

Subjects ate more breakfasts per week in September (3.4± 1.9) compared to April (2.8± 2.1). Mean BMI at the beginning of the study (Sept) was 23.7 ± 3.7 and 23.8 ± 1.4 in April ($p = .17$, $t = -1.4$). Reported kilo-calories per kilogram body weight decreased from September to April (29.3 ± 9.3; 26.9 ± 8.5 respectively; $t = 4.2$, $p = .17$). Average weight in September was 148.9 ± 31.4, mean weight in April was 150.1 ± 33.2 ($p = .02$, $t = -2.4$).

Table 1: Characteristics of Sample Population (n=230)

Characteristic	n (%)
Gender	
Male	71 (31%)
Female	160 (69%)
Race	
Caucasian	196 (85%)
Black/African American	18 (8%)
Asian	8 (3%)
Other	9 (4%)
Class/Age	
Freshmen (age 17 and 18)	62 (27%)
Ages 19-24	170 (73%)
Baseline Dietary Variables	**Mean ± standard deviation**
Kcal/kg	29.0 ± 9.3
Fiber/day	13.7 ± 6.0
Calcium/day	749 ± 355
Breakfasts/week	3.3 ± 2.0
Meals/day	4.0 ± 1.1
Drinks/day	0.8 ± 1.2
Alcohol percent of kcals	0.8 ± 1.2

Table 2: Baseline Body Mass Index

BMI	Female (n=155) n(%)	Male (n=70) n(%)	Total (n=225) n (%)
Underweight (<18.5)	5 (2%)	0 (0%)	5 (2%)
Normal weight (18.5-24.9)	118 (75%)	42 (59%)	161 (70%)
Overweight (≥25.0)	32 (20%)	28 (39%)	60 (26%)

Table 3: BMI, % Body fat, % kcals from Alcohol, # of Meals/day, # Breakfasts/week by Gender

	Males	Females	P	F	T
BMI	25.1 ± 4.0	23.0 ± 3.2 *	.24	1.4	-4.2
% body fat	14.4 ± 6.6	25.7 ± 5.1 *	.01	7.3	14.0
% kcals from alcohol	.85 ± 1.2	.82 ± 1.2	.62	.43	-.93
# meals/day	3.8 ± 1.0	4.1 ± 1.1	.14	.71	1.9
# BF/week	3.0 ± 1.9	3.5± 2.0	.82	.67	1.8

* statistically significant difference (independent t-test, p<0.05)

Dietary Intake, Meal Frequency and Weight change:

Associations between weight change and breakfast consumption

BF eaters gained less weight than those who did not eat breakfast (p= .10; independent t-test) (Table 4). BF eaters and non-BF eaters had similar levels of base line body fat percent (22.0 ± 8.0; 22.5 ± 7.1 respectively) (p = .20; independent t-test). Those who lost or maintained weight ate more breakfasts per week than those who gained weight (p=.78, f = .08, t = 1.5; independent t-test). BF skippers (0-3 bf/wk) gained the most weight from September to April compared to subjects that ate breakfast 4 or more times per week (Table 4). Mean weight gain, baseline BMI and percentage body fat were analyzed by BF categories and are reported in Table 5. No significant differences in weight change were observed between groups. Meat and egg eaters gained the most weight while protein and meal replacement shakes were second. Cooked cereal eaters lost the most weight from September to April. Subjects who consumed sugary drinks or mixed BF also experienced some weight loss. Dairy eaters had the lowest BMI but highest percent body fat while protein/meal replacement shake drinkers had the highest BMI of all groups. Those who ate quick-breads for BF had the lowest body fat percent followed by subjects who ate cooked cereals. Subjects who ate breakfast (> 4 BF/wk) had a BMI of 23.4 ± 3.3 while those who did not eat breakfast had a BMI of 23.8 ± 4.0 (p = .73; f = .12).

Table 4: Weight change by breakfast/week, meal frequency/day, and drinking status*

	Weight Change	**Frequency/ % of subjects who gained weight**	**F**	**t**	**P**
Breakfasts/week *					
Non eaters (0-3)	2.7 ± 6.5	101 (51%)	.010	1.65	.099
BF eaters (≥4)	1.1 ± 6.9	98 (49%)	.010	1.65	.099
Meal Frequency/day *					
Low frequency (0-4)	2.5 ± 6.9	112 (56%)	.026	1.27	.206
High frequency (>4)	1.3 ± 6.5	87 (44%)	.026	1.27	.206
Alcohol/day *, **					
Non-drinkers	3.1 ± 7.1	96 (55%)	.480	2.90	.004
Drinkers	0.5 ± 6.5	103 (45%)	.480	2.90	.004

