Dietary Patterns Associated with Weight Change in College Students

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ABSTRACT

Objective: To examine associations between weight change and dietary patterns in college students.
Design: A longitudinal observational study. Dietary intake and physical activity were self-reported on seven-day food records and compared to dietary guidelines for compliance with recommendations.
Subjects/Setting: Data from 80 students enrolled in a fall semester introductory nutrition course at a large state university were analyzed in the fall and spring semester.
Main outcome measures: Daily servings of total fruit (fruit and juice), total vegetables (fried and non-fried), dairy (regular and low-fat), whole grains, and dietary fiber, breakfast consumption, body weight changes and physical activity.
Statistical Analysis Performed: Associations between diet quality and weight change were analyzed using Chi-square analysis. Weight change was analyzed by diet quality and breakfast consumption using t-test and by metabolic equivalents (METHRS/day) using one-way analysis of variance (ANOVA) ($p<0.05$). Significant associations were analyzed by Pearson's correlation (two-sided, $p<0.05$).
Results: Weight and body mass index (BMI kg/m^2) were significantly higher compared to baseline. The majority of students did not meet recommendations for daily servings of fruit, vegetable, dairy, whole grains, and dietary fiber. Higher diet quality was significantly associated with more frequent breakfast consumption and students who maintained or lost weight reported significantly higher intakes of total fruit, low-fat dairy and whole grains.
Conclusion: Failure to meet dietary guidelines resulting in lower diet quality was distinctive of this population and was associated with significant changes in body weight over one academic year.
Applications: Educational interventions aimed at improving diet quality may inhibit weight gain commonly seen in college students.

Attribution

Throughout the course of my graduate school experience, I was fortunate to have the guidance and expertise of Dr. Kathy Hosig, Dr. Sharon Nickols-Richardson, Dr. Eileen Anderson, and Dr. Kerry Redican to help guide my research and studies until the completion of my Masters degree in Nutrition Education and Behavior.

Dr. Kathy Hosig, my advisor, mentor, and committee chair, received her B.S. in Human Nutrition, and Foods/Dietetics from Virginia Tech. She received 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. Dr. Hosig contributed tremendous amounts of time and energy into the pilot data collection phase while revising my progress throughout the course of my graduate studies.

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. Her expertise in human nutrition was applied to the structure of the methods used to implement the project and in conducting bone measurements on subjects.

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. She contributed a large amount of resources into the statistical methods and measuring metabolic equivalents of activities participated in by subjects.

Dr. Kerry Redican received a B.A. in Health Education from California State, Long Beach, a M.S. in Public Health from the University of California, Los Angeles, and a Ph.D. in Health Education from the University of Illinois at Urbana-Champaign.

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Chapter 1:

INTRODUCTION

The prevalence of obesity in the Unites States (US) has reached epidemic proportions. Data from the National Health and Nutrition Examination Surveys (NHANES) in 2003-2004 indicated that 57.1% of adults aged 20-39 years were overweight or obese and 66.3% of all US adults were overweight or obese (1). Obesity places individuals at a greater risk for many chronic conditions such as diabetes, hypertension, hypercholesterolemia, stroke, heart disease, certain cancers, and arthritis (2-6). In the US alone, an estimated 300,000 adults die from causes related to obesity annually (7). This places poor diet and physical inactivity combined, two major factors associated with obesity, as the number two cause of preventable death in the US (8).

An alarming increase in overweight is also seen in our nation's children and adolescents. In 2003-2004, 17.4% of adolescents (ages 12-19) were overweight [defined as at or above the 95^{th} percentile of body mass index (BMI kg/m^2) for age] compared to 15.5% in 1999-2000 (1,4). This same trend is also seen in children which puts them at risk to have one or several cardiovascular risk factors as well as becoming overweight adults (2,8-11).

The transition period from late adolescence to young adulthood is a particularly difficult time where many behavioral and physiological changes occur (12,13). Eating behaviors, diet quality and physical activity may change throughout this transition resulting in an increased risk of obesity (14). Gordon-Larsen et al. (15) found that the body mass index (BMI kg/m^2) of young adults was higher than the BMI of adolescents. However, a frequency distribution of BMI data from NHANES wave II and wave III compared with data from NHANES wave I showed that the

positive shift was greater at the upper end of the distribution, indicating an increase in obesity instead of normal growth. Also, the proportion of adolescents who became and remained obese into adulthood was very high; highlighting that this transition period coincides with a period of increased risk of development and maintenance of obesity (16).

The belief that young adults entering college gain 15 pounds during their first year at school is known as the "Freshman 15". Levitsky et al. (17) reported significant weight gain (1.9 $\pm$ 2.4 kg, P<.001) and increases in BMI (from 20.8 $\pm$ 2.1 to 21.5 $\pm$ 2.3 kg/m^2, P<.01) in college freshmen during the first 12 weeks of school along with an exaggerated rate of weight gain. However, limitations from this study along with others, such as using questionnaires to measure dietary and physical activity patterns in college students, provide crude estimates on habits and do not allow determination of an association between particular dietary or physical activity patterns with the weight gain.

Diet quality has also been shown to decrease from childhood to young adulthood. Results from the Bogalusa Heart Study found a dramatic shift in diet quality, with consumption of low-quality foods increasing twofold and consumption of high-quality foods decreasing 10% from childhood to young adulthood (18). This transition period is also characterized by decreased milk and fruit consumption and increased carbonated and/or sweetened beverage consumption (14,16).

The 2005 Dietary Guidelines (DG) recommend that adults participate in at least 60 minutes of moderate physical activity for weight maintenance and children to participate in 60 minutes of moderate physical activity most days of the week (18). However, the Surgeon General's report on Physical Activity and Health in 2001 reported that 40% of adults reported no leisure-time physical activity (19). Physical activity has also been shown to decline from

adolescence to young adulthood (15). Decreased diet quality and decreased physical activity characteristic of this transition period together serve as strong predictors of adult obesity (4).

Certain nutrients and dietary patterns have been associated with successful weight maintenance. Fruits and vegetables are high in fiber and water and have been shown to promote satiety, decrease energy intake and reduce energy density (20). Incorporating fruits and vegetables in the diet could displace more energy-dense foods resulting in decreased energy intake which is an effective strategy for weight loss and maintenance (20,21). The 2005 DG recommend three or more ounce-equivalents of whole grains per day for healthy adults (18). Whole grains are a good source of fiber and may help with weight maintenance by promoting a more slowly processed meal, earlier feelings of satiety and increased micronutrient intake (22). Consumption of milk products has been associated with overall diet quality and may have beneficial effects on body weight (18,23-26).

Dietary patterns that are low in fat, sugar, red and processed meats and are high in fruits, vegetables, reduced-fat dairy, whole grains and variety can decrease body weight and prevent weight gain over time (21,27). Also, consuming four or more meals per day may significantly reduce the risk of obesity compared to eating three or more meals per day (28). Particularly, meal patterns including regular breakfast consumption have been associated with lower body weight and improved dietary intake (29). Adults who skip breakfast are at higher risk for weight gain and are more likely to have less healthy behaviors such as increased snacking, sedentary lifestyle, smoking and high BMI (30).

The purpose of this study was to determine whether diet quality was associated with weight change in college students. Dietary variables included were daily servings of total fruit (fruit and juice), total vegetables (fried and non-fried), dairy (regular and low-fat), whole grains,

daily intakes of fiber and weekly breakfast consumption. This information can be used to determine which dietary variables are associated with weight change in college students and should be targeted during educational interventions.

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Chapter 2:

LITERATURE REVIEW

DIETARY FACTORS ASSOCIATED WITH BODY WEIGHT AND OBESITY

FRUITS AND VEGETABLES

Consuming fruits and vegetables in portions recommended by the 2005 DG can reduce the overall energy density of the diet and could displace more energy-dense foods (1,2). Reduced caloric intakes combined with increased diet quality are effective strategies for weight loss and weight maintenance. Including large amounts of fruits and vegetables as part of a healthful diet may also reduce a person's risk of chronic diseases such as stroke, cardiovascular disease (CVD), type 2 diabetes, and certain cancers (3). Despite the well documented benefits, data from the Behavioral Risk Factor Surveillance System in 2000 reported that only 24.4% of US adults ate fruits and vegetables at least 5 times a day (4).

Previous research has shown that increased satiety and decreased energy intake at subsequent meals was associated with reducing the energy density of a preload by increasing the water content (5,6). Fruits and vegetables could increase satiety in a similar way due to their low energy density and high water content (7,8). In one particular study, the satiety index of 38 common foods was compared and researchers concluded that fruits received the highest satiety rating (9).

Several intervention trials that advised subjects to increase fruit and vegetable intake found that subjects successfully maintained their body weight (10-12). The Women's Healthy

Eating and Living Study found that 74% of subjects maintained weight and 11% lost weight when they were advised to increase fruit and vegetables and decrease fat intake, with no weight loss component included in the study (13). Similar results were found in the Polyp Prevention Trial when subjects lost a significant amount of weight and remained below their baseline weight after 4 years when advised to increase fruit and vegetable intake and decrease dietary fat (14).

