WEIGHT CHANGE AMONG COLLEGE FRESHMEN: THE FRESHMEN 4

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Kelly Michelle Drawdy

Certificate of Approval:

_____	_____
Claire Zizza Assistant Professor Nutrition and Food Science	Sareen Gropper, Chair Professor Nutrition and Food Science
_____	_____
Karla Simmons Assistant Professor Consumer Affairs	Joe F. Pittman Interim Dean Graduate School

WEIGHT CHANGE AMONG COLLEGE FRESHMEN: THE FRESHMEN 4

Kelly Michelle Drawdy

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WEIGHT CHANGE AMONG COLLEGE FRESHMEN: THE FRESHMEN 4

Kelly Michelle Drawdy

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Signature of Author

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Date of Graduation

VITA

Kelly Michelle Drawdy, daughter of Jack and Lavonia Drawdy, was born in Leesburg, FL on October 9, 1981. Upon graduating from Leesburg High School in Leesburg, FL, Kelly chose to attend The University of Florida where she received her Bachelor of Science degree in Food Science and Human Nutrition with an emphasis in Dietetics. In August of 2005, Kelly moved to Auburn, AL where she enrolled into Auburn University's Graduate School and pursued a Master of Science Degree in Nutrition in the Department of Nutrition and Food Science under the direction of Dr. Sareen S. Gropper.

THESIS ABSTRACT

WEIGHT CHANGE AMONG COLLEGE FRESHMEN: THE FRESHMEN 4

Kelly Michelle Drawdy

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A common phenomenon called the "freshmen 15" is thought to occur during the first year of college. While this belief is popular in press, little scientific evidence supports this phenomenon. This study examined changes in body weight and fat in 36 college students during their freshmen year and factors associated with weight change. Subjects included 26 females and 10 males, mean age 18.08 ± 0.28 years. Subjects were measured for height, weight, and body composition at the beginning and end of fall semester 2006, and at the end of spring semester 2007. Subjects also completed lifestyle and dietary questionnaires.

At the beginning of fall semester, mean initial weight and height of the females were 124.9 ± 16.6 lbs and 64.68 ± 2.24 inches, respectively. By the end of fall semester, the females' (n = 25) mean weight significantly increased to 126.9 ± 16.4 lbs. Mean body fat and BMI increased significantly from 22.2 ± 4.1% to 23.2 ± 3.9% and from 21.0 ± 2.2

kg/m^2 to 21.4 ± 2.2 kg/m^2, respectively. Mean initial weight and height of the 10 males were 174.4 ± 24.6 lbs and 69.00 ± 1.90 inches, respectively. By the end of fall semester, mean body fat increased significantly from 14.2 ± 5.4% to 15.1 ± 4.8%. For the entire group (n = 35), mean weight significantly increased from 139.0 ± 29.5 lbs to 140.9 ± 3.8 lbs at the end of fall. Mean body fat and BMI increased significantly from 19.9 ± 5.7% to 20.9 ± 5.5% and from 22.4 ± 3.6 kg/m^2 to 22.7 ± 3.6 kg/m^2, respectively. From the end of fall to the end of spring semester, no significant changes in body weight, fat, or BMI occurred in the returning 21 females and eight males. However, for the entire group (n = 29), mean weight and BMI significantly increased.

Over the academic year, weight significantly increased by of 3.8 $\pm$ 5.0 lbs. Weight change for the academic year for females averaged a 3.2 ± 5.1 lbs gain and for males a 5.4 ± 4.5 lbs gain. Mean body fat and BMI also increased significantly by 1.1% and 0.7 kg/m^2, respectively. Weight change over the academic year ranged from a loss of 5.8 lbs to a gain of 13 lbs; 76% of students gained weight during the freshmen year of college.

Several factors which can influence weight gain were examined including differences in the frequency of exercise, sleeping, alcoholic drink consumption, restaurant and dining hall patronage, breakfast consumption, and number of dining companions, but not found to differ between subjects who gained weight versus subjects who lost weight or had no change in weight.

These findings suggest that the majority of college students are at risk of weight gain during their freshmen year. Weight gain, however, averaged about 4 lbs, and not the popularized 15 lbs. The causes of the observed gains are unclear.

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CHAPTER 1

INTRODUCTION

Obesity is considered an epidemic throughout the United States among all age groups, races, and gender. Not only are adults becoming more overweight, so are young adults, adolescents, and children. Approximately 127 million adults in the United States are classified as overweight and 60 million adults are classified as obese. According to the 2003-2004 National Health and Nutrition Examination Survey, 33.6% of children 2-19 years are overweight or at risk of overweight, 57.1% of young adults 20-39 years are overweight or obese, and 66.3% of all adults are overweight or obese (Ogden and others 2006). Statistics in younger adults are also high, with 26.9% of adults 18-24 years classified as overweight and 16.2% classified as obese (CDC 2005). In young adults, aged 18-24 years, 28.6% were overweight and 24.2% were obese in Alabama (CDC 2005).

While the prevalence of obesity is increasing throughout the nation, the southeastern states have the highest rates. Alabama is ranked second in the nation, just behind Mississippi, with a 28.8% prevalence of obesity in adults and a 64.6% prevalence of obesity or overweight in adults (CDC 2004). Other states with a high prevalence of obesity and overweight include: Louisiana, Tennessee, Texas, Kentucky, West Virginia, Arkansas, Alaska, and North Dakota (CDC 2005).

The consequences of obesity are many. Several adverse health effects are associated with obesity including: hypertension, dyslipidemia, type 2 diabetes, cardiovascular disease, and some cancers, among others (CDC 2006a). In children and young adults, obesity is also associated with poor self-image, depression, orthopedic problems, type 2 diabetes mellitus, hypertension, and sleep apnea, among others (AOA 2002).

College students, specifically freshmen, are a population at an increased risk for weight gain due to changes in lifestyle as they transition from high school to college. Several lifestyle changes are thought to contribute to weight gain observed in college students. One lifestyle change is decreased physical activity, which leads to a more sedentary lifestyle and decreased energy output. Ultimately, the reduction in physical activity can lead to weight gain if energy intake is not adjusted. Excessive energy intake from food available from on-campus dining facilities and/or restaurants (especially all-you-can-eat facilities) may lead to weight gain because these facilities often offer energy dense food and more food is often consumed in these environments. College life also can be accompanied by large amounts of stress and little sleep. Inadequate sleep has been linked to weight gain (Knutson 2005, Patel and others 2006). In addition, social life including increases in dining companions, alcohol consumption and use of tobacco may become more prevalent among college freshmen and play a role in changes in body weight (Liu and others 1994, Wannamethee and Shaper 2003). The “freshmen 15” is a popular term used to describe the usual weight gain exhibited by students during their

freshmen year of college. This study examined changes in body weight and fat among college freshmen as well as factors associated with these changes.

CHAPTER 2

REVIEW OF LITERATURE

This literature review will discuss the definitions of obesity; prevalence of obesity; health and economic consequences of obesity; and general causes of obesity. The section on causes of obesity focuses on behavioral factors associated with weight change in college students. Some of these factors that will be presented include: smoking, alcohol consumption, sleep, and physical activity. In addition, a few environmental factors related to eating and energy balance are discussed. These factors include: meal (breakfast) skipping, restaurant or on-campus dining, and dining companions. Lastly, studies examining weight change among college studies are presented.

Definition of Obesity

The Center for Disease Control defines overweight and obesity based on body mass index (BMI), which is calculated by dividing weight (in kg) by height squared (kg/m^2). A BMI of 30 kg/m^2 or greater is considered obese, 25.0 - 29.9 kg/m^2 is considered overweight, 18.5 to 24.9 kg/m^2 is classified as normal, and <18.5 kg/m^2 as underweight (CDC 2006b).

Prevalence of Obesity

In the past several decades, the prevalence of overweight and obesity in the United States (U.S.) has continually increased among adults, adolescents, and children

(CDC 2006a). Between 1980 and 2002, the prevalence of obesity doubled in adults (aged ≥ 20 years) and the prevalence of overweight children and adolescents (aged 6–19 years) has tripled (Ogden and others 2006). The most recent (2003-2004) data from the National Health and Nutrition Examination Survey (NHANES) found that 17.1% of U.S. children and adolescents were overweight and 32.2% of adults were obese (Ogden and others 2006). Approximately 127 million adults in the US are overweight, 60 million are obese, and 9 million are severely obese (AOA 2002). The prevalence of overweight adolescents aged 12-19 years increased from 5.0% to 17.4% from 1976-1980 and 2003-2004 (CDC 2006a). According to the Behavioral Risk Factor Surveillance System (BRFSS), Alabama is ranked second in the nation, preceded only by Mississippi, with 28.8% prevalence of obesity in adults and a 64.6% prevalence of obesity or overweight in adults (CDC 2004). In young adults, aged 18-24 years, 28.6% were overweight and 24.2% were obese in Alabama (CDC 2005).

Health and Economic Consequences of Obesity

Overweight or obesity is associated with many risk factors that increase the likelihood of developing certain diseases and health conditions. These conditions include: hypertension, dyslipidemia, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea and respiratory problems, and some cancers, among others (CDC 2006a). In children and young adults, obesity is also associated with poor self-image, depression, orthopedic problems, type 2 diabetes mellitus, hypertension, and sleep apnea, among others (AOA 2002). It is also an integral component of the metabolic syndrome, characterized by abdominal obesity, atherogenic dyslipidemia, elevated blood

pressure, insulin resistance or glucose intolerance, prothrombotic state, and/or proinflammatory state (Rubenstein 2005). People with metabolic syndrome are as risk for coronary heart disease and type 2 diabetes (AHA 2006). Alabama has the highest rate of diabetes (9.6%) of all states and is ranked 5th in the nation for heart disease and 7th in the nation for stroke in age-adjusted death rate rankings (Alabama Center for Health Statistics 2003).