* Difference between categories analyzed via independent t-test (p<0.05).
** Statistically significant between drinkers and non-drinkers

Table 5: Mean Number of Breakfasts/Week, Meal Frequency/Day, and Alcohol/day by Weight Change Category. *

	Breakfasts/week	Meal Freq/day	Alcohol/day
Loss/maintained	3.6±2.0	4.1±1.0	.98±1.1
Gained	3.2±2.0	4.0±1.1	.81±1.2
P	.78	.29	.78
t	1.5	.83	1.1
F	.08	1.1	.08

* Independent t –tests p<0.05

Table 6: Weight change, BMI and percent body fat by breakfast category *

Breakfast category	N	Weight change	BMI	Body fat %
Bf skippers	100	2.45 ± 7.2	23.8 ± 4.1	22.5 ± 7.1
Dairy	5	2.9 ± 5.5	21.5 ± 1.6	26.6 ± 2.6
Meat and eggs	3	8.6 ± 12.3	25.2 ± 1.6	20.1 ± 7.9
Fruits and Vegetables	4	3.0 ± 9.5	24.2 ± 4.2	25.1 ± 9.2
RTEC	25	1.5 ± 5.5	23.5 ± 3.0	22.0 ± 7.9
Cooked cereal	2	-8.9 ± 12.1	23.1 ± .15	17.5 ± 21.1
Breads	9	.18 ± 9.4	23.3 ± 3.0	22.8 ± 10.7
Quick breads	5	3.5 ± 3.0	24.8 ± 4.9	12.6 ± 6.5
Fats/Sweets	5	.95 ± 2.8	23.5 ± 4.0	20.0 ± 8.2
Beverages	7	-3.6 ± 9.7	23.6 ± 2.6	25.0 ± 6.4
Bars	12	.67 ± 4.2	23.1 ± 3.0	19.2 ± 6.6
Protein/meal replacement shakes	2	7.0 ± 8.1	26.2 ± 11.7	24.0 ± 0.3
Mixed Breakfast	20	-1.5 ± 7.1	23.1 ± 3.2	24.0 ± 6.9
Total	199	1.5 ± 7.1	23.7 ± 3.7	22.3 ± 7.5

* ANOVA
P = .962, F = .40 for ANOVA

Associations between weight change and meal frequency:

Subjects ate 4.06 (± 1.08) meals per day. Those who ate 0-4 meals per day gained more weight (2.5 ± 6.9 vs. 1.3 ± 6.6) and had higher baseline BMI levels than more frequent eaters (24.0 ± 4.1 vs. 23.1±3.0; $t = 1.7$, $p=.04$). Those who ate 0-4 meals/day had a baseline body fat of 22.9 ± 7.7 compared to subjects who ate more than 4 meals/day who had a mean body fat of 21.4 ± 7.4, $t =-1.2$, $p= 0.17$ (independent t-test). Those who lost or maintained weight ate slightly more meals per day than those who gained weight (Tables 4 & 5). Meal frequency was slightly lower for those who gained weight (Table 5).

Associations between weight change and alcohol consumption:

At baseline students reported drinking an average of .88 (± 1.19) alcoholic drinks per day. Ninety-six students were true non-drinkers (48%), while 103 were considered drinkers (52%). One hundred and twenty-five (63%) students drank less than one drink/day. Seventy-four (37%) subjects drank one or more drinks/day. Weight gain differed by drinking status (Table 7). Non drinkers gained significantly more weight than heavy drinkers and had a slightly higher baseline BMI compared to drinkers, however percent body fat was slightly lower in non-drinkers. Despite this, drinkers reported more kcals/kg/day compared to non-drinkers (Table 7). Those who lost or maintained weight reported drinking more drinks per day than those who gained weight ($p=.78$; independent t-test) (Table 4&5). Non drinkers reported a higher calcium intake, less fiber, greater kcals from fat, and lower kcals/kg/day (p>.05, Table 7).