One prospective cohort study conducted in the Nurses' Health Study examined the changes in fruit and vegetable intake in relation to risk of obesity and weight gain among middle-aged women (15). An inverse association was found between increased fruit and vegetable intake over time and risk of weight gain or obesity. Significant decreases in BMI were also found as fruit and vegetable intake increased in subjects from the National Health and Nutrition Examination Survey Epidemiologic Follow-up Study (16).

Promoting increased fruit and vegetable consumption for successful weight loss and weight maintenance emphasizes a positive message rather than a negative approach to weight. Encouraging increased consumption of healthy foods instead of restricting particular foods, which is often associated with dieting, is a healthy option for the public to follow (1).

CALCIUM/ DAIRY FOODS

Calcium and/or dairy foods play an important role against diseases such as osteoporosis, hypertension, certain cancers, insulin resistance syndrome and obesity (17). Calcium and total dairy intakes have been associated with decreased body fat and increased dietary variety and may be one important adjustable factor in a person's diet that may decrease their risk of developing obesity later in life (18,19).

Several large epidemiological studies have found an inverse relationship between calcium intake, body fat, BMI and body weight (20,21). Data from the Continuing Survey of Food Intakes by Individuals showed a dose-response relationship between obesity prevalence and calcium intake in women (22). The Coronary Artery Risk Development in Young Adults study found a similar inverse relationship between dairy food intake and incidence of obesity (23). Dietary calcium has also been associated with a reduction in body fat in mice and humans, particularly younger and older women (24-26).

Dietary quality and calcium intake has been positively associated in children and adults (18,19). Children's dietary scores were positively related to calcium intake and negatively related to carbonated/sweetened beverage intake (18). In adults, total dairy intake was associated with higher micronutrient intakes without influencing fat or dietary cholesterol, suggesting that people who consume more dairy foods may also make healthier choices related to their diet (19).

FIBER/WHOLE GRAINS

Whole grain products, fruits, vegetables and legumes are excellent sources of dietary fiber. These foods are generally lower in fat and added sugars and promote earlier satiety compared to more calorically dense foods (27). Diets containing generous amounts of fiber may reduce coronary heart disease risk (3,28). Specifically, whole grain intake is associated with decreased risk of developing CVD, diabetes, hypertension, all-cause mortality, and may reduce total blood cholesterol (29-31). The majority of grain products consumed in the US are highly refined with the average consumption of whole grains only one serving per day (28,30). This falls below the minimum three servings/day recommended in the 2005 DG. Data from

NHANES III reported that average intakes of fiber for women and men were 12.5 g/day to 14.7 g/day and 16.6 g/day to 20.0 g/day respectively (32). These intakes also fall below the 2005 DG recommendation of 20-35 g/day for healthy adults (27,31).

Whole grain intake is positively associated with dietary fiber intake (29) and micronutrient intakes such as magnesium, folate, vitamin E, vitamin B-6, zinc and calcium (30,33). Diets with increased whole grain intakes are associated with an overall healthier diet that is higher in fruits and vegetables (29) and lower in saturated fat, meat, cholesterol and alcohol (30,33). Several prospective cohort studies (29,33) and cross-sectional studies (30,31) showed that lifestyle patterns such as exercise, vitamin supplement use and not smoking were associated with whole grain intake. A general opposite effect was seen in women with greater refined grain intakes (33).

Dietary fiber and whole grain intake have been associated with less weight gain and lower BMI over time (28,29,33-35). Conversely, refined grain intake was related to greater weight gain over time (33). A dose response relationship has been found between whole grain intake and a decrease in BMI and waist circumference (29,35), suggesting that high fiber content of whole grain food may prevent weight gain or promote weight loss over time (30).

Proposed mechanisms for the role of high fiber diets that contain whole grains include favorable effects on weight loss and weight maintenance by decreasing energy intake due to its bulk, low energy density and through promoting earlier satiety (28,33,35). Whole grain foods are digested and absorbed more slowly with relatively lower insulin and glucose responses (33), compared to refined grain foods which more than double the glycemic and insulin responses when consumed (28).

DIETARY PATTERNS

Berrigan et al. (36) analyzed patterns of health behaviors in US adults, described by adherence to the public health recommendations for exercise, tobacco, alcohol, dietary fat and fruit and vegetable intake using data from NHANES III (1988-1994). The majority of adults did not adhere to recommendations for exercise, dietary fat and fruit and vegetable consumption but followed guidelines for alcohol and tobacco. This all too common pattern of unhealthy dietary patterns may be associated with the obesity epidemic sweeping our country today.

Certain food groups and nutrients are related to healthy dietary patterns and decreased risk of obesity. A diet mainly consisting of foods such as low-fat milk products, a variety of fruits and vegetables, whole grains and high fiber intake is associated with lower energy intakes and smaller gains in BMI over time (2,37-39) compared to people with lower intakes. Consuming higher amounts of high energy/low nutrient foods, red and processed meat, fat, sugar and low diet variety is associated with an increased risk of obesity (37) and greater gains in BMI over time (38,39).

Healthy dietary patterns are associated with healthy lifestyle factors (40). Being more physically active is associated with lower BMI and an improved diet profile, consuming a higher percent of energy from dietary fiber, protein and micronutrients such as folate, calcium, vitamin A, vitamin C and vitamin E (41). Decreased diet quality is associated with less exercise and frequency of eating meals away from home (42,43). Eating breakfast and/or dinner away from home were associated with significantly higher intakes of total calories and percentage of calories from total fat and saturated fat with an increased risk of obesity (43).

Irregular consumption of main meals may be related to poorer lifestyle factors and decreased diet quality (40). Subjects in the Baltimore Longitudinal Study of Aging had an increased risk of obesity if number of reported eating episodes per day was three or fewer (43). Breakfast skipping in these subjects was also associated with an increased risk of obesity. Eating patterns may be associated with obesity and adherence to public health recommendations may result in improved dietary quality and maintenance of weight.

BREAKFAST

Regular breakfast consumption has been associated with healthier diet choices and lifestyle behaviors in children, adolescents and adults (44,45). Breakfast consumption in 530 US schoolchildren, 9-19 years old was examined by their responses to a 124-item food checklist. The subjects' usual breakfast habits were then classified into one of six categories. The researchers found that subjects in the "Ready-to-eat cereal with fiber" category had significantly lower total cholesterol compared to all other categories. Regular breakfast consumption was also inversely related to serum total cholesterol and obesity, two risk factors for cardiovascular disease that may continue into adulthood (45).

Children and adolescents who skipped breakfast failed to meet the recommended dietary allowance (RDA) recommendations for several vitamins and minerals including vitamin A, vitamin D, calcium, and iron (45,46). The National Heart, Lung, and Blood Institute Growth and Health Study recruited 2,379 nine or ten year old girls at baseline for a 9 year longitudinal cohort study in which subjects completed annual 3-day food records (47). In adolescents, skipping breakfast was associated with a cluster of unhealthy behaviors and diet choices such as

smoking, alcohol drinking, caffeine intake and higher BMI. Similar results were found in 5,448 16 year old adolescent twins who filled out a behavioral and medical self-report questionnaire that also assessed breakfast frequency (44). Breakfast skipping was significantly associated with smoking, infrequent exercise, low education level at age 16, frequent alcohol consumption, and high BMI (44).

A cross-sectional survey of 504 young adults in Bogalusa, LA examined 24 hour dietary recalls that were collected from 1988 to 1991 (48). Researchers found that young adults who skipped breakfast did not meet two thirds of the RDA recommendations and the odds for dietary inadequacy were 2 to 5 times higher compared to those who ate breakfast (45,48). Breakfast skipping in adolescents and adults was associated with less health-conscious behaviors such as increased snacking, lunch skipping, sedentary lifestyle and obesity while general health-conscious behaviors were positively associated with breakfast consumption (44).

Breakfast is an excellent meal in which to consume foods and nutrients that are generally lacking in US diets. Common breakfast foods that are high in calcium include milk, yogurt and cheese. High fiber foods such as whole wheat toast and cereal are also often consumed at breakfast (49). Calcium and fiber intakes, along with vitamin D, vitamin C and phosphorus are significantly higher in breakfast eaters and intakes of these nutrients increase with frequency of breakfast consumption (46-48). The Bogalusa Heart Study showed that significantly more young adults consumed milk when they ate cereal for breakfast, compared to non-cereal eaters (45). Cereal consumption was also associated with significantly higher intakes of calcium and fiber and significantly lower intakes of fat and cholesterol in girls participating in the National Heart, Lung and Blood Institute Growth and health Study (50).

Despite the reported benefits of regular breakfast consumption being associated with lower BMI, healthier nutrient intakes and more health-conscious lifestyle behaviors, breakfast consumption may decrease over time. Over the past 25 years, breakfast consumption has decreased in all age groups, especially among adolescents (45-47,51,52). The frequency of breakfast consumption significantly decreases from adolescents to adults (44,45) and breakfast skipping is more prevalent in lower socioeconomic status groups (44). The percentages of young adults who skip breakfast are much higher than younger children (48,50). Furthermore, breakfast consumption is increasingly becoming less common among younger generations and this trend will most likely continue through adulthood (44).

DEFINING BREAKFAST

Breakfast has been defined by various ways such as; a meal consumed at a specified time of day, the first meal consumed after awakening, the type of food consumed, or a person's perceived breakfast meal (52). Previous researchers have defined breakfast for their subjects with a broad question such as "How often do you eat breakfast before going to school or going to work?" (44) or a specific definition such as the breakfast meal had to contain foods that equaled at least one serving of milk (48). Most commonly, breakfast is defined as eating between 5 AM and 10 AM on weekdays or 5AM to 11AM on weekends (47,50).