The health consequences associated with obesity are not unique to adults. Premature mortality and significant morbidity in young people are also associated with obesity (Rubenstein 2005). Approximately 60% of overweight children and adolescents have at least one additional risk factor for cardiovascular disease (Rubenstein 2005). The prevalence of type 2 diabetes in children and adolescents has been estimated to account for 8-45% of all new cases of diabetes. The prevalence of metabolic syndrome also has increased in adolescents from 4.2% in 1988–1992 to 6.4% in 1999–2000. This syndrome was present in 32.1% of overweight adolescents and it is estimated that there may be more than 2 million U.S. adolescents undiagnosed with this syndrome (Rubenstein 2005).

Not only are there many adverse health consequences associated with obesity, there also is a significant economic impact on health care. Medical expenses accounted for 9.1 % of total US medical expenditures in 1998 and may have reached $92.6 billion in 2002 (CDC 2006c). In 2000, direct medical costs in the United States were estimated to be $61 billion. Direct medical costs may include preventive, diagnostic, and treatment services related to obesity (CDC 2006c). This does not exclude medical costs for children

and adolescents. In 1979–1981, annual hospital costs related to obesity was $35 million and increased largely in 1997–1999 to $127 million dollars (CDC 2006c).

Causes of Obesity

Obesity is a complex, multi-factorial chronic disease involving environmental (social and cultural), genetic, physiologic, metabolic, behavioral and psychological components (AOA 2002). While complex in theory, energy imbalance (energy intake > energy expenditure) typically is the direct cause of weight gain, which can lead to overweight and obesity. In terms of energy imbalance, behavioral and environmental changes during the freshmen year often cause students to increase their energy intake and/or decrease their physical activity (Hoffman and others 2006). Young adults entering college are challenged with new responsibilities such as balancing exercise, nutritional intake, and body weight (Megel and others 1994). Many environmental and social forces interact to possibly influence food, drinking, and exercise choices (Hoffman and others 2006).

Behavioral Factors Associated with Weight Change

Smoking

Cigarette smoking is a major health problem in college students (Patterson and others 2004). Smoking cigarettes is the leading preventable cause of morbidity and mortality in the U.S., and is responsible for approximately 400,000 deaths/year (Wechsler and others 1998). The transition from high school to college allows freedom to make decisions; an important one is whether or not to smoke (Patterson and others 2004). The Harvard School of Public Health College Alcohol Study was a self-administered survey

that included 15,103 randomly selected students in 1993 and 14,251 students in 1997. Over four years, the prevalence of current (30-day) cigarette smoking increased 27.8%, from 22.3% to 28.5%. Currently, smoking in colleges is growing faster in public schools (22.0% to 29.3%) than in private schools (22.9% to 26.8%). Smoking prevalence was higher in whites than blacks or Asians, and higher in freshmen, sophomores, and juniors than seniors and fifth-year students. Schools in the Northeast, North Central, and South regions had higher smoking rates as compared to schools in the West (Wechsler and others 1998).

Tobacco use is not limited to cigarettes, but also includes cigars and smokeless tobacco. Rigotti and others (2000) analyzed the Harvard College Alcohol Survey in 1999 to assess the prevalence of all types of tobacco use among U.S. college students. Nearly half (47.5%) of 14,138 total respondents had used a tobacco product in the past year and 32.9% currently used tobacco. Cigarettes are the most common form of tobacco used among college students with 28.5% of current tobacco users smoking cigarettes compared to 8.5% currently smoking cigars. Men and women have almost identical cigarette smoking rates (28.4% for men vs 28.5% for women). However, total tobacco use was greater in men (37.9%) than women (29.7%) because more men smoke cigars (15.7% for men, 3.9% for women) and use smokeless tobacco (8.7% for men, 0.4% for women) as compared to women who typically only smoke cigarettes (Rigotti and others 2000).

There is much literature that suggests a relationship between smoking and weight control. In the general population, those that smoke weighed less than their non-smoking

peers (Klesges and Klesges 1988). Both young males and females place a high priority on achieving an ideal body weight (Klesges and Klesges 1988). Therefore, some people, particularly females, use smoking to practice unhealthy weight control behaviors in order to lose weight (Tomeo and others 1999). Although smoking leads to long term health consequences, the fear of gaining weight upon cessation of smoking causes many to continue the habit of smoking. There have been several studies that focus on weight control in adolescents and young adults that have showed significant results regarding experimentation in smoking in order to lose weight (Klesges and Klesges 1988, Strauss and Mir 2001).

A study in 1988 by Klesges and Klesges (1988) involved 1076 college students (458 males, 618 females) to determine if smoking was used as a diet strategy. The researchers found that 32.5% of 209 smokers reported smoking in order to lose weight. Of current smokers, 39% of females (n = 44) and 25% of males (n = 24) reported using smoking as a weight loss strategy. However, smokers who were overweight were not more likely to use smoking to lose weight than were normal weight smokers (34% versus 29%) (Klesges and Klesges 1988). Similarly, a study by Carroll and others (2006) also examined smoking among college students and weight loss. The researchers surveyed 300 students at the University of Kansas to determine if they smoked in order to control their weight. They found that smoking was not significantly related to weight loss intention but was significantly associated with a greater pressure to maintain an ideal weight. Students who were current smokers had higher body mass and body fat with an intention to lose weight than non-smokers. Also, current smoking was associated with

other poor health behaviors such as eating high caloric foods from fast food restaurants and engaging less in physical activity. Thus, not only is current smoking used as a weight loss intention, but it can also lead to unhealthy lifestyle choices that can adversely affect health (Carroll and others 2006). A study by Strauss and Mir (2001) found a similar trend in adolescents aged 12–18 years. This study found a two-fold increase in smoking among normal-weight adolescent females who had tried to lose weight. Normal-weight girls who reported trying to lose weight were significantly more likely to smoke versus normal-weight girls who were not trying to lose weight. In contrast, overweight males who were trying to lose weight (9.8%) were significantly less likely to smoke than overweight males who were not trying to lose weight (24.5%). These studies suggest that smoking as a weight loss strategy is very common among adolescents and young adults.

Alcohol Consumption

Alcohol provides 7.1 kcal/gram, higher than that generated by oxidation of protein and carbohydrate (~4 kcal/gram) but slightly less than that of fat (9 kcal/gram). The average alcohol intake by adults is approximately 10% of the total daily energy intake. Due to alcohol's high caloric density, alcohol intake alone has been assumed to be a risk factor for the development of obesity (Liu and others 1994). In addition, alcohol is often consumed with food. In fact, moderate alcohol drinkers tend to consume more energy than nondrinkers, which theoretically could lead to weight gain (Jequier 1999). However, study findings related to alcohol consumption and weight gain and obesity are contradictory (Suter 2005).

A study by Wannamethee and Shaper (2003) examined the relationship between alcohol intake and body weight gain among 7608 men aged 40–59 years. The researchers concluded that heavy alcohol intake (≥ 30 g/day) contributed directly to weight gain and obesity in middle-aged men. However, there was no evidence that light-to-moderate drinking (≤ 30 g/day) was associated with weight gain.

Liu and others (1994) examined the relation between alcohol consumption and weight gain among U.S. adults who participated in the First National Health and Nutrition Examination Survey (1971-1975) and who were reweighed in 1982-1984. Results from this study reported that both men and women drinkers tended to gain less weight than those who did not consume alcohol and drinkers had more stable weight over the 10-year follow-up period. These results suggest that alcohol consumption does not increase the risk of obesity (Liu and others 1994).

Although there is not enough evidence to determine whether or not alcohol consumption is a risk factor for weight gain and obesity, the use of alcohol is common among U.S. adults and college students. According to the BRFSS, in the U.S., 55.4% of adults had at least one drink of alcohol within the past 30 days, 4.9% were classified as heavy drinkers (defined as adult men consuming more than two drinks/day and adult women consuming more than one drink/day), and 15.4% were classified as binge drinkers (defined as males ingesting five or more drinks/occasion and females ingesting four or more drinks/occasion) (CDC 2006d). According to the National Survey on Drug Use and Health (NSDUH), in 2005, 10.8 million underage persons (aged 12 to 20 years) reported drinking alcohol in the past month (NSDUH 2005). NSDUH reported that young

adults aged 18 to 22 years who were enrolled in college full time were more likely to consume alcohol than their peers not enrolled full time in college, 64.4% and 53.2%, respectively. The American College Health Association National College Health Assessment (ACHA-NCHA) reported that 21.5% of college students did not consume alcoholic drinks the last time they partied, 36.3% consumed 1-4 drinks, 27.7% consumed 5-8 drinks, and 14.5% consumed ≥ 9 drinks (ACHA-NCHA 2003).

Sleep

Americans today are getting less sleep than in previous years. In 1910, the average sleep per night among adolescents was 9.1 hours per night, which decreased to 7.4 hours per night in 1994. In 1960, the American Cancer Society found that modal sleep duration was 8.0-8.9 hours, while in 1995, the National Sleep Foundation found that it had dropped to seven hours (Knutson and others 2007). Twenty-six percent of American adults in 2005 were obtaining 8 hours of sleep, which was lower than the previous 35% of adults sleeping eight hours in 1998 (Patel and others 2006).

Voluntary sleep deprivation is very common among college students, particularly during exam periods (Pilcher and Walters 1997). College students lose sleep during the week and compensate by increasing sleep time over the weekend. This pattern of deprivation and rebound can result in 24-48 hours of total sleep deprivation. When students lack the necessary amount of sleep, they are putting themselves at risk for sleepiness during the day, which leads to the inability to pay attention in class and have poor performance on exams (Pilcher and Walters 1997). In addition, studies also report a link between sleep loss and weight gain.