Table 7: Calcium Intake, Fiber, kcal/kg, Percent kcals from Fat, Percent Body Fat, BMI, and Weight Change by Alcohol Consumption Category. *

	Non-drinkers	**Moderate drinkers**	**Heavy drinkers**	**F**	**P**
Fiber in grams	13.7 ± 6.7	13.3 ± 405	14.2 ± 8.3	0.26	0.77
Calcium in mg	784.0 ± 4.7	734.8 ± 269	705.5 ± 1.5	0.99	0.40
Kcal/kg	28.0 ± 5.1	30.0 ± 315	31.0 ± 1.3	1.99	0.14
**% kcal from fat ** **	31.2 ± 5.7	31.6 ± 4.7	29.6 ± 4.7	3.14	.045
Mean % body fat	21.6 ± 7.3	24.1 ± 7.5	21.7 ± 7.7	2.0	0.14
BMI	23.9 ± 3.9	23.2 ± 3.6	23.6 ± 3.5	.449	.639
**Weight change ** **	2.94 ± 6.80	1.06 ± 6.2	-.55 ± 7.9	4.46	.013

*One-way ANOVA p<0.05

** Heavy drinkers significantly different from non-drinkers

Discussion:

Subjects gained a small amount (< 2 pounds) of weight from September to April. Much like the study done by Butler et al. where a decrease in caloric intake in freshmen women was found from the beginning of the school year and 5 months later (13). Our findings are consistent with other studies that found small but significant increases in body weight during an academic year of college (13, 14). No previous studies have reported meal frequency and breakfast consumption in college students.

This study was able to report the association between weight change and breakfast consumption in the college population. Our results like those of Bertone et al. showed that those who did not eat breakfast gained more weight compared to breakfast eaters (15). Although these differences were not significant, over a long period of time this trend could cause a significant difference in weight change between these two groups. This could indicate that eating breakfast between 5:00AM and 10:00 AM four or more times per week is important in weight management.

Types of foods eaten for breakfast have been shown in other studies to be associated with weight change and could therefore be an important component in weight management (6). Findings from the present study suggested that breakfast categories such as cooked cereal, beverages, and mixed breakfast groups may be associated with weight loss where other BF groups may be associated with weight gain (Meat and eggs, Meal replacements/protein shakes). Although the reason for these results is unknown, high fiber content and greater food variety may be possible explanations for why weight loss occurred among cooked cereal and mixed BF eaters. Potential mechanisms as to why the sugar sweetened beverages group lost weight are unknown, however this finding was consistent with a study done in conjunction with NHANES III that showed no association between sugar sweetened beverages and obesity risk (16). Many breakfast meats are high in fat and eggs are often coupled with butter. This may help to explain the weight gain in this category. Protein and meal replacement shakes are also high in calories and sometimes contain high percentages of fat. These supplements are also marketed to populations who desire to gain weight and or muscle. It seems reasonable therefore that shakes would be associated with weight gain. An additional question that was not addressed in this study was whether subjects intentionally gained or lost weight.

Fifty-six percent of subjects ate fewer than 4 meals per day, indicating potential for interventions geared toward increasing meal frequency throughout the day. This is consistent with findings from Koletzko et al who also found that fewer subjects ate more than 4 meals per day, and these subjects gained less weight compared to subjects who ate less often (7). Although results from the current study failed to show a strong association between meal frequency and weight change, meal frequency could still play an important role in weight maintenance over time. Alcohol consumed without food was included as a meal. Including alcohol as a meal could confound the influence of meal frequency on weight gain since other studies have shown alcohol intake to be associated with weight gain.

In a study by Heliovara, women who abstained from alcohol were at higher risk of obesity than those who consumed alcohol in moderation (17). This study assessed the association between weight change and alcohol consumption in college students. Surprisingly, these results indicated that heavy drinkers actually lost weight. This could be due to greater physical activity among drinkers and or saving calories earlier in the day. The drinking patterns of this population are most likely different from the general populations. College aged students tend to binge drink one to two nights per week and the primary for drinking is to get drunk, while the general population may drink in moderation more times per week (18).

Overall subjects who did not drink had better diet quality than heavy drinkers. Non drinkers took in fewer calories/kg/day and more calcium compared to heavy drinkers. Subjects who drank heavily had a higher fiber intake compared moderate and non-drinker, the reason for this is unclear. Baseline BMI was similar for all subjects; mean body fat percent was highest for moderate drinkers supporting a study done by Wannamethee et al that found alcohol intake to be associated with higher body fat percent (19). Heavy drinkers consumed the most kcal/kg followed by moderate and non-drinking groups respectively; this is consistent with findings from Verwegen et al.(20). Moderate and non-drinking groups consumed similar kcals from fat. Heavy drinkers consumed less percent kcals from fat; possibly substituting these for other macronutrients. Weight change was surprisingly significantly higher in the non-drinking group, compared to the heavy drinking group; reasons for this are unclear. Heavy drinkers actually lost weight while moderate and non-drinkers gained weight.

This study may have had different results had it not been conducted during football season. A significant difference in alcohol consumption from September to April was observed (.83 to .62 respectively $p=.002$).