DIET QUALITY, PHYSICAL ACTIVITY, AND WEIGHT CHANGE IN COLLEGE STUDENTS

It has been well documented that a healthy lifestyle including regular physical activity is associated with healthy dietary choices. To determine if these associations were seen in college students, Johnson et al. (53) recruited 576 seniors to participate in a study comparing two health courses. Subjects were then randomly assigned to an intervention class or a control class. Health behaviors were measured by the college version of the Youth Risk Behavior Survey and physical activity was measured by a modification of the Blair Seven-Day Physical Activity Recall. Researchers found that not eating healthy foods was associated with consuming fatty foods in men and women. Among women, eating healthy foods was significantly related to more vigorous activity and higher levels of strength training were associated with eating less fatty foods. Researchers concluded that physical activity had modest associations with eating behaviors in college students.

Despite the association found between exercise and diet in college students, research findings indicate that this population is not following selected components of the DG for diet or physical activity and college students who fail to meet recommendations for physical activity are more likely to become sedentary adults (54). A cross-sectional study that examined dietary intake in 60 female college students showed that none of the subjects consumed the minimum servings from all food groups of the food guide pyramid (54). Sodium intake of 2,400 mg per day and saturated fat were exceeded by more than half of the subjects and two thirds of the subjects respectively. All respondents were noncompliant with DG for dietary variety. These results were similar to findings by Haberman and Luffey (55), in which a majority of college

students (76%) reported eating the same foods day after day. Furthermore, Racette et al. (56) assessed the dietary patterns of 764 college students during freshman and sophomore years and found that by the beginning of freshman year, 70% ate less than five servings of fruits and vegetables daily and more than 50% ate fried or high-fat fast foods at least three times during the previous week.

Dietary inadequacy was also found in two cross-sectional studies assessing diet and physical activity in college students. Two hundred and twenty six subjects aged 18 to 26 years participated in coronary heart disease risk screening by providing blood samples for information on serum cholesterol, blood pressure, and self-reported health behaviors (57). Researchers found that over half of the subjects consumed a diet high in saturated fats and one third of the subjects did not consume recommended intakes of fiber or participate in recommended levels of exercise (57). Huang et al. (58) evaluated diet using the Berkely fruit, vegetable, and fiber screener and physical activity by the Youth Risk Behavior Survey in 736 college students in spring of 2001 and 2002. A high percentage of subjects were overweight and had inadequate intakes of fruits, vegetables, and fiber and participated in low amounts of physical activity. However, no significant associations were found between diet and physical activity. Aerobic exercise was reported significantly higher in subjects $\leq$ 19 years compared to subjects $\geq$ 20 years, suggesting that physical activity may decrease over time (58).

The National College Health Risk Behavior Survey reported that 35% of college students may be overweight or obese (58). Additional research on this population have shown that students during freshman year may gain modest to significant amounts of weight, this trend is widely known as the "Freshman 15". Graham and Jones (59) surveyed incoming freshmen and reported that 90% of subjects had heard of the "Freshman 15" and could accurately describe

what it was (59). Sixty eight freshmen participated in a serial, correlational study that assessed the amount of weight gain and behaviors that were associated with weight gain during the first 12 weeks of school (60). Significant weight gain (1.9 $\pm$ 2.4 kg, P<.001) and increases in BMI (from 20.8 $\pm$ 2.1 to 21.5 $\pm$ 2.3 kg/m^2, P<.01) were seen over the 12 week period. Total weight gain in these subjects approximately equaled 7.41 kg over 12 months at the rate of weight gain these subjects experienced, which was much faster than what is observed in the general population. These subjects gained 158.3 g/wk during the 12 week study, while weight gain in adults has been estimated to be about 8 g/wk (60). Even though students did not gain the equivalent of the "Freshman 15", the exaggerated rate of weight gain may be yet another factor responsible for the obesity epidemic seen today.

Similar findings were found when weight and dietary intakes via three-day diet records were collected during the first 16 week semester of 27 freshman students (61). Mean body weight increased significantly (3.0lbs, p=0.001) and BMI increased significantly from 23.6$\pm$0.7 kg/m^2 to 24.1$\pm$0.8 kg/m^2 (p=0.002). Mean caloric intake did not change significantly, suggesting weight gain was due to decreased physical activity (61). In contrast, no significant increases in weight were found in 49 freshmen who completed questionnaires and were weighed at the beginning and end of their first academic year (59). Fifty nine percent of subjects gained an average of 4.6 pounds and 36% of subjects actually lost weight (59). Results suggested that the "Freshman 15" may be more of a harmful myth that can influence negative attitudes towards weight.

College presents an environment that has been characterized by unhealthy dietary patterns and reduced physical activity which places students at a greater risk of weight gain (62-64). The greatest increase in obesity from 1991 to 1997 was found among 18 to 29 year olds

(7.1% to 12.1%) and those with some college education compared to those with no college degree (10.6% to 17.8%) (63). Relatively few studies have measured dietary intakes and physical activity in college students to determine which measures were associated with weight change. Previous studies investigating the college population suggest that college students are a prime target for future health behavior interventions.

SUMMARY

Dietary patterns that include recommended servings of fruits, vegetables, whole grains and fiber, and dairy, combined with regular physical activity are optimal choices for weight loss or weight maintenance. Regular meal patterns that include breakfast and frequent meals throughout the day have also been associated with healthy lifestyles and maintaining weight over time. College students are a particular population that are at an increased risk for weight gain due to environmental and behavioral changes that are associated with decreased dietary quality and physical inactivity. Preventing weight gain in college students may have a profound impact on prevalence of overweight or obesity later in life. However, only a few studies have documented dietary and physical activity habits in college students, and to date, no studies have examined breakfast consumption. Previous research has measured dietary and physical activity patterns in college students over the first weeks of freshman year but results did not allow determination of an association between dietary and physical activity patterns. This study will follow students that range from freshman to seniors over the course of one academic year to examine such associations.

AIMS OF THE PRESENT STUDY

College lifestyle is characterized by unhealthy dietary patterns and reduced physical activity. Relatively few studies have attempted to document these patterns in students and to date; no studies have examined the association between breakfast consumption and weight change. The purpose of this study was to measure the association between diet quality and weight change in college students. Dietary quality was assessed based on daily servings of total fruit (fruit and juice), total vegetables (fried and non-fried), dairy (regular and low-fat), whole grains, daily intakes of fiber and weekly breakfast consumption. Higher diet quality was expected to be associated with lower weight gain. Greater number of breakfasts per week was expected to be associated with higher diet quality and lower weight gain.

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Chapter 3:

Dietary Patterns Associated with Weight Change in College Students

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Dietary Patterns associated with Weight Change in College Students

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ABSTRACT

Objective: To examine associations between weight change and dietary patterns in college students.
Design: A longitudinal observational study. Dietary intake and physical activity were self-reported on seven-day food records and compared to dietary guidelines for compliance with recommendations.
Subjects/Setting: Data from 80 students enrolled in a fall semester introductory nutrition course at a large state university were analyzed in the fall and spring semester .
Main outcome measures: Daily servings of total fruit (fruit and juice), total vegetables (fried and non-fried), dairy (regular and low-fat), whole grains, and dietary fiber, breakfast consumption, body weight changes and physical activity.
Statistical Analysis Performed: Associations between diet quality and weight change were analyzed using Chi-square analysis. Weight change was analyzed by diet quality and breakfast consumption using t-test and by metabolic equivalents (METHRS/day) using one-way analysis of variance (ANOVA) ($p<0.05$). Significant associations were analyzed by Pearson's correlation (two-sided, $p<0.05$).
Results: Weight and body mass index (BMI kg/m^2) were significantly higher compared to baseline. The majority of students did not meet recommendations for daily servings of fruit, vegetable, dairy, whole grains, and dietary fiber. Higher diet quality was significantly associated with more frequent breakfast consumption and students who maintained or lost weight reported significantly higher intakes of total fruit, low-fat dairy and whole grains.
Conclusion: Failure to meet dietary guidelines resulting in lower diet quality was distinctive of this population and was associated with significant changes in body weight over one academic year.
Applications: Educational interventions aimed at improving diet quality may inhibit weight gain commonly seen in college students.

INTRODUCTION

The transition period from late adolescence to young adulthood (persons aged 18-24 years) is a particularly difficult time where many behavioral and physiological changes occur (1,2). Eating behaviors, diet quality, and physical activity may change resulting in an increased risk of obesity (3). Data from the National Longitudinal Study of Adolescent Health reported that the proportion of adolescents who became and remained obese into adulthood was very high, emphasizing that this transition period coincides with a period of increased risk of development and maintenance of obesity (4,5).

Certain food groups and nutrients have been related to healthy dietary patterns and a decreased risk of obesity. Diets mainly consisting of foods such as low-fat milk products, a variety of fruits and vegetables, whole grains and high fiber intake are associated with lower energy intakes (6) and smaller gains in body mass index (BMI kg/m^2) over time (7-9). Also, healthy dietary patterns are associated with healthy lifestyle factors such as being more physically active (10,11) and regular consumption of main meals including breakfast (10).