A few studies have examined sleep and weight change. In 2005, a study by Knutson (2005) examined the relationship between sleep and weight among adolescents. The majority of male adolescents (79%) and female adolescents (82%) slept less than nine hours per night, and 42% of males and 46% of females slept less than eight hours per night. Sleep duration was found to be a significant predictor of weight in males, not females. Longer sleep durations were associated with lower BMI and lower risk of overweight in the adolescents. According to logistic regression, every hour increase in sleep was associated with a 10% reduction of risk for being overweight in male adolescents.

The Nurses' Health Study examined the association between sleep and weight gain in 68,183 women over 16 years (Patel and others 2006). Women who slept five hours or less gained 1.14 kg more than those who slept seven hours, and women who slept six hours gained 0.71 kg more than those who slept seven hours. After age adjustment, women sleeping five hours or less weighed 2.47 kg more at baseline, and those sleeping six hours were 1.24 kg heavier when compared to those sleeping seven hours. Results from this study suggest that a decrease in the amount of sleep per night is associated with greater weight gain and BMI (Patel and others 2006).

Physical Activity

Regular physical activity, defined as any bodily movement produced by skeletal muscles that results in energy expenditure (USDA 2005) can improve physiological and psychological health (Kilpatrick and others 2005). Physical activity has many benefits such as decreasing risk for obesity, heart disease, hypertension, diabetes, colon cancer,

and premature mortality (CDC 2003). The American College of Sports Medicine recommends a minimum of 30 minutes of moderate-intensity activity on most days of the week for adults (Pate and others 1995). According to the United States Department of Agriculture (USDA), children and adolescents should engage in at least 60 minutes of moderate to vigorous physical activity on preferably all days of the week. Moderate-intensity exercise includes brisk walking or bicycling (CDC 2003). Greater health benefits can be obtained by engaging in vigorous intensity or longer duration exercise (USDA 2005). Examples of vigorous activity include jogging or other aerobic exercise that burn more calories per unit of time.

The majority of people in the United States do not meet the current recommendations for physical activity. The Behavior Risk Factor Surveillance System found that 52.8% of adults did not meet the recommendations for moderate physical activity, and 73.7% did not meet the recommendations for vigorous physical activity (CDC 2005). In the state of Alabama, 59.7% and 78.7% of adults do not meet the recommendation for moderate physical activity and vigorous physical activity, respectively (CDC 2005).

During the transition from high school to college, the level of physical activity declines (Kilpatrick and others 2005). During this transition, routines and habits that were previously established in high school and home become disrupted (Bray and Born 2004). In 1995, the National College Health Risk Behavior Survey assessed the amount of physical activity among undergraduate college students attending 2 and 4 year universities and colleges. A total of 4,609 students aged 18 to 24 years completed the

survey. Of those surveyed, 37.6% of the students reported they had participated in vigorous physical activity for at least 20 minutes on 3 or more days of the 7 days preceding the survey, and only 20.2% participated in moderate physical activity on more than five days of the 7 days preceding the survey (CDC 1995).

More recently (2006), the American College Health Association – National College Health Assessment examined physical activity in 54,111 college students during spring 2005. The researchers found that 43.6% (n = 23,143) of students exercised vigorously for at least 20 minutes or moderately for at least 30 minutes on 3 of the past 7 days. Only 49.3% of students (n = 26,049) reported that they engaged in strength exercises (i.e. push-ups, sit-ups, weight lifting) at least 2 out of the past 7 days (ACHA-NCHA 2006).

Other smaller studies found similar results. Haberman and Luffey (1998) investigated the health behaviors of 302 college students attending the University of Pittsburgh. Of these students, only 39% reported that they exercised 3 or more times per week. Therefore, 61% did not meet minimal recommendations for physical activity.

The relationship between physical activity, exercise, and sedentary behaviors in 493 college students (205 males, 288 females) who were enrolled in required conditioning classes was examined by Buckworth and Nigg (2004). Males reported significantly greater participation in physical activity and exercise as compared to females but also reported more hours per week watching television and/or computer video games. Seniors and 5th year students spent significantly more time using the computer than freshmen and juniors (Buckworth and Nigg 2004).

Bray and Born (2004) investigated vigorous physical activity and psychological well-being during the transition period from high school to college. Participants included 145 first-year college students (39 men, 106 women) aged 18–19 years. Subjects reported the average number of sessions of vigorous physical activity they engaged in per week as well as the average duration of each vigorous activity session during the last 2 months of high school and the first 2 months of college. Two-thirds (66.2%) of students reported adequate levels of vigorous activity in high school, whereas significantly fewer (44.1%) met the adequate level during the first 2 months at college. One-third of students were active in high school but became insufficiently active once attending college.

Overall, college students are not meeting recommended levels for physical activity. It is a major concern because a decline in physical activity during college may lead to an unhealthy pattern of inactivity that may continue through adulthood (Bray and Born 2004).

Dietary Related Environmental Factors Associated with Weight Change

Several dietary factors may contribute to increases in energy intake which can lead to weight gain in college students. Some of these factors include breakfast skipping, restaurant or on-campus dining, and dining companions.

Breakfast Skipping

Breakfast has been coined the most important meal of the day, yet it is the meal that is often missed (Affenito 2007). Breakfast can be a determinant of a healthy lifestyle and is known to provide a high percentage of micronutrients. However, in the U.S., skipping breakfast is highly prevalent ranging from 10-30% among all age groups

(Affenito 2007). The relationship between breakfast consumption and body weight has recently been given much attention. Some studies report that people who regularly skip breakfast tend to weigh more and have a higher BMI than those that consume breakfast daily (Berkey and others 2003, Niemeier and others 2006, Siega-Riz and others 1998). Given that college students often skip breakfast (Megel and others 1994), they would be at an increased risk for weight gain.

A large cross-sectional study by Siega-Riz and others (1998) reported that a one-unit (1 kg/m^2) increase in BMI was associated with a decreased likelihood of breakfast consumption in adolescents aged 11 to 18 years. Another study examined whether skipping breakfast was associated with changes in body fatness in 14,000 boys and girls from different regions of the U.S. (Berkey and others 2003). Change in BMI over three 1-year periods was examined among children based on breakfast consumption frequency. Normal weight adolescents who never ate breakfast exhibited greater gains in BMI (boys + 0.21 kg/m^2, girls +0.08 kg/m^2) versus peers who ate breakfast nearly every day. However, overweight children who never ate breakfast lost BMI (boys -0.66 kg/m^2, girls -0.50 kg/m^2) compared to overweight children who ate breakfast daily.

The National Longitudinal Study of Adolescent Health investigated if breakfast skipping was associated with weight gain during the transition from adolescence to adulthood. This study consisted of 9,919 adolescents aged 11–27 years over five years. Participants reported that they consumed breakfast on an average of four to five days during adolescence, and this significantly decreased to three days per week in young adulthood. With a decrease in breakfast consumption from adolescence to young

adulthood, there was an increase in weight gain (Niemeier and others 2006). These studies suggest that weight gain occurs when individuals do not consume breakfast regularly.

Restaurant or On-Campus Dining

Along with the increase of obesity in the U.S., there has also been a continuous rise of increased energy intake from restaurants (Diliberti and others 2004). Over the past decades, there has been an increased popularity of dining out at restaurants. In 1995, about 40% of the food budget was spent on food away from home (Lin and others 1999) compared to the early 1970s where about 20% was spent on food away from home (French and others 2000). In 1953, fast food comprised 4% of total sales of food away from home, compared to 34% of away from home food sales in 1997. The average American eats out about four times weekly, frequently at fast food restaurants (Driskell and others 2006). College students are a population in the U.S. that frequent fast food restaurants. Some reports suggest that college students eat at fast food restaurants 6 to 8 times weekly (Driskell and others 2006). As patronage of fast food restaurants has increased, so has the number of fast food restaurants. These restaurants have increased greatly from 30,000 locations in 1970 to 233,000 locations in 2004 (Driskell and others 2006). An increase in fast food and restaurant food consumption has led to an increase of total daily energy consumed. The amount of calories consumed from away-from-home foods has increased from 18% in 1977–1978 to 34% in 1995, and intakes of other nutrients such as fat, cholesterol, and sodium also have increased (Lin and others 1999). Food consumed at these eating facilities are higher in saturated fat, total calories, and

cholesterol (Duffey and others 2007). Therefore, an increased volume of food obtained away from home may adversely affect the nutritional quality of the diet; such as higher intakes of fat and lower intakes of fiber, calcium, and iron (Lin and others 1999). Overall, food consumed away from home typically contains more of the nutrients overconsumed and less of the nutrients that are underconsumed in the U.S. (Lin and others 1999). It is not surprising that with an increase of restaurant consumption there has also been an increase in portion size which contributes to the greater intake of fat and total calories in restaurant meals. A study by Diliberti and others (2004) found that increased portion size leads to increased energy intake. Those who purchased the larger portion increased their energy intake of the entree by 43% (172 kcal) and of the entire meal by 25% (159 kcal) (Diliberti and others 2004).