When human subjects are involved and self-reported behaviors are reported, there is a chance of self-selection bias that could affect the results. Subjects were all enrolled in health and nutrition courses, therefore weight gain may have been lower due to their interest in nutrition and overall health. Despite these limitations, results from this study suggest that college students are vulnerable to weight gain and that breakfast consumption and meal frequency may be related to weight gain, especially if a more representative sample was recruited. This was the first study to our knowledge that considered associations between weight gain, meal frequency and breakfast consumption in the college population.

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Chapter 4: Summary

Greater breakfast consumption per week and higher meal frequency were associated with slightly less weight gain, but differences were not statistically significant. Similar results were found for meal frequency and weight change. Although a significant increase in weight was found among non-drinkers, more studies are warranted to investigate this finding. This was the first study to our knowledge that considered associations between weight gain and meal frequency and breakfast consumption in the college population.

Because this was a pilot study, there were limitations. The subject population who were largely Caucasian females enrolled in freshmen level food and nutrition or personal health courses did not represent the majority of the student population. Only a portion (46%) of subjects completed the data in April. There is a potential that subjects who did not complete the latter part of the study chose not to complete requirements because of their realization of their poor diet or weight gain over the 7 month period.

Overall it seems that small changes in both breakfast and meal frequency can have an impact on weight maintenance over a long period of time. This study was able to reinforce this idea by showing a trend in less weight gained over a 7 month period when subjects ate more frequently and consumed more breakfasts per week.

Implications for Research and Practice:

This study helped to strengthen the literature on meal frequency and breakfast consumption as they are associated with changes in body weight, BMI, and body fat percentage. The study was also the first to our knowledge to use subjects in a college setting to assess these associations. Our findings suggest that although students may not gain 15 pounds their first year of college, weight gain does seem to be a trend in this population. If this trend continued over a life time, serious health consequences could occur.

Results from our study showed that breakfast consumption and meal frequency were inversely related to weight gain. In addition less than half of the subjects in this study ate 4 or more BF per week or greater than 4 meals per day. Breakfast type also seemed to play a role in weight management. Cooked cereals seemed to be associated with weight loss while meat and eggs as well as meal replacement shakes caused weight gain. Interventions targeted toward first-year college students should therefore be designed to increase breakfast consumption and promote types of breakfast that are beneficial to weight maintenance and are easily accessible to college students. An effort should also be made to increase overall meal frequency though out the day. Small increases in meals per day and breakfasts per week as well as being mindful of breakfast types and overall food quality may have a positive influence over time on maintaining a healthy weight during a college career.

Final Thoughts:

Additional data gathered during this pilot study has yet to be analyzed. Our next course of action includes comparing subject activity levels and intensity to drinking frequency using Pearson's correlation. By doing so we may be able to shine light on why or heavy drinkers lost weight. Excluding alcohol as a meal may also give us different results in meal frequency as it relates to weight gain.

Irregular schedules, lack of healthy food choices, and time constraints are all barriers many college students face. Interventions geared toward eating breakfast as well as breakfast type and meal planning to increase eating frequency thoughout the day may be invaluable for preventing weight gain during student's college career. This study supported other studies that showed a correlation between breakfast consumption, type, and meal frequency as key roles in weight management (6-11). Future studies with larger population size and greater class and major diversity may be beneficial in adding to these findings.

APPENDIX A: INFORMED CONSENT

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Informed Consent for Participants in Research Projects Involving Human Subjects

Title of Project: Pilot Study: Crush the Freshman 15

Investigators: Kathy Hosig, Ph.D, MPH, RD, Shelly Nickols-Richardson, PhD, RD, Linda Davis, M.S., R.D., Kerry Redican, EdD, Eileen Anderson, PhD, Janet Wojcik, PhD, Tricia Shepard

I. Purpose of this Research/Project

All students enrolled in HNFE 1004 and EDHL 1514 for Fall 2005 will be invited to participate in this study. Parental consent will be required for students under 18 years of age. This is a pilot study, and the purpose of the study is to find out whether an online nutrition and physical activity education program can help college students eat healthier, be more physically active, and maintain a healthy weight. Results will be used to plan larger studies in the future.

II. Procedures

Everyone who agrees to be in this study will be assigned to one of two groups; a comparison group or an intervention group. If you are assigned to the comparison group, you will complete data collection only. If you are assigned to the intervention group, you will complete data collection and have the opportunity to participate as much as you wish in activities provided to help you learn more about eating healthy and being physically active at Virginia Tech.