An important subset of persons aged 18-24 are college students, who experience a transitional period compacted with environmental changes characterized by unhealthy dietary patterns and reduced physical activity which place students at a greater risk of weight gain (12-14). The greatest increase in obesity between 1991-1997 was found among 18-29 year olds (7.1%-12.1%) and in persons with some college education compared to those with no college degree (10.6% to 17.8%) (13).

Cross-sectional studies examining the dietary intake of college students showed the majority of subjects did not consume the minimum servings from all food groups of the food

guide pyramid (15), consumed a diet high in saturated fats and low in fiber (16), and failed to meet recommendations for physical activity (17). Similar results have been reported in which students reported inadequate dietary variety (18).

The belief that college students gain 15 pounds during their first year at school is commonly known as the "Freshman 15" and few studies have attempted to investigate this belief. Levitsky et al. (19) reported significant weight gain (1.9 ± 2.4 kg, $P<.001$) and increases in BMI (from 20.8 ± 2.1 to 21.5 ± 2.3 kg/m^2, $P<.01$) in college freshmen during the first 12 weeks of school along with an exaggerated rate of weight gain. Similar patterns were found by Hovell et al. (20) in University women who were found to gain a mean of 0.73 lbs/month which was 36 times faster than community women (20). However, limitations in these studies do not allow determination of an association between a particular dietary or physical activity patterns with the weight gain.

Preventing weight gain in college students may have a profound impact on prevalence of overweight or obesity later in life. However, only a few studies have documented dietary and physical activity habits in college students and no studies to date have examined the importance of breakfast consumption. The primary aim of this study was to measure diet quality and its association with weight change in college students. The secondary aim was to measure breakfast consumption and determine associations with diet quality and weight change in college students. Higher diet quality was expected to be associated with lower weight gain and greater number of breakfasts per week was expected to be associated with higher diet quality and lower weight gain.

METHODS

STUDY DESIGN

A longitudinal observational design was used to determine associations between dietary variables, physical activity, and body weight changes over one academic year in a convenience sample of college students at a large state university in southwest Virginia. This study was approved by the university's Institutional Review Board.

SUBJECTS

College students enrolled in an introductory nutrition course for the fall semester were recruited to participate in the study. All students in the class were eligible to participate except students who were pregnant due to expected weight change. Prior to participation, all participants received and signed an informed consent form detailing their responsibilities and informing them of the risks and benefits from their participation. Subjects who completed all data collection received 2% of total points available in the class for the fall and a twenty dollar gift certificate for a local grocery store in the spring.

MEASUREMENTS

All data were collected at two time points, at the beginning of the academic year in September and at the end of the academic year in April. Data collected included demographic information, height and weight measurements, dietary intake, and physical activity.

DEMOGRAPHIC QUESTIONNAIRE

Subjects completed a questionnaire for demographic information, eating habits, and physical activity patterns. Questions included frequency of breakfast consumption and physical activity habits.

DIET

Subjects were provided with instructions and completed seven-day food records. Food records were checked for completeness and email messages were sent to subjects to clarify serving sizes, foods, etc. only when needed. All food records were entered into Nutritionist Pro™ (version 2.4.1; First DataBank, San Bruno, CA) for nutrient analysis. Daily servings of total fruit (fruit and juice), total vegetables (fried and non-fried), dairy foods (regular and low-fat), and whole grain foods were extracted from food records by calculating servings from daily food intakes. Daily intakes of grams of dietary fiber per 1000 kilocalories (fiber/1000 kcal), and percent of total kilocalories from fat (% kcal from fat) were also calculated. The number of breakfasts consumed per week was recorded from 7-day food records. Breakfast was defined by two separate criteria; eating a meal between 5:00am and 10:00am (10AM) or eating a meal within two hours of waking (120min). The breakfast meal had to consist of at least 50 calories with ingredients other than simple sugars.

PHYSICAL ACTIVITY

Each subject was required to wear a pedometer during all waking hours (except during bathing, swimming, etc.) for each seven-day period that food records were recorded. Pedometers were supplied to subjects. Subjects recorded daily step totals and daily activities, which included planned physical activity and minutes spent walking to class, on the seven-day food/activity record. Metabolic equivalents per day (METHRS/dy) were determined by entering daily activities into the Center for Research in Health Behavior's Activity Log Recording Program (CRHB-ALRP) (21).

ANTHROPOMETRIC MEASUREMENTS

Fasting weight and height measurements were measured and BMI was calculated in the morning hours by a registered dietician to ensure accuracy. Subjects were measured wearing light clothing and before ingesting more than one cup of liquid. Weight and height were measured with a Seca ™ (Hanover, MD) balance beam scale with stadiometer.

DATA ANALYSIS

Daily servings of total fruit (fruit and fruit juice), total vegetables (fried and non-fried), dairy (regular and low-fat), whole grain, g fiber/1000kcal, % kcal from fat, number of breakfasts per week, daily steps, METHRS/dy, BMI and body weight were analyzed using a paired t-test to test for differences between time points.

Baseline diet quality was determined using frequency data by categorizing subjects into either a "good diet" (37%) or "needs improvement" (63%) group based on six dietary components: fruit, fruit juice, total vegetables (fried and non-fried), low-fat dairy, whole grain, and % kcals from fat. A subject's diet was determined "good" if they followed dietary guidelines (DG) for 2 to 6 of the dietary components listed above. A subject's diet was determined "needs improvement" if they followed the DG for 0 to 1 of the dietary components listed above.

To follow the DG recommendations, subjects had to consume the minimum amount of servings recommended for each dietary component. The 2000 DG (22) were used to determine if subjects met recommended servings of fruits, vegetables, and <30% of calories from fat because this study was conducted before the 2005 DG were available. This amounted to 2 servings of fruit, 3 servings of vegetables, and < 30% of calories from fat. The 2005 DG (23) were used to determine if subjects met recommended servings of fruit juice, low-fat dairy, and whole grains because these guidelines were more specific and quantifiable. This amounted to less than 50% of total fruit intake as fruit juice, 3 servings of low-fat dairy, and 3 1-ounce equivalents of whole grains.

Breakfast consumption was determined by the definition of eating within 2 hours of waking (120 min) or by eating between 5:00 AM and 10:00 AM (10AM) and subsequently put into two categories (0-5 or 6-7 breakfasts/wk) based on frequency data. Approximately 2/3 of subjects consumed 6-7 breakfasts/wk (120 min) and 1/3 of subjects consumed 6-7 breakfasts/wk (10AM). Weight change was determined by two categories, gained (>0.5 lb) and maintained ($\geq$-0.5 lb to $\leq$ 0.5 lb) or lost (>0.5 lb). METHRS/dy were categorized into three categories using relatively equal (number of subjects) groups (<5.0, 5.0-7.5, >7.5 METHRS/dy). Associations

between diet quality, BMI, breakfast consumption, weight change, and METHRS/dy. Groups were analyzed using Chi-square analysis.

Weight change was analyzed by diet quality and breakfast consumption using t-test and by METHRS/dy using one-way analysis of variance (ANOVA) ($p<0.05$). Number of breakfasts per week, percent of total calories from breakfast, grams of breakfast fiber, minutes until breakfast, daily servings of total fruit, total vegetable, low-fat dairy, and whole grain were analyzed by weight change category (gain >0.5 lb or maintained/lost <0.5lb) using t-test ($p<0.05$). Significant associations found between variables were then analyzed by Pearson correlation two-sided. Frequency data was used to determine if data was normally distributed. Subjects who reported eating <1000 kcal or expended <1 MET/dy were excluded. All data analyses were performed on SPSS software (version 14.0, 2005; Chicago, IL).

RESULTS

STUDY POPULATION

Of the 375 students who were enrolled in the introductory nutrition course and were recruited to participate in this study, approximately 210 students volunteered to participate. Of the 210 volunteers, 80 students participated in both September and April and were included in the current analysis. Distributions of subject characteristics of the sample are summarized in Table 1. The majority of the subjects were female, Caucasian, and either in their freshman or

Table 1: Characteristics of sample population (n=80)

Variable	n (%)
Gender	
Male	11 (13.6)
Female	69 (85.2)
Race	
Caucasian	70 (86.4)
Black/African American	3 (3.7)
Asian/Pacific Islander	5 (6.2)
Other	2 (2.5)
Class	
Freshman	22 (40.7)
Sophomore	26 (32.1)
Junior	14 (17.3)
Senior	6 (7.4)
Grad	1 (1.2)
BMI kg/m^2	
Underweight (<18.5)	8 (10)
Normal (18.5-24.9)	56 (69)
Overweight ($\geq$25.0)	16 (20)

sophomore year. Most subjects were normal weight based on BMI (BMI 18.5-24.9 kg/m^2) with a small percent classified as underweight (BMI<18.5) or overweight (BMI $\geq$25.0).

PHYSICAL ACTIVITY AND WEIGHT CHANGE

Physical activity and anthropometric characteristics are described in Table 2. Over the course of the study, subjects had significant increases in weight (P=0.011) and BMI (P=0.017). Freshman subjects gained approximately 1 pound while sophomores, juniors, and seniors gained approximately 2 pounds. Fifty four out of 80 subjects (67%) gained weight while 27 subjects (33%) lost or maintained weight. Subjects reported lower daily steps in April compared to baseline. No significant associations were found between METHRS/dy and weight change, diet quality, or breakfast consumption (using both definitions).