Studies have been performed to determine the effect of food consumed away from home and body weight. A study by Duffey and others (2007) compared the association of restaurant food and fast food consumption with current and 3-year changes in BMI among young adults in the Coronary Artery Risk Development study. The researchers found that 40% of the adults (n = 3394) increased their weekly consumption of restaurant or fast food over the 3-year period. Cross-sectionally, fast food, not restaurant food, was positively associated with BMI change. In the Pound of Prevention study by French and others (2000), intake of fast foods and body weight were examined in 891 women aged 20–45 years old. Twenty-one percent of the women reported eating ≥ 3 fast food meals/week, 24% reported that they ate on average zero times per week, 39.2% ate once per week, and 15.7% ate twice per week at fast food restaurants. Increases in frequency

of eating at fast food restaurants were associated with increases in total energy intake, percentage of energy from fat, and body weight. On average, an increase of one fast food meal per week was associated with an increase of 56 kcal/day, an increase of 0.6% in fat energy/day and a weight gain of 1.6 lbs over three years above the average weight gain of 3.7 lbs (French and others 2000). McCrory and others (1999) examined the association between the frequency of consuming restaurant food and body fatness in 73 subjects (58 women, 15 men). On average, restaurant food was consumed an average of 7.5 ± 8.5 times/month. Within this population, the researchers found that men consumed restaurant food nearly twice as often as women. The frequency of consuming food from seven types of fast food restaurants combined (fried chicken, burger, pizza, Chinese, Mexican, fried fish, and other) was significantly associated with body fatness measured by hydrostatic weighing. Similar to this study, Driskell and others (2006) investigated the difference between college men and women's fast food eating habits. A total of 226 subjects (113 women, 113 men) completed questionnaires that assessed eating habits at fast food restaurants. A significantly higher percentage of men (84%) than women (58%) typically ate at fast foods for lunch at least once weekly. A total of 82% of the subjects reported eating dinner at a fast food restaurant at least once weekly and there was no significant difference between males and females. A significantly higher percentage of men (70%) than women (63%) typically ate at American burger/fries fast food restaurants at lease once weekly. When making choices based on nutrition information, 51% of women and 37% of men reported that they chose menu options that were healthier at fast food restaurants (Driskell and others 2006).

In cafeteria settings, consumers often serve themselves from unlimited supplies of food and varieties of food (Bryant and Dundes 2005). The same is true at on-campus dining facilities, which can put college students at risk for weight gain. The use of all-you-can-eat dining halls is an effective recruiting technique at colleges, but they may be responsible for much of the weight gain that occurs during the first year of college (Levitsky and others 2004). Students with larger appetites may prefer to eat at all-you-can-eat on-campus dining facilities because they provide more food for less money when compared to other restaurants (Levitsky and others 2004). A few studies have examined the relationship between cafeteria settings and weight change in the college populations. Hovell and others (1985) examined 158 college women over three years. These women were required to live on-campus and eat at on-campus cafeterias their freshmen year of college. During the freshmen year, women gained 0.69 lbs/month and during the sophomore year, women gained 0.18 lbs/month; however, by the junior year, women lost 0.40 lbs/month. The lifestyle (living and eating on campus) was credited as being responsible for the weight gain that occurred during the freshmen year. During their sophomore year, the women moved into apartments or sorority houses, without cafeteria food services. With the move from on-campus dorms to off-campus residences, the women's rate of weight increase dropped and attributed to the women no longer eating at the on-campus cafeterias. Also, many women reported that the dormitory food was a probable cause of weight gain because they often overate at these high calorie meals (Hovell and others 1985).

In conclusion, weight gain during the first year of college may be influenced by eating choices that freshmen are faced with. Fast food restaurants provide quick food for students that are often pressed for time, however these foods are packed with energy and fat. Of the freshmen that live on-campus, they are often encouraged to eat at the cafeteria settings because they provide a variety of foods at a low cost. However, overconsumption often occurs and the choices made at these type of settings also are usually high in energy and fat, which may lead to weight gain.

Dining Companions

Social and environmental factors can influence the eating behavior of humans (de Castro and de Castro 1989). The number of people present as well as the relationship between the people can greatly influence the amount of food intake. When people eat in groups, they tend to eat more than they do when alone, which is called social facilitation (Herman and others 2003). De Castro (2000) has shown that meals eaten with one other person were 33% larger than those eaten alone. Similar to de Castro's findings, Patel and Schundt (2001) found that when people ate with others they ate almost 30% more than they did when eating alone. However, when dining with strangers, the opposite may occur. In impression management, the presence of others usually results in decreased amounts eaten because the individuals are attempting to project positive images of themselves (Pliner and others 2006). This can occur when eating companions are strangers because people are concerned about making a good impression on those who do not know them well. Therefore, they are likely to be less comfortable and correspondingly less eager to prolong the meal, which results in less food consumed

(Herman and others 2003). On the other hand, when meals are eaten with familiar and friendly people (family and close friends), an increased amount is consumed because the meal is more relaxing, enjoyable, and longer (Wansink 2004). This may be due to the individual's reduced ability to monitor consumption or the time-extension hypothesis (Pliner and others 2006). The time-extension hypothesis is that as meal length increases, the number of eaters increase, and this extension of the time spent eating increases the amount eaten (Pliner and others 2006).

Clendenen and others (1994) investigated the social facilitation of eating among friends and strangers in 120 female undergraduate students at the University of Toronto. The study manipulated group size (solo, pairs, groups of four) and familiarity (friends versus strangers) in a laboratory setting that resembled a kitchen with eating area. In the control (solo) group, energy consumption averaged 375 ± 161 kcal/meal, in the group of two it averaged 721 ± 345 kcal/meal, and in the group of four the mean was 703 ± 364 kcal/meal. There were significantly more calories consumed in the groups of pairs and groups of four compared to those who dined alone; therefore, there is a significant effect of group size on total energy intake. When the effect of acquaintance and group size on consumption was examined, the researchers found significance when comparing friends versus strangers on total energy intake. However, there was no significant effect on group size. In the group of friends eating with two, the total energy intake was 814 ± 814 kcal and in the group of friends eating with four, the total energy intake was 872 ± 410 kcal. Among strangers eating in groups of two, the total energy intake was 637 ± 354 versus 534 ± 205 kcal in the group of strangers eating in groups of four. This study supports the

idea that social facilitation increases the amount of energy individuals consume when dining with others. Subjects in this study ate substantially more, almost double, when they ate in groups of two or four than when they ate alone, and when they ate with familiar people (Clendenen and others 1994).

De Castro and de Castro (1989) examined the seven-day dietary records of 63 (14 males, 49 females) adults to determine the social influences on eating. Meals eaten alone contained significantly less total food energy and macronutrient composition compared to meals eaten with others. A total of 410 kcal were consumed when the meal was eaten alone versus 591 kcal when eaten with others, which was significantly different. There was also a significant difference between energy intake from carbohydrate (190 kcal alone versus 241 kcal with others), fat (157 kcal alone versus 230 kcal with others), and protein (65 kcal alone versus 100 kcal with others). However, meals eaten alone (47%) had a significantly higher proportion of carbohydrate than meals eaten with other people (42%). The study found a significant relationship between the presence of other people and the amount of food energy that is consumed during a meal. Meal sizes were approximately 44% larger with larger amounts of fat, carbohydrate, and protein when eaten with others versus alone (de Castro and de Castro 1989).

A total of 133 undergraduate college students (29 males, 104 females) were asked to wear heart rate monitors and record their seven-day dietary record to determine the arousal of certain factors of the food environment (Stroebele and de Castro 2006). The researchers examined the presence of other people and time of day meals were eaten among these subjects. Subjects described themselves as significantly more elated and

excited when more people were present at dining events; however, the researchers found no significant differences in mean meal heart rate. Subjects ate significantly more carbohydrate, fat, and protein as the number of people present at the meal increased. The intake of energy from carbohydrate significantly increased from 257 ± 9 kcal when the subjects ate alone to 302 ± 11 kcal when eating with one other person, and further increased to 327 ± 11 kcal when eating with ≥ 2 people. The same was true for fat and protein. The amount of kcal consumed from fat was 183 ± 9 kcal for those who ate alone, 260 ± 13 kcal for those who ate with one person, and 272 ± 12 kcal for those who ate with ≥ 2 people. For protein, a total of 74 ± 3 kcal was consumed when eating alone, 111 ± 5 kcal for those eating with one other person, and 125 ± 6 kcal for those eating with ≥ 2 people. Further analysis concluded that eating alone occurred significantly earlier in the day (14:29 ± 0:20 military time) than did eating with one (16:14 ± 0:23) or more people (16:47 ± 0:22). Although there was no significant physiologic arousal collected from the heart rate monitors, this study supports the idea that more food is consumed as the number of people present while eating increases (Stroebele and de Castro 2006).

Weight Change among College Freshmen

The "freshmen 15" is a coined phrase based on the belief that students, especially females, gain an average of 15 lbs during their freshman year of college (Hodge and others 1993). Only a few studies, however, have examined whether or not college freshman gain weight, making it a common but undocumented myth among college students.

A study by Anderson and others (2003) determined whether the transition from high school to college is a critical period for weight gain. The purpose of this study was to provide initial data on weight gain during the freshman year and took place at the University of Albany in New York. The amount of weight change was followed from the beginning of the fall semester (September) to the end of the spring semester (May). During the first semester (September to December), 35 (26%) of the 135 freshmen (58 males, 77 females) gained at least 2.3 kg (5 lbs) while 95 (70%) remained within 2.3 kg (5 lbs of their baseline weight, and 5 (4%) of the students lost more than 2.3 kg. According to CDC BMI categories, 15 (14%) of the 107 participants classified originally as normal BMI were reclassified to either overweight or obese in December. By the end of the first semester, nearly one third of the freshmen sample was overweight or obese, compared to one fifth at the beginning of the semester. Weight gain during the second semester (December to May) was not statistically significant. Of the 46 students (17 males, 29 females) that returned in May, weight gain was not statistically significant. Twenty-eight (61%) of the 46 students remained within 5 lbs of their baseline weight, 15 (33%) gained weight, and 3 (7%) lost weight. By the end of the academic year, another 11% of students classified with a normal BMI were reclassified as overweight or obese.

Weight gain among freshmen was evaluated in 60 freshmen (51 females, 9 males) at Cornell University during the first semester (Levitsky and others 2004). Along with weight, a questionnaire also was given that addressed diet and physical activity. At the end of the semester (12 weeks), mean weight gain was 1.9 ± 2.4 kg. A linear regression model was done based on the questionnaire and found that 20% of the variance in weight

gain was due to “all-you-can-eat” dining halls and another 20% of the variance in weight gain was due to snacking and eating high fat junk food.