<u>Data Collection (all subjects)</u>

If you decide to participate in this study, you will be asked to do certain things at two different times during this academic year (2005-2006). The total time commitment for filling out questionnaires and body measurements is about 6 hours (3 hours each time).

Things you will be asked to do twice (once in September and once in early April) include:

1. Complete 7 questionnaires about your health, eating habits, physical activity, sleep habits and stress levels
2. Keep a record of your food intake and physical activity for 7 days
3. Come to a faculty office in Wallace Hall to have your weight, height, waist and hip, and skinfold (arm, back and chest for men; arm, abdomen and waist for women, chest for men/ hip for women) measurements taken; you will need to make an appointment to

come for these measurements when you have not eaten yet that day and have only had a maximum of 1 cup (8 ounces) of beverage that day. A skinfold is measured by pinching together 2 layers of skin and measuring how thick they are.

You will receive the questionnaires and food/activity via email before your appointment for the body measurements. If you prefer to have printed copies of these forms, you may inform Dr. Hosig and stop by her office to pick them up. You will bring the completed forms to your body measurement appointment.

Your weight and height and waist/hip circumference measurements will be taken in a faculty office (Dr. Hosig's office in 227 Wallace) by either Dr. Hosig or a graduate research assistant. The door will be partially open. You will keep your clothes on but will be asked to remove any outer clothing such as hat, coat, sweater and shoes. We will measure your hips and waist over light clothing such as a t-shirt and cotton shorts or pants. We will measure skinfolds on bare skin, but we will bare only the section being measured. You may have to loosen the waistband of your pants so that we can get an accurate waist measurement. If you wear clothes that are too thick or tight, we will provide a t-shirt and shorts for you to change into in the restroom down the hall before your measurements are taken.

<u>Intervention Program (only subjects assigned to the intervention group)</u>
If you are assigned to the intervention group, you will have access to a Blackboard™ site that is designed to provide short educational flyers about eating healthy and being physically active. This site will also give you tips on how to eat healthy and be physically active at Virginia Tech, help you find people to eat or exercise with, provide links to other information that you might find helpful, invite you to social events for study participants, and ask you to complete daily checklists about foods you eat and your physical activity. You will sometimes receive emails about the study through the Blackboard™ site. You will not be required to participate in any parts of the intervention. You may choose to do all or none of the things available to you. The study site will show on your Blackboard™ account any time you access the system for your Virginia Tech courses, but you will determine how often you access it by clicking on the link for that site.

III. Risks

Some subjects may be uncomfortable having body measurements taken; we will keep the door to the room partially closed so that you will have privacy during these measurements.

Some subjects may experience minor emotional distress during completion of the questionnaires; you may refuse to answer any questions that make you feel uncomfortable. The questions on the questionnaires are not designed to be about sensitive information.

IV. Benefits

Potential benefits of participation in this study include receiving personal information about your body measurements, nutrient content of your diet, sleep patterns and stress level. You may request a copy of your body measurements, nutrient analysis from your food record, sleep patterns and stress level once they are analyzed by checking the appropriate box(es) on this consent form.

The general public, especially college students, may benefit from this study if the intervention is successful in improving diet and physical activity habits of college students. Researchers can use results of the study to plan future larger interventions. Results of this study may be distributed in newsletters to college students and in scientific journals.

V. Extent of Anonymity and Confidentiality

All of your information from the study will be confidential. Your name will not be used on the questionnaires, food and activity record, body measurement forms, or any other data collection forms. Instead, you will be given a special code number that will be on these forms. The researchers will keep a list of names and code numbers in a locked file cabinet. This list is to make sure that the correct code number is put on the forms you get so that all of your information has the same code number. Your code number will be put on the forms when you bring them to your body measurement appointment. Published results will not contain results for individual subjects.

VI. Compensation

You will be compensated separately for participation in each data collection period (two periods – beginning of Fall semester; end of Spring semester).

Compensation available for completion of all components for the Fall semester data collection period is 15 extra credit points for HNFE 1004 and/or credit for the applied component (15% of course points) of EDHL 1514. Compensation for partial completion of data collection components will be provided as follows: 5 points (HNFE) or 5% of course points (EDHL) for questionnaires; 5 points (HNFE) or 5% of course points (EDHL) for food/activity record; 5 points (HNFE) or 5% of course points (EDHL) for body measurements. You may earn an equal number of points in these classes by alternate means, even if you decide not to participate in this study.

Compensation available for completion of all components for the Spring semester data collection period is $20. Only subjects who participated in data collection at the beginning of the study will be eligible to participate in subsequent data collection periods, because the researchers need data from each time period for each subject for data analysis. Compensation for partial completion of data collection components will be provided as follows: $5 for questionnaires; $5 for food/activity record; $10 for body measurements.