DIETARY INTAKE

Dietary intake for the sample population is described in Table 3. Subjects consumed approximately 1 serving per day of total fruit, with fruit juice comprising 42% of total fruit intake. Subjects consumed less than 2 servings of vegetables (fried and non-fried) per day and less than 2 servings of dairy per day, with low-fat dairy comprising 35% of that total. Daily caloric intake was significantly lower from September to April; there were no other significant differences in dietary intake between time periods. Subjects reported eating more breakfasts per week (120min) compared to eating breakfast by 10AM. Subsequent data analysis is reported for baseline dietary variables and for number of breakfasts per week by 10AM.

Table 2: METHRS/day and Anthropometric Measurements

Variable (n)	September Mean±SD[1] (n)	Range (min, max)
METHRS/day	7.32±4.85 (73)	(2.47,12.17)
Steps/day	8702±4516 (72)	(4186,13218)
Weight (lbs)	140.7±28.3*(81)	(112.4,169)
Height (inches)	65.83±2.86(80)	(62.97,68.69)
BMI (kg/m^2)	22.81±3.79*(80)	(19.02,26.6)
Class Level [2]		
Freshman	0.60±5.95 (33)	(-12.5,10.5)
Sophomore	2.20±5.80 (26)	(-12.75,11.25)
Junior	2.21±3.48 (14)	(-2.75,7.5)
Senior	1.92±4.92 (6)	(-2.0,11.25)

* Statistically significant paired t-test used to determine differences in group means from baseline to follow-up, $p<0.05$

[1] SD=standard deviation

[2] Mean weight gain by class level

Table 3: Mean intakes of dietary variables (n=79)

Dietary Variable	September (mean ± SD)	Range (min, max)
Calories per day	2053±520*	(1533,2573)
Fat Percent [1]	31.2±5.8	(25.4,37)
Fruit	0.96±1.46	(0,2.42)
Fruit Juice	0.69±2.38	(0,3.07)
Total Fruit	1.65±2.85	(0,4.5)
NonFried Veg	1.36±0.80	(0.56,2.16)
Fried Veg	0.15±0.24	(0,0.39)
Total Veg	1.51±0.81	(0.7,2.32)
Reg Dairy	0.92±0.65	(0.27,1.57)
Lowfat Dairy	0.49±0.40	(0.09,0.89)
Total Dairy	1.41±0.83	(0.53,2.24)
Calcium	816±359	(457,1175)
Whole Grain	1.10±0.83	(0.27,1.93)
Fiber(g) [2]	17±7.36	(9.64,24.36)
Fiber/1000 Kcals [3]	8.6±3.8	(4.8,12.4)
Number of Breakfasts/week		
120 min [4]	5.5±1.6	(3.9,7.1)
By 10am [5]	4.6±1.8	(2.8,6.4)

[*] Statistically significant paired t-test $p<0.05$
[1] Percent of calories from fat
[2] Grams of dietary fiber/day
[3] Grams of dietary fiber/1000 kcals
[4] Breakfast defined by eating within 2 hours of waking
[5] Breakfast defined by eating between 5:00 AM and 10:00 AM

BASELINE DIET QUALITY

At baseline, 39 of 62 (63%) subjects consumed a diet that "needs improvement", while 23 (37%) subjects consumed a "good" diet. Mean daily intake for fruit, vegetable, dairy, whole grain and fiber did not meet current recommendations and about half of the subjects met recommendations for limiting fruit juice and total fat intake. Only 20% of subjects reported eating more than 6 or 7 breakfasts per week (10AM) compared to 31% consuming 6 or 7 breakfasts per week (120min).

ASSOCIATIONS BETWEEN DIET QUALITY, BREAKFAST CONSUMPTION, AND WEIGHT CHANGE

Diet quality was significantly associated with breakfast consumption (10 AM, X^2 =9.4, P<0.01). "Good" diet quality was associated with more frequent breakfast meals (≥6 per/wk, 68.2% observed) and a diet classified as "needs improvement" was associated with less frequent breakfast meals (<6 per/wk, 74.2% observed). Diet quality and breakfast consumption were not significantly associated with weight change or BMI.

Mean intakes of dietary variables by breakfast (10AM) and weight change categories are listed in Table 4. Higher daily fruit intake (without juice), total fruit, and whole grains were significantly associated with frequent breakfast (10AM) consumption (p=0.012, p=0.021, p=0.028 respectively). Subjects who maintained or lost weight reported significant higher intakes of total fruit, low-fat dairy, and whole grains (p=0.005, p=0.043, p=0.013 respectively). Correlations among dietary variables and weight change are listed in Table 5. Higher intakes of

Table 4: Mean intakes of dietary variables by categories of breakfast consumption and weight change

	Breakfast (10AM) [1]			Weight Change [2]		
Dietary Variable	**0-5 meals/wk** mean ± SD (n)	**6-7 meals/wk** mean ± SD (n)	**P Value**[3]	**Gained** mean ± SD (n)	**Maintain/Lost** mean ± SD (n)	**P Value**
Fruit	0.65±0.55 (38)	1.64±2.24 (25)	.012	-	-	-
Fruit Juice	0.41±0.54 (39)	1.22±4.0 (25)	NS[6]	-	-	-
Total Fruit	1.07±0.86 (38)	2.86±4.53 (25)	.021	1.07±0.75 (52)	3.09±4.95 (21)	.005
Total Vegetable	1.42±0.85 (39)	1.62±0.81 (25)	NS	1.44±0.79 (51)	1.64±0.83 (25)	NS
Lowfat Dairy	0.47±0.46 (40)	0.59±0.59 (26)	NS	0.41±0.39 (53)	0.64±0.62 (27)	.043
Regular Dairy	0.94±0.72 (40)	0.89±0.60 (26)	NS	0.94±0.69 (53)	0.89±0.55 (27)	NS
Total Dairy	1.42±0.85 (40)	1.49±0.87 (26)	NS	1.35±0.83 (53)	1.53±0.82 (27)	NS
Whole Grains	0.96±0.74 (36)	1.46±0.96 (24)	.028	0.92±0.77 (46)	1.43±0.87 (25)	.013
Fiber/1000 kcal [4]	8.3±3.8 (40)	9.9±4.2 (26)	NS	-	-	-
Fat Percent [5]	31.4±5.13 (40)	29.3±6.64 (26)	NS	-	-	-

[1] Breakfast defined by eating between 5:00 AM and 10:00 AM meals per week
[2] Weight change from baseline to follow-up in pounds
[3] T-test was used to determine differences in group means
[4] Grams of dietary fiber/1000 kcals
[5] Percent of calories from fat
[6] NS=not significant; P>0.05

Table 5: Correlations among dietary variables and weight change

Dietary Variables	Weight Change[1]
Nonfried Veg[2]	-0.24*
Total Vegetable[2]	-0.18
Fruit[2]	-0.35**
Whole Grain[2]	-0.15
Total Dairy[2]	-0.05
Lowfat Dairy[2]	-0.18
Diet Quality	-0.23
Breakfast Fiber (g)[3]	-0.26*
Breakfast 10am[4]	-0.21
Breakfast 120min[5]	-0.16

*Statistically significant correlation *P*<.05
** Statistically significant correlation *P*<.01
[1] Weight change in pounds
[2] Daily intakes of serving sizes defined by 2005 Dietary Guidelines
[3] Grams of fiber consumed at breakfast
[4] Breakfast defined by eating between 5:00 AM and 10:00 AM
[5] Breakfast defined by eating within 2 hours of waking

non-fried vegetables and fruit (without juice) were correlated with lower weight gain (r= -0.24, P<0.05, r= -0.35, P<0.05 respectively). Higher fiber intake (g/1000kcal) was significantly associated with eating six or more breakfast (10AM) meals per week (p=0.004) and higher intake of breakfast fiber (g/dy) was correlated with lower weight gain (r= -0.26, P<0.05).

DISCUSSION

In our sample of college students both weight and BMI were significantly higher at the end of the study, suggesting even modest changes in diet and physical activity may result in significant weight gain. Dietary patterns such as increased fruit and non-fried vegetable consumption was significantly associated with less weight gain. Subjects who were able to maintain or lose weight over the course of the study consumed a significantly greater amount of total fruit (fruit and fruit juice), low-fat dairy and whole grains. A significant decrease in mean caloric intake was observed, along with decreased steps per day and lower diet quality. Interesting similarities have been reported for freshman women, where significant decreases in caloric intake and significant increases in body weight were found (24).

This study was able to report breakfast consumption in college students and the impact on weight and dietary quality. Breakfast is commonly defined as eating between 5:00 AM and 10:00 AM (25). For the purpose of this study, breakfast was also defined as eating within 2 hours of waking due to irregular sleep patterns commonly seen in college students (26). Our results indicated that more frequent breakfast meals between 5:00 AM and 10 AM was significantly associated with higher diet quality, specifically higher intakes of fruit, total fruit

(fruit and fruit juice), and whole grains. No significant associations were seen between breakfast meals consumed within 2 hours of waking and diet quality or weight change.