Change in diet, physical activity, and body weight associated with transition from home to college was examined in a study by Butler and others (2004). This study involved 54 women with a mean age of 17.79 years at a large Midwestern university who resided in on-campus residence halls. Body weight significantly increased from 140.46 ± 25.01 lbs to 142.05 ± 25.15 lbs along with a significant increase in BMI from 23.64 ± 3.86 kg/m^2 to 23.91 ± 3.88 kg/m^2. Significant increases also were seen in fat mass and fat-free mass, and a significant decrease in total physical activity occurred and was hypothesized to be accountable for the significant weight gain.

A study conducted at Michigan State University monitored weight change in 110 freshmen women during their first month at college and again six months later (Hodge and others 1993). The women also completed measures of self-esteem, body image, locus of control, and self-monitoring. After six months, 61 women were reweighed with no significant change in mean weight. However, when women were grouped into those that gained weight (n = 18) and those that lost weight (n = 11), the women that gained weight gained an average of 7.2 lbs and those that lost weight lost an average of 5.45 lbs. Correlations between weight change and personal characteristics for participants for those that gained/lost weight were not significant (Hodge and others 1993).

A study by Megel and others (1994) examined the relationship between self-esteem, health promotion, nutrition, and weight among 57 female college freshmen (mean age 18.5 years). At the beginning of the freshman year, the mean weight was

141.38 ± 27.0 lbs compared to the end of the freshmen year which was 143.94 ± 28.62 lbs. Subjects' average weight gain was 2.45 pounds during the freshman year. Sixteen (31%) of the subjects gained 0.2 to 4.0 lbs, 10 (19%) gained 5 to 10 lbs, and 6 (11%) gained 10 or more lbs. Self-esteem was positively correlated with health promotion behaviors, nutrition, and weight satisfaction (Megel and others 1994).

Another small study was performed by Graham and Jones (2002). Eighty-one incoming freshmen (average age 18.5 years) at a small Midwestern liberal arts college were recruited. Of the 81, 49 returned at the end of the freshman year, 39 (80%) of the participants were women and 10 were males. Fifty-nine percent of the sample gained an average of 4.6 lbs. Thirteen (29.6%) gained 0.5 to 4.5 lbs, 10 (22.7%) gained 5.0 to 9.5 lbs, and 3 (6.8%) gained 10.0 to 15.0 lbs (Graham and Jones 2002).

Finally, Hoffman and others (2006) measured changes in body weight and body fat in 67 freshmen students (32 male, 35 female) attending Rutgers in New Jersey from beginning of fall to late spring semester (last two weeks of April). The mean change in body weight was 2.86 lbs and the mean change in body fat was 0.7%. Of the students who gained weight (n = 49) mean increases of 6.82 lbs (3.1 ± 2.4 kg) and 0.9% ± 3.8% body fat were found.

Conclusions and Justification

In conclusion, weight gain among college freshmen does not appear to average 15 lbs as highly publicized. A more appropriate estimate appears to be a weight gain of approximately 5 lbs during the first year at college. Yet, these studies are typically based

on a small sample size, have often included only females, have often been conducted for only one semester, and have been conducted in only selected regions of the U.S.

Obesity is associated with several health problems including heart disease, stroke, hypertension, osteoarthritis, and some cancers, among other problems. The transition from high school to college is associated with several lifestyle changes that put college freshmen at increased risk for weight gain. Some of these lifestyle factors include decreased physical activity, increased use of alcohol, and increased consumption of fast foods, restaurant foods, and on-campus dining hall foods. The purposes of this study were to examine changes in body weight and fat during the first year of college and selected factors associated with weight change.

Research Hypotheses

1. Freshmen will significantly gain weight and body fat during their first year at college.
2. Consumers of alcohol will gain significantly more weight than non-consumers of alcohol.
3. Weight gainers will consume significantly more alcoholic beverages than weight losers.
4. Individuals who sleep less will gain significantly more weight than individuals who get more sleep.
5. Weight gainers will sleep significantly less than weight losers.
6. Non-consumers of breakfast will gain significantly more weight than consumers of breakfast.

7. Weight gainers will consume breakfast significantly less often than weight losers.
8. Individuals who engage less often in physical activity, including strength training, vigorous, and moderate activity, will gain significantly more weight than those who engage in such activities more often.
9. Weight gainers will exercise significantly less often than weight losers.
10. Individuals who dine out at restaurants more frequently will significantly gain more weight than those who eat at restaurants less frequently.
11. Weight gainers will dine out significantly more often than weight losers.
12. Individuals who eat with more people at restaurants will significantly gain more weight than those who eat with less people.
13. Weight gainers will dine out at restaurants with significantly more people than weight losers.
14. Individuals who eat at on-campus dining facilities more frequently will significantly gain more weight than those who eat at on-campus dining facilities less frequently.
15. Weight gainers will eat at on-campus dining facilities more often than weight losers.
16. Individuals who eat with more people at on-campus dining facilities will significantly gain more weight than those who eat with less people.
17. Weight gainers will eat at on-campus dining facilities with significantly more people than weight losers.

18. Students who live in on- or off-campus dorms will gain more weight than students who live in apartments/houses.

CHAPTER 3

WEIGHT CHANGE AMONG COLLEGE FRESHMEN: THE FRESHMEN 4

ABSTRACT

A common phenomenon called the "freshmen 15" is often thought to occur in the freshmen year of college. While this belief is popular in press, there is not much scientific evidence to support this phenomenon. This study examined the changes in body weight and fat in 36 college students during their freshmen year and selected factors associated with weight change. Subjects included 26 females and 10 males with mean (± SD) age of 18.08 ± 0.28 years. Subjects were measured for height, weight, and body composition using standard techniques at the beginning and end of fall semester 2006, and end of spring semester 2007. Subjects also completed lifestyle and dietary questionnaires at each data collection.

Mean initial (beginning of fall semester) weight and height of the females were 124.9 ± 16.6 lbs and 64.68 ± 2.24 inches, respectively. By the end of the first semester, the females' (n = 25) mean weight significantly increased to 126.9 ± 16.4 lbs. Mean body fat and BMI increased significantly from 22.2 ± 4.1% to 23.2 ± 3.9% and from 21.0 ± 2.2 kg/m^2 to 21.4 ± 2.2 kg/m^2, respectively. Mean initial weight and height of the 10 males were 174.4 ± 24.6 lbs and 69.00 ± 1.90 inches, respectively. By the end of fall semester, mean body fat increased significantly from 14.2 ± 5.4% to 15.1 ± 4.8%. For the entire

group (n = 35), mean weight significantly increased from 139.0 ± 29.5 lbs at the beginning of fall to 140.9 ± 3.8 lbs at the end of fall. Mean weight change was 1.9 ± 3.8 lbs. Mean body fat and BMI increased significantly from 19.9 ± 5.7% to 20.9 ± 5.5% and from 22.4 ± 3.6 kg/m^2 to 22.7 ± 3.6 kg/m^2, respectively. Weight change ranged from a loss of 5 lbs to a gain of 10 lbs. About 70% of the subjects gained weight during fall semester.

From the end of fall semester to the end of the spring semester, no significant changes in body weight, fat, or BMI were found for the returning 21 females and eight males. However, for the entire group (n = 29), mean weight increased significantly from 139.3 ± 28.7 lbs at the end of fall semester to 141.2 ± 30.2 lbs at the end of spring semester. The mean weight gain was 1.9 $\pm$ 4.1 lbs. Mean BMI also increased significantly from 22.6 ± 3.5 kg/m^2 to 22.9 ± 3.7 kg/m^2. Weight change for spring semester ranged from a loss of 5 lbs to a gain of 11.4 lbs. About 59% of the subjects gained weight during the spring semester.

Over the academic year, weight significantly increased. For the entire group over the year, weight gain averaged 3.8 $\pm$ 5.0 lbs; females averaged a 3.2 ± 5.1 lbs gain and the males averaged a 5.4 ± 4.5 lbs gain. Mean body fat and BMI also increased significantly 1.1% and 0.7 kg/m^2, respectively, for the group. By the end of the academic year, three subjects that were classified as normal weight at the beginning of fall were classified as overweight at the end of spring. Weight change over the first academic year ranged from a loss of 5.8 lbs to a gain of 13 lbs. Seventy-six percent of subjects gained weight during their first academic year of college.

Several factors which can influence weight gain were examined including differences in the frequency of exercise (strength training, vigorous activity, and moderate activity), sleeping, alcoholic drink consumption, patronage at restaurants and dining halls, breakfast consumption and skipping, and number of people present at dining occasions. When comparing the group that gained weight versus the group that lost weight or did not gain, no significant differences were found for spring semester and only one significant difference was found for fall semester. Subjects that gained weight participated fall semester in vigorous activity (2.8 ± 1.5 days/wk) significantly more often versus those that lost weight/didn't gain (1.5 ± 1.4 days/wk). In addition, weight change was examined between groups based on place of residence, frequency of exercise, sleep duration, frequency of restaurant and dining hall patronage, breakfast skipping, and number of people present at dining events. No significant differences in weight change were found for any of these factors for fall or spring semester.

These findings suggest that the majority of college students, including males and females, are at risk of weight gain during their freshmen year, especially fall semester. Weight gain, however, averaged about 4 lbs, and not the popularized 15 lbs. The causes of the weight gain are unclear.

INTRODUCTION

Obesity is considered an epidemic throughout the United States among all age groups, races, and gender. Not only are adults becoming more overweight, so are young adults, adolescents, and children. Approximately 127 million adults in the United States are classified as overweight and 60 million adults are classified as obese. According to

the 2003-2004 National Health and Nutrition Examination Survey, 33.6% of children 2–19 years are overweight or at risk of overweight, 57.1% of young adults 20–39 years are overweight or obese, and 66.3% of all adults are overweight or obese (Ogden and others 2006). Statistics in younger adults are also high, with 26.9% of adults 18–24 years classified as overweight and 16.2% classified as obese (CDC 2005). In young adults, aged 18–24 years, 28.6% were overweight and 24.2% were obese in Alabama (CDC 2005).