VII. Freedom to Withdraw

If you agree to participate in this study, you are free to withdraw or stop participation at any time without penalty. You will receive compensation for any part of the study that you have completed, as shown above. If you choose to withdraw during Fall semester, your grade in the course will not be affected. You will not receive compensation for any parts of the study that you did not complete, but the points that you have earned for the course will not be reduced. If you withdraw from the study, you may gain unearned points up to 15 points maximum (HNFE) or 15% of course points (EDHL) – for each 15 extra credit points (HNFE) or 15% of course points (EDHL), you may keep a detailed 7-day food and activity record, enter the information into a nutrient analysis program available online, and turn in the food/activity record, printed nutrient analysis results, and a one-page paper describing the experience and analyzing your personal results. You will turn in this assignment to your instructor for the class; completion of requirements for compensation will be verified by the researchers and conveyed to your instructor for the course in which you are enrolled (HNFE or EDHL).

If the researchers decide that you should not continue as a subject for any reason, such as missing data or incomplete information on study forms, you may be asked to withdraw from the study. If this happens, you will receive compensation as above for any parts of the study that you completed. Your grade for the course will not be affected. You will not receive points for any parts of the study that you did not complete, but the points that you have earned for the course will not be reduced. You may gain unearned points as described above - for each 15 extra credit points (HNFE) or 15% of course points (EDHL), you may keep a detailed 7-day food and activity record, enter the information into a nutrient analysis program available online, and turn in the food/activity record, printed nutrient analysis results, and a one-page paper describing the experience and analyzing your personal results. You will turn in this assignment to your instructor for the class; completion of requirements for compensation will be verified by the researchers and conveyed to your instructor for the course in which you are enrolled (HNFE or EDHL).

VIII. Subject's Responsibilities

I voluntarily agree to participate in this study. By agreeing to participate in the study, I agree to complete all responsibilities listed above in section II, Procedures. I understand my right to withdraw my participation at any time.

X. Subject's Permission

I am 18 years of age or older have read and understand the Informed Consent and conditions of this project. I have had all my questions answered and have been given a copy of this form to keep. I hereby acknowledge the above and give my voluntary consent to participate:

____ Date __________________

Signature

Subject information:

Printed Name: ____

Phone number: ____________________ E-mail address: ____________________________________

☐ I would like to receive a copy of my nutrient analysis results when complete.

☐ I would like to receive a copy of my body measurements.

☐ I would like to receive a copy of my sleep questionnaire results.

☐ I would like to receive a copy of my stress questionnaire results.

Should I have any pertinent questions about this research or its conduct, and research subjects' rights, and whom to contact in the event of a research-related injury to the subject, I may contact:

Dr. Kathy Hosig______________ (540) 231-4900/ khosig@vt.edu
Investigator Telephone/ e-mail

Dr. William G. Herbert________ (540) 231-6565/ wgherb@vt.edu
Departmental Reviewer Telephone/ e-mail

Dr. David Moore_____________ (540) 231-4991/ moored@vt.edu
IRB Chair Telephone/ e-mail
Institutional Review Board
for Human Subject Research Ethics

APPENDIX B: DEMOGRAPHIC SURVEY

Pilot Study: Crush the Freshman 15

Your Code Number (entered by staff members when you come to be weighed and measured): _________

General Information About You

Age:_____   **Date of birth:**_____________   **Gender** (circle):
Female   Male

Race/Ethnic background (check all that apply):

_____ White   _____ Asian/ Pacific Islander   _____ Native American

_____ Black/African American   _____ Other (please specify): ________________________

Are you Hispanic or Latino (circle)?   YES   NO

Major (if known): ____________________________   **OR** ____ Unknown at this time (check)

Please check **all** courses below that you are currently taking:

_____ Morning section of HNFE 1004 (nutrition, foods and exercise)

_____ Afternoon section of HNFE 1004 (nutrition, foods and exercise)

_____ On-campus section of EDHL 1514 (personal health)

_____ Online section of EDHL 1514 (personal health)

Were you an **athlete in high school** (circle)?   YES   NO

if yes, what sport(s) did you play: ____

Do you **play sports in college** (circle)?   YES   NO

if yes, please indicate which which level and which sport(s) you play below:

____ collegiate: ____

____ club level: ____

____ intramural: ____

Please indicate **reasons you are taking the course(s)** you are taking: (mark all that apply)

Reason for taking	**HNFE 1004**	**EDHL 1514**
Required for major		
Meets university core requirement		
Elective		
Increase GPA		
Interest in topic		
Class was at a convenient time		
Other: please specify:		
Other: please specify:		

APPENDIX C: INSTRUCTIONS FOR COMPLETING FOOD/ACTIVITY RECORD

Instructions for Completing the 7-Day Food Record

It is extremely important that you take this part of the study seriously. We need for you to be as complete and specific as possible.