Our findings parallel previous studies that assessed the amount of weight gain in freshmen during their first semester and found modest, yet significant increases in body weight and BMI (27-30). Prior research has been unable to relate certain dietary patterns with weight changes in college students (31,32) although associations between diet quality, physical activity and weight are apparent in current literature. In the current study, nearly two thirds of subjects consumed a diet that "needs improvement" which is comparable to diets reported in college students that mainly consisted of inadequate intakes of fruits, vegetables, and fiber, along with low amounts of physical activity (31,32.). Our results indicate that dietary components, such as consuming recommended daily intakes of total fruit (fruit and fruit juice), non-fried vegetables, low-fat dairy, whole grains, and more frequent breakfast meals between 5:00 AM and 10:00 AM are associated with less weight gain over time.

As with any study involving human subjects and self-reported behaviors, potential self-selection bias may have affected results. Weight gain may have been lower due to prior interest in nutrition and knowledge gained from the introductory nutrition course which focused on current concerns in foods and nutrition and its affects on the nutritional health and well-being of people. The small sample size and homogenous nature of the population in this preliminary study cannot characterize dietary intakes of all college students. Despite limitations, results from this study suggest that weight gain does occur in college students and for a considerable amount of students, the amount of weight gain was clinically significant. Also, to our knowledge, this was the first study to date that has defined breakfast using two definitions in a college population for subsequent data analysis.

In this exploratory study, higher diet quality that included more daily servings of total fruit, non-fried vegetables, low-fat dairy, whole grains, and more frequent breakfast meals was associated with less weight gain in college students. These results suggest the need for further research with larger numbers of students enrolled in non-nutrition courses. Identifying factors that influence weight gain in college students will provide valuable information that can be used to design interventions specifically targeting this population. This may help to reduce the incidence of overweight and obesity later in life and decrease the risk of heath problems associated with being overweight.

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CHAPTER 4:

SUMMARY

The majority of subjects did not consume the recommended amounts of daily servings of fruit, vegetable, dairy, and whole grains which are comparable to dietary guideline compliance reported for college students in current literature. To our knowledge, this study is one of the first to examine associations between breakfast consumption, diet quality, and weight change in college students. More frequent breakfast meals was associated with higher diet quality, specifically greater intakes of fruit and whole grains. Dietary fiber consumed during breakfast meals was associated with less weight gain over the course of one academic year.

The exploratory nature of the study set limitations in the interpretation of the findings from the current study. Also, the homogenous nature of the subjects who were primarily Caucasian, female, and enrolled in an introductory nutrition course, did not represent the general student body. Only a sub-set of subjects provided data through April and it is possible that subjects with larger weight gains or had diets that "needed improvement" chose not to provide follow-up data.

Interventions that target specific dietary components, such as consuming recommended amounts from the 2005 DG and increasing physical activity may help to prevent overweight and obesity later on in life. The importance of seemingly minor and perhaps even harmless changes in eating or exercise behavior may result in large changes in weight over an extended period of time should be stressed.

This study was able to reinforce the importance of a good breakfast. Eating breakfast meals that contain high amounts of fiber, whole grains, and fruits can help manage weight while highlighting a healthy solution to help control weight changes over time.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Results from this study expanded the literature on the incidence of lower diet quality in college students and helped to identify dietary patterns that were associated with weight changes. The "Freshman 15" is a widely common belief that college students gain an average of 15 pounds during their first year. As current research shows, modest but significant amounts of weight gain may occur during college and interventions that target increasing dietary quality and physical activity may help to prevent weight gain and promote healthy lifestyle practices to last a lifetime.

Students entering their first year of college should be targeted for interventions designed at increasing daily intakes of fruit, non-fried vegetables, low-fat dairy, and whole grains. The importance and implications of daily breakfast consumption on weight maintenance should be a key factor emphasized in these interventions. Breakfast meals should include fruits and other sources of dietary fiber and should be consumed before 10 AM. Results from our study show significant associations with breakfast, diet quality, and weight change and could be used as variables targeted in health promotion programs.

Interventions should also target the importance of small changes in diet and physical activity patterns, such as choosing whole grains over white breads and participating in extra

curricular activities that focus on physical activity. Changes such as these could help students with weight maintenance and decrease the risk overweight and obesity over time. College-based interventions have the potential to reach a large amount of the young adult population and could decrease the incidence of overweight and subsequent health complications associated with overweight in the United States.

APPENDICES

Appendix A: Demographic questionnaire

Determinants of Weight Change in College Students

Your Assigned Code Number: _____ Today's Date: _____

Major: If you have declared or are seriously thinking about a major, please tell me what it is. If you are not sure what you are going to major in, check that choice.

Major: _____ **If Unsure →** _____ Not sure

Age: What is your age? _____ years

Class: If you are enrolled as an undergraduate student, are you currently classified as a (circle one):

Freshman Sophomore Junior Senior

Gender: Please circle your gender: Female Male

Race: What is your race?

_____ White _____ Asian/ Pacific Islander

_____ Black/African American _____ Other: _____

_____ Native American

Are you Hispanic or Latino? _____ Yes _____ No

Weight:

Has your weight changed in the past 6 months? (circle) Yes No

<u>If your weight has changed in the past 6 months</u>, was this change on purpose? (circle)

Not applicable Yes No

<u>If your weight has changed in the past 6 months</u>, please write in the amount you have gained or lost in the past 6 months: (check N/A if not applicable)

_____ N/A _____ pounds gained _____ pounds lost

Breakfast

For this survey, breakfast is defined as eating something within 2 hours of waking up.

1. How many days per week would you say you eat breakfast? (circle your answer)

   0 1 2 3 4 5 6 7

2. When you eat breakfast, what do you eat most often for breakfast? (write it in the space below)

   Please be specific and write in your complete usual breakfast, including drink,etc. – include amounts if possible

Fruits and Vegetables

Now we need some information related to eating fruits and vegetables. Please answer each question as well as you can. Try not to leave any question blank unless that is the best choice for that question.

1. During the past year or so, how many times per day, week, or month (**use only one blank per question for day, week or month**) did you usually have……

   a. 100% orange juice or grapefruit juice, either fresh or from concentrate, not including orange or grapefruit drinks?

      ____ none **or** ____ times/day **or** ____ times/week **or** ____ times/month

   b. Other 100% fruit juices, not counting fruit drinks?

      ____ none **or** ____ times/day **or** ____ times/week **or** ____ times/month

   c. Green salad (with or without other vegetables)?

      ____ none **or** ____ times/day **or** ____ times/week **or** ____ times/month

d. French fries or fried potatoes?

____ none **or** ____ times/day **or** ____ times/week **or** ____ times/month

e. Baked, boiled, or mashed potatoes?

____ none **or** ____ times/day **or** ____ times/week **or** ____ times/month

Please use only one blank per question, for day, week, or month

2. About how many servings of vegetables, overall, do you eat per day, week, month or year, not counting salad or potatoes? (A serving is ½ cup cooked or 1 cup raw vegetable)

_____ servings/day **or** _____ servings/week **or**

_____ servings/month **or** _____ less than 1 serving per month or none

3. About how many servings of fruit do you eat per day, week, month or year, not counting juices? (A serving is 6 ounces of juice, ½ cup canned fruit, or 1 medium piece of fresh fruit such as an apple, orange, or banana).

_____ servings/day **or** _____ servings/week **or**

_____ servings/month **or** _____ less than 1 serving per month or none

4. When you eat vegetables, how often are they cooked in butter, margarine, oil or lard? (circle one)

Always Usually Sometimes Rarely Never

5. When you eat cooked vegetables, how often do you add regular cheese sauce, cream sauce, butter, margarine, or oil to them? (circle one)

Always Usually Sometimes Rarely Never

6. When you eat salads or raw vegetables, how often do you use salad dressing? (circle one)

Always Usually Sometimes Rarely Never

7. What kind of salad dressing do you usually use?

_____ Low calorie, low fat or diet _____ Regular

_____ None

8. How many servings of fruits and vegetables do you think a person should eat each day for good health?

_____ Servings/day (total for fruits and vegetables combined)

9. How would you rate your current consumption of fruit/vegetables? Mark an "X" in the blank that best describes your intake:

_____ Very high

_____ High

_____ Moderate

_____ Low

_____ Very low

10. **If you ranked your intake of fruit/vegetables as high or very high**, how many months have you followed a diet that is high in fruit/vegetables? You can use partial months, such as 0.5 or 1.5. If you ranked your intake as moderate or less, choose "not applicable".

_____ Months (write in actual number)

_____ Not Applicable: I did not rank my intake as high or very high (mark with "x")

11. Are you currently trying to eat more fruit/vegetables?

_____ Yes _____ No

12. **If you answered yes to the last question (#11), answer this question. If you answered no to the last question, mark an "X" before "not applicable"**. On a scale from zero to ten, where 0 means not at all successful and 10 means extremely successful, how successful are you at trying to eat more fruits and vegetables?