While the prevalence of obesity is increasing throughout the nation, the southeastern states have the highest rates. Alabama is ranked second in the nation, just behind Mississippi, with a 28.8% prevalence of obesity in adults and a 64.6% prevalence of obesity or overweight in adults (CDC 2004). Other states with a high prevalence of obesity and overweight include: Louisiana, Tennessee, Texas, Kentucky, West Virginia, Arkansas, Alaska, and North Dakota (CDC 2005).

The consequences of obesity are many. Several adverse health effects are associated with obesity including: hypertension, dyslipidemia, type 2 diabetes, cardiovascular disease, and some cancers, among others (CDC 2006a). In children and young adults, obesity is also associated with poor self-image, depression, orthopedic problems, type 2 diabetes mellitus, hypertension, and sleep apnea, among others (AOA 2002).

College students, specifically freshmen, are a population at an increased risk for weight gain due to changes in lifestyle as they transition from high school to college. Several lifestyle changes are thought to contribute to weight gain observed in college

students. One lifestyle change is decreased physical activity, which leads to a more sedentary lifestyle and decreased energy output. Ultimately the reduction in physical activity can lead to weight gain if energy intake is not adjusted. Excessive energy intake from food available from on-campus dining facilities and/or restaurants (especially all-you-can-eat facilities) may lead to weight gain because these facilities often offer energy dense food and more food is often consumed in these environments. College life also can be accompanied by large amounts of stress and little sleep. Inadequate sleep has been linked to weight gain (Knutson 2005, Patel and others 2006). In addition, social life including increases in dining companions, alcohol consumption and use of tobacco may become more prevalent among college freshmen and play a role in changes in body weight (Liu and others 1994, Wannamethee and Shaper 2003). The "freshmen 15" is a popular term used to describe the usual weight gain exhibited by students during their freshmen year of college. This study examined changes in body weight and fat among college freshmen as well as factors associated with these changes.

SUBJECTS AND METHODS

Subjects

Freshmen students were recruited for participation in the study by email and class announcements at the beginning of the fall semester (2006) at Auburn University. The freshmen class at Auburn University in 2006–2007 consisted of 4,092 students of the 20,302 total undergraduate students. The retention rate for the freshmen class of 2006 was 84%. Of the freshmen population, females composed 49.5% and males composed 50.5%. Minority students represented 12.2% of the student population. The freshmen

students' permanent place of residence ranges from all regions of the U.S. and other countries. The majority of 12,720 students are permanent residents of Alabama. Some of the other states contributing heavily to Auburn's student population include 2,883 from Georgia, 915 from Florida, 669 from Tennessee, 332 from Texas, 216 from Virginia, 173 from North Carolina, 135 from South Carolina, 124 from Louisiana, and 101 students were from Mississippi (OIRA 2006).

An informed consent from parents and students for subjects aged 19 years or younger was obtained prior to participation in the study (Appendix A). Subjects received $25 each time they completed the study requirements.

Study Design

Participants were assessed three times during the academic year: the beginning of fall semester 2006, the end of fall semester 2006, and the end of spring semester 2007. At each of these times, subjects completed a questionnaire and underwent anthropometric measurements. This study was conducted as a part of a larger study, which also included measurement of body size and shape and another questionnaire on body image/ satisfaction.

Approval

This study was approved by the Institutional Review Board for the Use of Human Subject in Research at Auburn University.

Questionnaire

Subjects were requested to complete a questionnaire assessing dietary and lifestyle habits. As part of the questionnaire, subjects answered questions addressing the

following: frequency (number of days per week) of physical activity (vigorous, moderate, and strength), amount of sleep per week, consumption of alcohol, amount of tobacco products used, number of times they dined out at a restaurant/day, breakfast consumption, number of people present while eating, and place of residence. This questionnaire is found in appendix B.

Anthropometric Assessment

Weight was measured on all occasions to the nearest 0.1 lb using a digital scale (Health-O-Meter, Sunbeam Products, Model # HDL543DQ-95, Boca Raton, FL) on a level floor. The digital scale was verified for accuracy using external weights and had a precision of < 0.05%. For each weighing, subjects wore their regular indoor clothing (typically shorts and t-shirts) and no shoes or jackets. Subjects were also asked to take heavy items (such as keys and cell phones) out of their pockets. Subjects tended to dress in similar fashion at all three measurements; thus, it is unlikely that there were large differences in the weight of clothing at different measurements. Height was measured to the nearest one-quarter inch using a fixed measuring tape placed on the wall and a headboard using standard techniques. To measure height, subjects stood barefoot with their heels, buttocks, upper back, and head touching the wall, and head looking straight forward. Body mass index (BMI) was calculated from each subject's height and weight measurements based on the formula: BMI = weight in kg divided by height in meters squared. Each subject's BMI was categorized as underweight, normal, overweight, or obese based on the Center for Disease Control definitions (CDC 2006b). Body composition was measured using bioelectrical impedance (BodyStat, Detroit, MI).

Bioelectrical impedance analysis (BIA) measures the impedance of an electrical current (50kHz) through body tissues. The instrument generates the current which is passed through the body via four electrodes placed at specific locations on the right hand and wrist and right foot and ankle. The resistance to impedance between the electrodes is measured and provides an estimate of body water. This information along with the subject's gender, age, height, and weight are entered into the BIA instrument to enable calculation of body fat and fat free mass. BodyStat has been validated for accuracy against underwater weighing (densitometry) which is considered a gold standard for body composition measurements. Precision of BodyStat measurements within this study is less than 0.5% with repeated measurements on the same subject. In conducting BIA measurements, subjects were asked to lie down in a supine position with limbs abducted at a 30–45 degree angle from the trunk on a floor mat for five minutes. Because hydration status affects BIA accuracy, prior to measurements, subjects were instructed not to drink caffeine or alcohol or engage in strenuous exercise for 12 hours prior to coming in for the study. Also, they were asked not to eat for at least 2–4 hours prior to measurements. Subjects were measured at similar times of the day (morning) throughout the year to help ensure accuracy.

Statistical Analyses

Statistical analyses were performed using the software InStat Version 3.0 (GraphPad Software, San Diego, CA). Paired student's t-test were used to compare subject's differences in weight, body fat, and BMI between the beginning of fall semester and end of fall semester, and between the end of fall and the end of spring semesters.

Repeated measures analysis of variance (ANOVA) was used to compare weight, body fat, and BMI among the three time periods: beginning of fall, end of fall, and end of spring semesters. Statistically significant findings using ANOVA were followed by Tukey's multiple comparisons test.

A student's t-test was used to compare differences in weight change between males and females. It was also used to examine differences in weight change based on differences in place of residence (dorms versus apartments/houses), physical activity frequency (≤ 2 days/wk versus > 2 days/wk and ≤ 4 days/wk versus > 4 days/wk), alcoholic drink consumption (≤ 3.5 drinks/month versus > 3.5 drinks/month), number of hours sleep per week (≤ 46 hours/wk versus > 46 hours/wk), frequency of restaurant dining (≤ 0.5 time/day versus > 0.5 time/day), frequency of breakfast consumption (≥ 3 times skipped/wk versus < 3 times skipped/wk), restaurant dining companions (≤ 2 people versus > 2 people), on-campus dining companions (< 2.5 people versus ≥ 2.5 people) , and frequency of dining on-campus (≤ 1 times/day versus > 1 times/day). In addition, the student's t-test was used to examine differences in physical activity, alcoholic drink consumption, sleep, restaurant dining, on-campus dining, breakfast consumption, restaurant dining companions, and on-campus dining companions between those who gained weight versus those who lost weight or remained the same. A participant was categorized as having gained weight if he/she gained ≥ 0.1 lbs, and a participant was categorized as having lost weight or maintained weight if he/she had no weight change or lost ≥ 0.1 lbs. Statistical significance was set at p value of < 0.05.

RESULTS

Subjects

A total of 36 students (26 females, 10 males) volunteered for the study at the start of fall semester. Selected demographic data are shown in Table 1.

Anthropometric Findings

Changes from the beginning of fall semester to the end of fall semester

At the end of the fall semester, all 36 subjects (26 females, 10 males) returned for follow-up assessments. However, data from one female was not included in the analysis due to a diagnosis of an eating disorder and the student's withdrawal from the university.

Of the 25 females, two were initially underweight (BMI < 18.5 kg/m^2), 22 were normal weight (BMI 18.5-24.9 kg/m^2), and one was overweight (BMI 25-29.9 kg/m^2). Mean initial weight and height of the females were 124.9 ± 16.6 lbs and 64.68 ± 2.24 inches, respectively. By the end of the first semester, the females' mean weight significantly increased to 126.9 ± 16.4 lbs. Mean percent body fat increased significantly from 22.2 ± 4.1% to 23.2 ± 3.9%. Mean BMI significantly increased from 21.0 ± 2.2 kg/m^2 to 21.4 ± 2.2 kg/m^2 (Table 2). By the end of fall semester, two of the girls classified by BMI as normal weight at the beginning of fall semester were classified as overweight.

Of the 10 males, five were normal weight, four were overweight, and one was obese (BMI ≥ 30 kg/m^2). Mean initial weight and height of the males were 174.4 ± 24.6 lbs and 69.00 ± 1.90 inches, respectively. By the end of the semester, mean percent body fat increased significantly from 14.2 ± 5.4% to 15.1 ± 4.8% (Table 2). By the end of the

fall, one of the males classified by BMI as normal weight at the start of the semester was classified as overweight.