1. Please don't forget to write down **what time you got up** for the day!!!!

2. Please write down **everything** you eat or drink as soon as possible after you consume it.

3. Include **anything** you "eat", including hard candy, gum, etc.

4. Please fill out each column for each food item

Time

We need this to see if timing of eating makes a difference in the things we are looking at

Amount

We need this to be able to enter your food intake correctly into the computer. Use your best judgment, and here are some tips:

a. 1 cup is about the size of a baseball (or a half-pint milk carton from the cafeteria, or your fist if your hand is average size) – also usually 1 scoop of main dish at a cafeteria
   i. ½ cup is about the size of a tennis ball (usually 1 scoop of side dish at a cafeteria)
   ii. 1 teaspoon is about the size of the end of your thumb – 3 teaspoons is 1 tablespoon
   iii. ¼ cup is about the size of a golf ball
   iv. 3 ounces of meat is about the size of a deck of cards
b. Try to use amounts such as cups, tablespoons, ounces, etc. if possible, but just describe the amount if you are not sure
c. If the item is a standard size at a fast food restaurant, you can just say exactly what the item was and what size (small/medium/large, 6-inch/12-inch, single/double, etc.) – remember to say WHERE you ate
d. If you make it yourself, tell us how many pieces/slices of EACH thing on sandwiches, how much of EACH condiment or topping, etc.
e. For drinks, tell us whether it was regular or diet, sweet or unsweetened, and the SIZE (small/medium/large, 8-oz/12-oz/16-oz./20-oz./24-oz), and

anything you added (i.e. cream, sugar, etc.) **– please don't forget to include drinks!!!**

f. If the item is one "pack" or "package", please tell us the size of the package – should be on the package itself

g. For any foods that you can, especially bread/cereal/pasta/rice, etc., please tell us the **BRAND NAME and PRODUCT NAME** of the food you ate.]

5. **Examples** of complete entries: **use your own information and serving sizes, of course!!!**

Please email me at khosig@vt.edu if you have any questions about how to enter a food that you ate – I will respond quickly

a. Kellogg's Complete Bran Flakes – 1.5 cups
b. Pepperidge Farms Multi-Grain Bagel – 1 large bagel (12oz per 6 bagels)
c. Entenmann Chocolate Cake Donuts, large – 2 donuts
d. Chips Ahoy Chewy Chocolate Chip Cookies – 4 cookies
e. Quaker Chewy Granola Bars (peanut butter and chocolate chip) – 2 bars
f. Kraft Singles 2% American Cheese – 1 slice
g. Plumrose Deli Ham, baked – 2 slices
h. Kraft Light Done Right ranch salad dressing – 3 tablespoons, ¼ cup, etc.

CONTINUES………..(over)

i. Kroger 2% milk – 1 cup
j. Subway 6-inch turkey/ham with provolone on honey/oat bread with mayo, mustard, pickle, black olives, etc.
k. Firehouse large pepperoni and mushroom pizza, regular crust (or thin crust, etc.) – 4 slices
l. Chef Salad at Dietrick – large with 1 cup lettuce, ¼ cup ham, ¼ cup turkey, 1 egg, ¼ cup cheese, ½ cup croutons, ¼ cup bacon bits, ¼ cup green pepper, ½ cup regular (as opposed to low fat or fat free) French dressing
m. Spaghetti with meat sauce – 2 cups pasta with 1 cup sauce and ¼ cup Parmesan Cheese
n. Mello Yello (regular) – 20oz bottle (or 12oz can, etc.)
o. Dr. Pepper (diet) – 20oz bottle (or 16oz cup, etc.)
p. Hardees 1/3 pound thickburger with mayo, mustard, lettuce, tomato
q. Wendy's single cheeseburger with lettuce, tomato, mayo
r. Krispy Kreme chocolate glazed crème-filled doughnut – 2 doughnuts
s. Sweet tea – Big Gulp at 7-Eleven (indicate ounces if you know it)
t. Beer – indicate how many draft beers, how many cans, name and whether regular or light