_____ (write in number)

_____ Not Applicable: I did not answer yes to the last question (mark with "x")

13. Have you been thinking about changing your diet to eat more fruits/vegetables?

_____ Yes _____ No

14. Do you actually plan to eat more fruits and vegetables than you do now over the next 6 months?

_____ Yes _____ No

15. If you are planning to eat more fruit/vegetables, how confident are you that you will eat more fruit/vegetables during the next 6 months? Enter a number from 0 to 10 in the blank provided, with 0 being not at all confident and 10 being totally confident:

_____ (write in number)

_____ Not Applicable: I am not planning to eat more fruit/vegetables (mark with "x")

16. Are you now eating more, the same, or fewer fruits and vegetables than you were 6 months ago?

_____ Eating more now

_____ Eating about the same as 6 months ago

_____ Eating fewer now

17. **If you are eating more fruits and vegetables**, mark an "X" beside all of the reasons you are eating more. If you are eating the same or fewer fruits and vegetables, mark **ONLY** "not eating more".

_____ I am not eating more fruits and vegetables now

_____ Decrease risk of cancer

_____ Decrease risk of heart disease

_____ Health/trying to eat healthier foods

_____ Lose weight

_____ Lifestyle change

_____ Taste/they taste better to me now

_____ Availability/better access

_____ I keep hearing that I should eat more

_____ No reason in particular

_____ Other (specify): _____

18. On a scale from 0 to 10, how likely is it that eating more fruits and vegetables could help you prevent some kinds of cancer (0= not at all likely, 10= very likely)?

_____

19. On a scale from 0 to 10, how likely is it that eating more fruits and vegetables could help you prevent heart disease (0= not at all likely, 10= very likely)?

_____

20. On a scale from 0 to 10, how likely is it that eating more fruits and vegetables could help you lose or maintain your weight (0= not at all likely, 10= very likely)?

_____

21. On a **scale** from 0 to 10, where 0 means not at all sure and 10 means very sure, how sure are you that you can…. (write in number, not just an "x"):

_____ Eat at least 3 servings of fruits and vegetables every day?

_____ Have 100% juice or fruit in the morning most days?

_____ Eat fruits and vegetables for snacks?

_____ Eat fruits and vegetables when eating away from home?

_____ Eat at least 5 servings of fruits and vegetables every day?

22. On a scale from 0 to 10, where 0 means that they do not encourage you at all and 10 means they encourage you a great deal, how much does your family encourage you to eat fruits and vegetables?

_____

23. On a scale from 0 to 10, where 0 means that they do not encourage you at all and 10 means they encourage you a great deal, how much do your friends encourage you to eat fruits and vegetables?

_____

24. Please indicate how much you agree with each of the following statements. Use a **scale** from 0 to 10, where 0 means you don't agree at all and 10 means you strongly agree: (write in a number, not just an "x").

_____ My family eats lots of fruits and vegetables

_____ My friends eat lots of fruits and vegetables

_____ Eating fruits and vegetables makes me feel better

_____ I need more information about how to prepare fruits/vegetables

_____ Preparing fruits and vegetables takes too much time

_____ Fruits and vegetables are not readily available where I shop or eat

_____ It takes too much willpower to eat fruits and vegetables every day

_____ The quality of fresh fruits and vegetables is poor where I shop or eat

_____ Frozen and canned fruits and vegetables are too expensive

_____ Fresh fruits and vegetables are too expensive

_____ I have made it a habit to eat lots of fruit/vegetables ever since I was a child

_____ There is a lot of confusing advice about healthy ways to eat

_____ I like the taste of fruits

_____ I like the taste of vegetables

For the following questions, indicate how often you: (circle one)

25. Eat at least one vegetable at lunch

Always Usually Sometimes Rarely Never

26. Eat at least one fruit at lunch

Always Usually Sometimes Rarely Never

27. Eat at least one fruit at breakfast

Always Usually Sometimes Rarely Never

28. Eat at least one vegetable at supper (evening meal)

Always Usually Sometimes Rarely Never

29. Eat at least one fruit at supper (evening meal)

Always Usually Sometimes Rarely Never

30. Eat fruit or vegetables for snacks

Always Usually Sometimes Rarely Never

31. Eat fruit for dessert

Always Usually Sometimes Rarely Never

32. Eat French fries as the main vegetable at meals

Always Usually Sometimes Rarely Never

Physical Activity

1. About how many hours per week would you say you spend in some type of physical activity? Physical activity is any activity you do during your leisure time instead of sitting around. Examples range from housework and gardening to running/jogging or sprinting.

_____ Hours per week (write in actual number for your best estimate)

2. Please fill in average number of hours you spend **per week** for any activity in which you have participated regularly for at least one month:

Activity	**Average number of hours you spend each week (write in number of hours)**
Aerobics (step, land, water)	
Backpacking	
Basketball	
Bicycling (outside)	
Bicycling (indoor machine)	

Boating (canoeing, rowing, sailing)	
Bowling	
Boxing	
Calisthenics	
Cardio/aerobic machine (climber, elliptical, treadmill, rowing machine, etc.)	
Dancing (ballet/ballroom, etc.)	
Fishing	
Football	
Gardening (spading, weeding, digging, moving earth)	
Golf	
Hiking	
Horseback riding	
Jogging/running	
Judo/karate/tae-bo	
Mountain or rock climbing	
Rugby	
Racquetball	
Skating (ice or roller)	
Soccer	
Softball/ baseball	
Swimming	
Table tennis (ping-pong)	
Tennis	
Volleyball	
Walking	
Weight lifting	
Other (please list): _____	
Other (please list): _____	

3. How would you rate your current level of physical activity? Mark an "X" in the blank that best describes your activity level:

_____ Very high

_____ High

_____ Moderate

_____ Low

_____ Very low

4. **If you ranked your activity level as high or very high, how many months have you been this active**? You can use partial months, such as 0.5 or 1.5. If you ranked your activity level as moderate or less, choose "not applicable".

_____ Months (write in actual number)

_____ Not Applicable: I did not rank activity level as high or very high (mark with "x")

5. Are you currently trying to become more physically active? (circle one)

Yes No

6. Have you been thinking about becoming more physically active? (circle one)

Yes No

7. Do you actually plan to increase your physical activity over the next 6 months? (circle one)

Yes No

8. If you are planning to increase your physical activity, how confident are you that you will do this during the next 6 months? Enter a number from 0 to 10 in the blank provided, with 0 being not at all confident and 10 being totally confident:

_____ (write in number)

_____ Not Applicable: I am not planning to increase my physical activity (mark with "x")

9. Please mark an "X" beside ALL of the reasons you are not more physically active during your leisure time:

_____ I already get enough physical activity

_____ I don't have enough time

_____ I am too tired or don't have the energy

_____ I am too "lazy"

_____ I am ill or otherwise physically unable

_____ I do not enjoy being active

_____ I do not have anyone to be active with

_____ I am afraid of getting hurt or injured

_____ It is too expensive

_____ Some other reason (please list):

_____

10. How much do you weigh? _____ Pounds

11. How tall are you? _____ feet, _____ inches

THANK YOU!!!

Appendix B: Instructions for completing food/activity records

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 <u>complete</u> entries: **use your own information and serving sizes, of course!!!**

Please email me at <u>khosig@vt.edu</u> 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 C: Food/activity record

Food/Activity Record

Code number_____ Day of Week _____
Date _____

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

*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 Record Step Count for Today from Pedometer: _____ steps

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 back

Time (include	Food Eaten - How Prepared	Amount Eaten	Special Notes

Space continued on next page (opposite side)

(Food Record) -- Page 2 of 2

Time	Food Eaten - How Prepared	Amount Eaten	Special Notes

Appendix D: Informed consent

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Informed Consent for Participants in Research Projects Involving Human Subjects

Title of Project: Determinants of Weight Change in College Students

Investigators: Kathy Hosig, Ph.D, MPH, RD, Shelly Nickols-Richardson, PhD, RD, Elena Serrano, PhD and Linda Davis, M.S., R.D.

I. Purpose of this Research/Project

All students enrolled in HNFE 1004 for Fall 2004 will be invited to participate in this study. Parental consent will be required for students under 18 years of age. The purpose of the study is to collect information about what college students eat, their physical activity, and their body composition. The information will be used to find out what factors related to diet and physical activity affect weight change in college students.

II. Procedures

If you decide to participate in this study, you will be asked to do certain things at four different times during this academic year (2004-2005). The total time commitment for filling out questionnaires and body measurements is about 10 hours.

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

1) fill out a questionnaire that takes about 20 minutes to do and bring it with you to Wallace Hall when you come for height, weight and waist/hip measurements;
2) come to Wallace 229 at a scheduled day and time for measurement of body composition (amount of lean and fat mass) by dual energy X-ray absorptiometry (DXA) – this includes additional questionnaires and takes about 2 hours (described in detail below).

Things you will be asked to do four times (August, November, February and April) include:

1) come to 227 Wallace at a scheduled day and time (before you eat that day) to have your height, weight and waist/hip circumference measured – this takes about 5 minutes;
2) keep a record of what you eat and your physical activity for 7 days – this takes about 10 minutes each day;
3) wear a pedometer (step-counter) for the same 7 days and record step count on a separate sheet

Weight and height and waist/hip circumference will be measured in a faculty office (Dr. Hosig's office in 227 Wallace) by either Dr. Hosig or a graduate research assistant. The door will be open. You will keep your clothes on but will be asked to remove any outer clothing such as hat, coat, sweater and shoes. You may have to loosen the waistband of your pants so that we can get an accurate waist measurement.