For the entire group (n = 35), mean weight significantly increased from the beginning of fall (139.0 ± 29.5 lbs) to the end of fall semester (140.9 ± 3.8 lbs). Mean weight gain was 1.9 ± 3.8 lbs, with a median weight gain of 1.6 lbs. Mean percent body fat increased significantly from 19.9 ± 5.7% to 20.9 ± 5.5%. Mean BMI significantly increased from 22.4 ± 3.6 kg/m^2 to 22.7 ± 3.6 kg/m^2 (Table 2). Weight change ranged from a loss of 5 lbs to a gain of 10 lbs. About 70% of the subjects gained weight during the first semester. The average number of days between the measurements was 87 $\pm$ 14 days. Weight change for the females averaged 0.14 lb/week and for the males 0.17 lbs/week and did not significantly differ between males and females.

When subjects were asked to describe their current weight status on the questionnaire at the end of fall semester 3% said they were slightly underweight, 60% said they were about the right size, and 37% said they were slightly overweight. However, when asked what they were currently trying to do about their weight, 51% said they were trying to lose weight, 6% were trying to gain, and 43% were trying to stay the same weight.

Changes from the end of fall to the end of spring semester

At the end of the spring semester, 30 subjects (22 females, 8 males) returned for the follow-up assessments. However, data from one female was not included in the analysis due to a suspected eating disorder (24 lbs weight loss and BMI of 17.2 kg/m^2). Thus, 29 subjects were used in data analysis for spring semester.

Of the 21 females, one was classified by BMI as underweight, 17 were classified as normal weight, and three were overweight. No significant changes were found in mean body weight, body fat, and BMI for the females (Table 3). None of the subjects changed BMI classifications from the end of fall to the end of spring semester.

Of the 8 returning males at the end of spring, four were classified by BMI as normal weight, three were overweight, and one was obese. Like the females, no significant changes were found in mean weight, body fat, and BMI for the males, from the end of fall semester to the end of spring semester (Table 3). No changes in BMI classifications were found for the males from the end of fall to the end of spring semester.

For the entire group (n = 29) from the end of fall semester to the end of spring semester, mean weight increased significantly from 139.3 ± 28.7 lbs to 141.2 ± 30.2 lbs, with a median weight gain of 1.4 lbs a mean weight change of 1.9 ± 4.1 lbs. Mean BMI increased significantly from 22.6 ± 3.5 kg/m^2 to 22.9 ± 3.7 kg/m^2 (Table 3). Weight change for spring semester ranged from a loss of 5 lbs to a gain of 11.4 lbs. About 59% of the subjects gained weight during the spring semester. The average number of days between the measurements taken at the end of fall semester and the end of spring semester was 141 ± 6 days. Weight change for the females averaged 0.07 ± 0.18 lbs/week and for the males averaged 0.16 ± 0.26 lbs/week and did not significantly differ between the two groups. At the end of spring, when subjects were asked on the questionnaire about their current weight status 3% stated they were slightly underweight, 66% reported they were about the right size, and 31% stated they were slightly overweight, respectively. At the end of spring, 45% were trying to lose weight, 10% were trying to

gain weight, 38% were trying to stay the same weight, and 7% stated they were doing nothing about their weight.

Academic year: Changes from beginning of fall to end of spring semesters

For the entire group (n = 29), mean weight increased significantly from 137.3 ± 28.4 lbs at the beginning of fall semester to 141.2 ± 30.2 lbs at the end of spring semester (Table 4). The median weight gain was 4.8 lbs, and the mean weight gain was 3.8 ± 5.0 lbs. Weight change for the academic year for the females averaged a 3.2 ± 5.1 lbs gain and for the males a 5.4 ± 4.5 lbs gain. Weight change/week for all subjects was 0.12 ± 0.15 lbs/week. Mean body fat also increased significantly from 20.1 ± 6.0% to 21.2 ± 5.7%. Mean BMI also increased significantly from 22.2 ± 3.4 kg/m^2 to 22.9 ± 3.7 kg/m^2 (Table 4). By the end of the academic year, one subject was classified by BMI as underweight, 21 subjects were classified as normal weight, six subjects were classified as overweight, and one subject was obese. Three subjects that were classified as normal weight at the beginning of fall were classified as overweight at the end of spring. Weight change over the first academic year ranged from a loss of 5.8 lbs to a gain of 13 lbs. Of the female subjects, 38% gained weight both fall and spring semesters, 33% gained weight fall semester and either lost weight or didn't change weight spring semester, 14% lost weight both fall and spring semesters, and the remaining 14% lost weight or stayed the same weight fall semester and gained weight spring semester. Of the male subjects, 50% gained weight both fall and spring semesters, 25% gained weight fall semester and either lost weight or didn't change weight spring semester, and 25% lost weight or stayed

the same weight fall semester and gained weight spring semester. Seventy-six percent of subjects gained weight during their first academic year of college.

Factors Associated with Weight Change

Several factors were examined to determine if there were differences between those that gained weight versus those that lost weight or had no change in weight. Differences in the frequency of exercise (strength training, vigorous activity, and moderate activity), sleeping, alcoholic drink consumption, frequency of restaurant dining, frequency of on-campus dining, breakfast consumption, restaurant dining companions, and on-campus dining companions were compared between subjects in the two categories. The weight gain group gained an average of 3.7 ± 2.8 lbs fall semester and 4.0 ± 3.3 lbs spring semester. The weight loss/no change group lost an average of -2.5 ± 1.5 lbs fall semester and -2.2 ± 1.3 lbs spring semester. In addition, weight change was examined between groups based on place of residence, frequency of exercise, sleep duration, frequency of restaurant dining, frequency of on-campus dining, breakfast skipping, and number of dining companions.

Fall semester

When examining the group that gained weight versus the group that lost weight/no change, only one significant difference was found for fall semester. Subjects that gained weight participated in vigorous activity (2.8 ± 1.5 days/wk) significantly more often versus those that lost weight/no change (1.5 ± 1.4 days/wk) (Table 5).

Weight change also was examined among subjects based on place of residents, frequency of exercise, sleep duration, frequency of restaurant patronage, breakfast

skipping, number of times eat on-campus, and number of people present while dining at restaurants or on-campus facilities. During fall semester, no significance differences were found for any of the parameters (Table 6).

Spring semester

For the spring semester, no significant differences were found for any of the factors between those that gained weight versus those that lost/didn't gain weight (Table 7). When weight change was examined spring semester between subjects based on place of residence, frequency of exercise, sleep duration, frequency of restaurant patronage, breakfast skipping, and number of people present at dining events, no significant differences in any of the parameters were found (Table 8).

DISCUSSION

It is a popular belief that freshmen gain an average of 15 pounds during their first year of college; however, few studies have been conducted examining weight change and those that have been done often included only females, were typically conducted for only one semester, and were conducted outside the southern region of the United States, where the prevalence of obesity is high. The results of this study found about 76% of students, including males and females, gained weight their freshmen year, suggesting weight gain is a problem. However, instead of highly publicized "freshmen 15", a more accurate representation may be the "freshmen 4".

Anthropometric Findings

Of the seven studies found in literature, only four studies examined weight change over an academic year in both females and males (Anderson and others 2003, Graham

and Jones 2002, Levitsky and others 2004, Hoffman and others 2006). The present study found 76% of students gained weight their freshmen year. Further, weight gain averaged 4 lbs and did not differ between males and females. These findings are similar to those of Anderson and others (2003) who reported 74% of freshmen gained weight and found no significant difference in weight gain between males and females. In addition, weight gain averaged about 3–4 lbs (Anderson and others 2003, Hoffman and others 2006). Another study, examining only women during their freshmen year, reported a slightly lower average weight gain of 2.45 lbs (Megel and others 1994).

Of the studies have that have only examined weight change during the first semester (Butler and others 2004, Levitsky and others 2004), Levitsky and others (2004) reported an average weight gain of 4 lbs in freshmen after one semester. These findings are slightly higher than the average 2 lbs gain found in the males and females after one semester in the present study.

When comparing weight gain between fall and spring semesters, the present study reported body weight significantly increased in females (but not males) fall semester only (not spring semester). These findings are similar to those reported by Anderson and others (2003).

Lastly, a couple of studies divided freshmen into those that gained weight versus those that lost weight during the freshmen year (Hodge and others 1993, Hoffman and others 2006). Weight gains in the weight gain group in these studies averaged 7.2 lbs (women only) (Hodge and others 1993) and 6.8 lbs (women and men) (Hoffman and others 2006) at the end of the freshmen year. These findings are slightly less that those

found in the present study which documented an average weight gain of about 7.7 lbs in the weight gain group. Further, unlike some studies which report that it is those who are overweight who gain weight (Megel and others 1994), the results of this study found students that gained weight were typically initially classified by BMI as underweight or normal weight. These findings are similar to Anderson and others (2003).

Of the published literature to date, only Hoffman and others (2006) examined changes in body composition in college freshmen. The researchers found that body fat increased during the academic year by 0.7%, which is similar to the 1.1% increase in body fat observed in the present study. BMI also increased in the present study by 0.7 kg/m^2. Similar increases of 1 kg/m^2 and 0.5 kg/m^2 were reported by Hoffman and others (2006) and Anderson and others (2003), respectively.

The present study adds important findings to the existing literature. Freshmen weight gain is not confined to primarily female students and is not the highly publicized 15 lbs. Significant weight gain occurred in both male and female college students during their freshmen year while attending a large public university in the South, and averaged about 4 lbs. It is possible that weight or body fat change may have been greater in this study had the sample of recruited freshmen been blinded to the study's purpose and been from more diverse colleges. Recruitment was not random. Students were primarily recruited from classes offered through the College of Human Sciences with majors such as dietetics and fashion merchandising which often attract students with more concerns about body image, weight, and appearance than the average student interested in other

fields of study. Further, self-selection bias may have occurred as only students who felt secure enough with their body and weight to be measured returned.