u. Extra sugar-free gum – 1 slice
v. Skittles candy – 1 bag (1.15 ounce)
w. Apple – 1 large
x. Banana – 1 medium
y. Broccoli with cheese sauce – ¾ cup
z. Campbell's Chunky Vegetable Beef soup – 1 can
aa. Great Value saltine crackers – 8 squares
bb. Canned peaches in heavy syrup (or light syrup or juice) – ½ cup, or 4 slices
cc. Kraft Easy Mac macaroni and cheese – 2 packages
dd. Kroger macaroni and cheese from mix – 2 cups
ee. Tuna sandwich – 1 can tuna in oil (drained), 3 tablespoons regular mayo, dash salt and pepper, 2 slices Kroger sandwich bread
ff. Peanut butter sandwich – 3 tablespoons Jif peanut butter, 1 tablespoon grape jelly, 2 slices Arnold 7-grain bread
gg. Ramen noodles, oriental flavor – 1 package (3 oz)
hh. Sbarro broccoli and spinach stromboli, small
ii. Sbarro large drink, Dr. Pepper
jj. Casserole with pasta, chicken, carrots, corn, lima beans, peas – 1.5 cups total (could put recipe in "special notes" column if you made it or know the proportions)
kk. Red grapes – 1 cup (or might use number such as 10 grapes, if you count them, or say 1 handful, 2 handfuls, etc.)

6. **Please don't forget to write down your physical activity** for the day on the front of the food/activity record, even if you don't use the back for food

Again, please be specific about what you did, how strenuous it was, and how long

Examples (use actual time, etc.):

a. basketball, full court, 20 minutes
b. jogged, 10-minute mile, 45 minutes
c. cardio machines, 30 minutes
d. walked, 40 minutes total
e. bicycle, outdoor, 1 hour
f. racquetball, 30 minutes
g. land aerobics class, 30 minutes
h. lifted weights, total actual lifting time 20 minutes

APPENDIX D: FOOD ACTIVITY RECORD

Food/Activity Record – Crush the Freshman 15 Pilot

Code # (entered when you are weighed)___________ Day of Week ____________________ Date ______________

What time did you get up today? ___________________ (include am or pm)
How many hours did you sleep last night? _________________

If you napped today, please list how long you napped: ________________________________

*Remember: Please do not alter your normal activity or diet while keeping this record. Keep the record for 7 consecutive days. Use additional pages for each day if necessary. For foods eaten out, indicate where foods were purchased. For mixed foods, include recipe on a separate page.

Physical Activity
Please list any physical activity you had today, **including walking around campus to and from class**.

Type of activity	Time spent in minutes	Special Notes

Food You Ate Today – (continue on next page)

Time	Food eaten- How prepared	Amount Eaten	Special Notes

Continued on back……….

Day of week:
Date:

Time	Food Eaten - How Prepared	Amount Eaten	Special Notes

APPENDIX E: ANTHROPOMETRIC DATA COLLECTION INSTRUMENT

Anthropometric Data Collection Form

Pilot Study: Crush the Freshman 15

Subject Code Number: _______________ **ProjectStaff:**___________

Date: ____________________ Time of day: ____________ am / pm

Weight: ____________________ pounds

Height: ____________________ inches

Circumferences

Waist – narrowest point (cm)__________

____

____

Waist – above suprailiac crest (cm) __________

____

____

Hip (cm): __________

____

____

Abdomen (cm) __________

____

____

Skinfold Measurements

Abdominal skinfold: __________

____

____

Triceps skinfold__________

____

____

Subscapular skinfold: __________

____

____

Suprailiac skinfold:__________

____

____

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

Institutional Review Board

Dr. David M. Moore
IRB (Human Subjects)Chair
Assistant Vice President for Research Compliance
CVM Phase II- Duckpond Dr., Blacksburg, VA 24061-0442
Office: 540/231-4991; FAX: 540/231-6033
email: moored@vt.edu

DATE: July 29, 2005

MEMORANDUM

TO: Kathy Hosig HNFE 0430
Sharon M. Nickols Human Nutrition, Foods, & Exercise 0430
Linda Davis HNFE 0430
Eileen S. Anderson Psychology 0274

FROM: David Moore

SUBJECT: **IRB Expedited Approval:** "Pilot Study: Crush the Freshman 15" IRB # 05-454

This memo is regarding the above-mentioned protocol. The proposed research is eligible for expedited review according to the specifications authorized by 45 CFR 46.110 and 21 CFR 56.110. As Chair of the Virginia Tech Institutional Review Board, I have granted approval to the study for a period of 12 months, effective July 29, 2005.

Virginia Tech has an approved Federal Wide Assurance (FWA00000572, exp. 7/20/07) on file with OHRP, and its IRB Registration Number is IRB00000667.

cc: File
Department Reviewer: William G. Herbert

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