Things that you will be asked to do at each of the DXA appointments (about 2 hours) include:

a) answer questions included on the Medical Screening Form to determine age, use of medications, medical conditions, history of bone fractures, and family history of osteoporosis among other medical-related issues;
b) complete six short questionnaires related to calcium intake, health, eating habits and physical activity;

c) stand on a digital scale to have body weight measured and stand next to a stadiometer to have body height measured (extra measurements needed the same day to interpret body composition data);

d) lie on or sit next to the dual energy X-ray absorptiometer (DXA) as directed by a Licensed Radiologic Technologist – Limited who will conduct DXA scans of your total body, lumbar spine, hip, and forearm for bone mineral density and body composition measurement (20 minutes).

If 2 hours are not available at one time, the testing may be divided into multiple sessions to fit your schedule.

III. Risks

Exposure to radiation will occur during DXA scans for measurement of your bone mineral density and body composition. Radiation exposure will occur from the DXA scans because the DXA machine uses x-ray technology. Radiation exposure is measured in millirads (or mR). The total amount of exposure for each of the two DXA scans in this study is 20 mR (whole body = 1 mR, lumbar spine = 7 mR, hip = 7 mR, forearm = 5 mR). This represents 2% of the estimated exposure to increase cancer risk in only 0.03% of the population. This dose is very small and poses minimal risk. The following table lists the radiation limits for an adult research participant according to the National Institutes of Health, Office for Protection from Research Risk (NIH-OPRR), compared to the exposure during this study.

NIH-OPRR Radiation Limits for an Adult Research Participant per Year	**Exposure During Participation in this Research Study**
Whole body (single dose) = 3,000 mR	Whole body (single dose) = 1 mR x 2 scans = 2 mR
Lumbar spine (single dose) = 5,000 mR	Lumbar spine (single dose) = 7 mR x 2 scans = 14 mR
Hip (single dose) = 5,000 mR	Hip (single dose) = 7 mR x 2 scans = 14 mR
Forearm (single dose) = 5,000 mR	Forearm (single dose) = 5 mR x 2 scans = 10 mR
CUMULATIVE EXPOSURE = 18,000 mR	CUMULATIVE EXPOSURE (whole body + lumbar spine + hip + forearm) x 2 scans = 40 mR

Any individual may choose to not complete any one, combination, or all of these DXA scans. If any scan is unreadable or unusable, a replacement scan will not be conducted to avoid further exposure. If you are pregnant or think that you may be pregnant, you should not undergo DXA scans because radiation exposure from DXA scans may cause harm to your unborn fetus. It is unknown how much or how little damage may occur to an unborn fetus during DXA scans. The risk of harm to an unborn fetus is unknown but is possible. It is best to not have DXA scans done if you think that you are or if you know that you are pregnant. In fact, before DXA scans are done, a pregnancy test kit will be completed for each woman who is pre-menopausal or peri-menopausal with a sample of her urine. If this pregnancy test is negative (or shows "not pregnant"), participation in the study will continue. If this pregnancy test is positive (or shows "pregnant"), participation in the study will not be allowed and referral to the Women's Clinic at the Schiffert Health Center on the Virginia Tech campus will be done. If the pregnancy test is

positive, any and all costs related to the pregnancy will be borne by the individual and not by Virginia Tech. So that there is an equal opportunity to be in this study, any woman who is not pregnant and is enrolled in HNFE 1004 will be given the chance to participate in this study if desired. Pregnant women will be given the opportunity to earn up to 20 extra credit points as described in section VII (Freedom to Withdraw) of this consent form. DXA scans will be conducted in the BONE laboratory, Room 229 Wallace Hall, on the Virginia Tech campus by an investigator who is a Licensed Radiologic Technologist – Limited in the Commonwealth of Virginia.

Your weight and height and waist/hip measurements will be measured privately – no one but the researchers will see your individual results. Keeping the food and activity record will require you to be responsible and remember to do it after each time you eat, but the time it takes is short.

IV. Benefits

Potential benefits of participation in this study include receiving personal information regarding body composition assessment, bone mineral density measurements, evaluation of dietary calcium intake, and beliefs related to osteoporosis. Individual results from each procedure during DXA analysis will be given to each participant after data collection for the entire study is complete. If your data fall within an atypical range, or you test positive for pregnancy, we will indicate this to you, and you may wish to discuss those findings with your personal physician. Any and all costs related to such findings will be borne by the individual and not by Virginia Tech. If you participate in this study you may also benefit from analysis of the nutrient content of your diet by a trained nutrition researcher. You may request a copy of the nutrient analysis from your food record once the food records are analyzed by checking the appropriate box on this consent form.

The general public, especially college students, may benefit from this study as new relationships among diet and physical activity patterns and weight change in college students may be determined. 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. Results from the pregnancy test will not be shared with anyone else, including parents of students under 18 years of age. Your name will not be used on the questionnaires, food and activity record, and weight and height forms, DXA forms, or other data collection instruments. 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. When you receive a survey instrument or food and activity record, the top sheet will have only your name on it. Once you receive the form, you will be instructed to remove the top sheet so that your name is no longer on the form.

VI. Compensation

You will be compensated separately for participation in each data collection period (four periods – beginning and end of Fall semester; beginning and end of Spring semester). Total compensation available for completion of all components for all four data collection periods is 20 extra credit points for HNFE 1004 and $30 in gift certificates to a local store, such as Kroger or Walmart. 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.

Beginning of Fall 2004 semester
If you complete all 4 components of data collection (survey, food/activity record, and measurement of height and weight, DXA analysis) at the beginning of Fall semester, you will receive 10 extra credit points for HNFE 1004. Partial compensation will be provided as 1 point for completion of the initial survey, 3 points for completion of the food/activity record (including daily pedometer step count), 1 point for fasting height/weight and waist/hip circumference measurement, and 5 points for completion of DXA analysis and accompanying questionnaires.

End of Fall 2004 semester
If you complete both components of data collection at the end of Fall semester, you will receive 10 additional extra credit points for HNFE 1004. Partial compensation will be provided as 7 points for completion of the food/activity record (including daily pedometer step count) and 3 points for fasting height/weight and waist/hip circumference measurement.

Beginning of Spring 2005 semester
If you complete both components of data collection at the beginning of Spring semester, you will receive up to $10 in gift cards to a local store. Partial compensation will be provided as $7 for completion of the food/activity record (including daily pedometer step count) and $3 for fasting height/weight and waist/hip circumference measurement.

End of Spring 2005 semester
If you complete all 4 components of data collection (survey, food/activity record, and measurement of height and weight, DXA analysis) at the end of Spring semester, you will receive up to $20 in gift cards to a local store. Partial compensation will be provided as $2 for completion of the final survey, $7 for completion of the food/activity record (including daily pedometer step count), $3 for fasting height/weight and waist/hip circumference measurement, and $8 for completion of DXA analysis and accompanying questionnaires.

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 extra credit 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 extra credit points up to 20 points maximum in the same way that students who do not elect to participate may earn these points – for each 10 extra credit points,

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 HNFE 1004.

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 extra credit 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 extra credit points up to 20 points maximum in the same way that students who do not elect to participate may earn these points – for each 10 extra credit points, 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 HNFE 1004.

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.

X. Subject's Permission

18 years of age or older:
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

Under 18 years of age – both subject assent and parental consent required:

Subject assent to participate:
I 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 assent to participate:

_____ Date _____
Signature

Parental consent:

I 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 for my child to participate:

Parent's printed name: _____

_____ 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.

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. Kevin Davy	(540) 231-3487/ kdavy@vt.edu
Departmental Reviewer	Telephone/ e-mail
Dr. David Moore	(540) 231-4991/ moored@vt.edu
IRB Chair	Telephone/ e-mail

Appendix E: Anthropometric data collection instrument

Determinants of Weight Change in College Students

Subject Code Number: _____

September

Date: _____

Weight: _____ pounds Waist: _____ inches

Height: _____ inches Hip: _____ inches

November

Date: _____

Weight: _____ pounds Waist: _____ inches

Height: _____ inches Hip: _____ inches

February

Date: _____

Weight: _____ pounds Waist: _____ inches

Height: _____ inches Hip: _____ inches

April

Date: _____

Weight: _____ pounds Waist: _____ inches

Height: _____ inches Hip: _____ inches

Appendix F: IRB Approval

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: August 19, 2004

MEMORANDUM

TO: Kathy Hosig HNFE 0430

FROM: David Moore

SUBJECT: **IRB Full Review Approval**: "Determinants of Weight Change in College Students" IRB # 04-338 FR

The above referenced protocol was submitted for full review and approval by the IRB at theJuly 12, 2004 meeting. The board had voted approval of this proposal contingent upon receipt of responses to questions raised during its deliberation. Following receipt and review of your responses, I, as Chair of the Virginia Tech Institutional Review Board, have, at the direction of the IRB, granted approval for this study for a period of 12 months, effective July 12, 2004.

Approval of your research by the IRB provides the appropriate review as required by federal and state laws regarding human subject research. It is your responsibility to report to the IRB any adverse reactions that can be attributed to this study.

To continue the project past the 12 month approval period, a continuing review application must be submitted (30) days prior to the anniversary of the original approval date and a summary of the project to date must be provided. Our office will send you a reminder of this (60) days prior to the anniversary date.

cc: File
Department Reviewer Kevin Davy 0351