Factors Associated with Weight Change

Weight gain among freshmen is thought to be associated with changes in lifestyle that occur during the transition from high school to college. Other studies have concluded that decreased total physical activity (Butler and others 2004) or "all-you-can-eat" dining halls or snacking on high fat junk foods (Levitsky and others 2004) may be the cause of weight gain in this population, but these conclusions are not well documented. Factors thought to be associated with weight change that were examined in the present study included place of residence, sleep duration, frequency of restaurant and on-campus dining, breakfast skipping/consumption, number of companions present while dining at restaurants and on-campus, and physical activity frequency. However, findings of the present study were limited by the relatively small sample size, which reduced the power of the statistical tests, and the subject's ability and desire to accurately answer the questionnaire. Findings of the present study showed only one statistically significant finding. Subjects who gained weight fall semester (but not spring semester) participated in vigorous activity (but not moderate activity or strength training) significantly more often than those who lost weight. However, the duration of the activity was not reported and dietary intake information was not collected making it unclear as to how much vigorous activity was performed and how much food (energy) was consumed. Theoretically, with increased frequency of exercise, one would expend more energy and therefore lose weight as long as the expenditure was not counter balanced by a greater

energy intake, as may have occurred here. Alternately, the subject's reporting of their frequency of vigorous physical activity could have been overestimated.

CONCLUSIONS

In conclusion, weight gain is a problem for most college students during their freshmen year, especially during fall semester. Additional studies are needed to determine factors contributing to the weight gain.

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Table 1: Selected demographic characteristics of sample population

	Beginning of Fall (n = 36)	End of Fall (n = 35)	End of Spring (n = 29)
Mean ± SD Age (years)	18.08 ± 0.28		
Gender[+]			
Male	10 (28%)	10 (29%)	8 (28%)
Female	26 (72%)	25 (71%)	21(72%)
Race[+]			
Caucasian	33 (92%)		
African American	1 (3%)		
Hispanic	2 (5%)		
Family Income ($)			
30,000-50,000	1 (2.8%)		
50,000-70,000	2 (5.6%)		
70,000-90,000	3 (8.3%)		
90,000-110,000	2 (5.6%)		
110,000-130,000	2 (5.6%)		
130,000-150,000	2 (5.6%)		
>150,000	7 (19.4%)		
Don't Know	17 (47.2%)		
Permanent Residence[+]			
Alabama	19 (53%)		
Georgia	6 (17%)		
Florida	2 (6%)		
South Carolina	2 (6%)		
Texas	2 (6%)		
Delaware	1 (3%)		
North Carolina	1 (3%)		
Tennessee	1 (3%)		
Virginia	1 (3%)		
Wyoming	1 (3%)		
School Residence[+]			
Apartment/House			
Male	6 (67%)	6 (67%)	4 (57%)
Female	3 (33%)	3 (33%)	3 (43%)
On- or Off- campus dorm			
Male	4 (15%)	4 (15%)	4 (18%)
Female	23 (85%)	22 (85%)	18 (82%)
Smoke[+]			
No	31 (86%)	27 (77%)	26 (90%)
Yes	5 (14%)	8 (23%)	3 (10%)
Alcohol Consumption[+]			
No	17 (47%)	10 (29%)	6 (21%)
Yes	19 (53%)	25 (71%)	23 (79%)

[+] Data are presented as n (%)

Table 2: Body weight, body fat, and body mass index (BMI) of college freshmen at the beginning and end of fall semester[+]

Gender/Time	Body Weight[a] (lb)	Body Fat[a] (%)	BMI[a] (kg/m^2)
Females (n = 25)			
Beginning of fall	124.9 ± 16.6	22.2 ± 4.1	21.0± 2.2
End of fall	126.9 ± 16.4[*]	23.2 ± 3.9[*]	21.4 ± 2.2[*]
Males (n = 10)			
Beginning of fall	174.4 ± 24.6	14.2 ± 5.4	25.9 ± 4.1
End of fall	176.1 ± 25.5	15.1 ± 4.8[*]	26.1 ± 4.1
All Subjects (n = 35)			
Beginning of fall	139.0 ± 29.5	19.9 ± 5.7	22.4 ± 3.6
End of fall	140.91 ± 3.78[*]	20.9 ± 5.5[*]	22.7 ± 3.6[*]

Mean ± SD 87 ± 14 days between measurements
[a] Data are presented as mean ± SD
[*] Statistically significantly ($p < 0.05$) greater than beginning values

Table 3: Body weight, body fat, and body mass index (BMI) of college freshmen at the end of fall semester and the end of spring semester[+]

Gender/Time	Body Weight[a] (lb)	Body Fat[a] (%)	BMI[a] (kg/m^2)
Females (n = 21)			
End of fall	126.5 ± 16.3	23.7 ± 3.6	21.4 ± 2.2
End of spring	127. 9 ± 17.3[**]	23.6 ± 3.3	21.6 ± 2.2
Males (n = 8)			
End of fall	172.8 ± 27.6	14.2 ± 4.8	25.7 ± 4.3
End of spring	176.0 ± 29.7	14.8 ± 5.8	26.2 ± 4.9
All Subjects (n = 29)			
End of fall	139.3 ± 28.7	21.1 ± 5.8	22.6 ± 3.5
End of spring	141.2 ± 30.2[*]	21.2 ± 5.7	22.9 ± 3.7[*]

[+] Mean ± SD 141 ± 6 days between measurements
[a] Data are presented as mean ± SD
[*] Statistically significantly ($p < 0.05$) greater than end of fall values
[**] Approach statistical significance ($p = 0.05 - 0.10$) versus end of fall values

Table 4: Body weight, body fat, and body mass index (BMI) of college freshmen at the beginning of fall semester and the end of spring semester[+]

Gender/Time	Body Weight[a] (lb)	Body Fat[a] (%)	BMI[a] (kg/m^2)
Females (n = 21)			
Beginning of fall	124.7 ± 16.5	22.7 ± 3.8	21.1 ± 2.2
End of spring	127.9 ± 17.3[*]	23.6 ± 3.3[*]	21.6 ± 2.2[*]
Males (n = 8)			
Beginning of fall	170.6 ± 26.2	13.1 ± 5.3	25.4 ± 4.3
End of spring	176.0 ± 29.7[*]	14.8 ± 5.8[*]	26.2 ± 4.9[*]
All Subjects (n = 29)			
Beginning of fall	137.3 ± 28.4	20.1 ± 6.0	22.2 ± 3.4
End of spring	141.2 ± 30.2[*]	21.2 ± 5.7[*]	22.9 ± 3.7[*]

[+] Mean ± SD 229 ± 14 days between measurements
[a] Data are presented as mean ± SD
[*] Statistically significantly ($p < 0.05$) greater than beginning values

Table 5: Differences in activity, alcohol consumption, sleep, restaurant dining, on-campus dining, breakfast consumption, restaurant dining companions, and on-campus dining companions among freshmen who gained weight versus those that lost/no change at the end of fall semester

Parameters	**Weight Gain Group[a] (n = 25)**	**Weight Loss/No Change Group[a] (n = 10)**
Strength training (days/wk)	1.6 ± 1.4	2.1 ± 2.6
Vigorous activity (days/wk)	2.8 ± 1.5*	1.5 ± 1.4*
Moderate activity (days/wk)	5.6 ± 1.7	4.9 ± 1.7
Alcoholic drink consumption (no./month)	4.1 ± 2.7+	4.6 ± 1.7+
Sleep (hr/wk)	48.6 ± 7.5**	43.6 ± 7.7**
Restaurant dining (no. times/day)	0.8 ± 0.4+	1.2 ± 1.2+
On-campus dining (no. times/day)	N/A	N/A
Breakfast consumption (no./wk)	5.2 ± 1.7	4.2 ± 2.4
Restaurant dining companions (no.)	2.6 ± 1.2+	2.0 ± 0.9+
On-campus dining companions (no.)	2.8 ± 1.5+	2.1 ± 1.1+

[a] Data are presented as mean ± SD

+ For weight gain and weight loss/no change groups, alcoholic drink consumption n =19 and n = 6, respectively; for restaurant dining n = 24 and n = 9, respectively; for restaurant dining companions n = 22 and n = 9, respectively; for on-campus dining companions n = 11 and n = 4, respectively;

* $p < 0.05$

** Approached statistical significance p = 0.05-0.10

N/A = Statistical analysis was not possible due to a standard deviation of 0

Table 6: Weight change among subjects based on differences in place of residence, frequency of strength training, vigorous activity, moderate activity, alcoholic drink consumption, sleep, restaurant dining, on-campus dining, breakfast skipping, restaurant dining companions, and on-campus dining companions for fall semester

Parameter	(n)	Weight Change[a] (lbs)
Place of residence		
Apartment/House	9	-0.1 ± 3.1
Dorm (on or off campus)	26	2.6 ± 3.8**
Strength training		
≤ 2 days/wk	24	2.0 ± 3.9
> 2 days/wk	11	1.6 ± 3.7
Vigorous activity		
≤ 2 days/wk	20	0.9 ± 3.5
> 2 days/wk	15	3.2 ± 3.9**
Moderate activity		
≤ 4 days/wk	9	2.0 ± 4.0
> 4 days/wk	26	1.9 ± 3.8
Alcoholic drink consumption (no./month)		
≤ 3.5	14	2.3 ± 3.9
> 3.5	21	1.6 ± 3.8
Sleep (hr/wk)		
≤ 46	21	1.4 ± 3.8
> 46	14	2.7 ± 3.8
Restaurant dining (no. times/day)		
≤ 0.5	9	2.2 ± 4.8
> 0.5	24	1.9 ± 3.5
On-campus dining (no. times/day)		
≤ 1	14	1.3 ± 4.0
> 1	8	4.4 ± 3.5**
Breakfast skipping (no./wk)		
≥ 3	14	1.2 ± 3.8
< 3	21	2.3 ± 3.8
Restaurant dining companions (no.)		
≤ 2	16	2.0 ± 3.4
> 2	15	2.4 ± 4.1
On-campus dining companions (no.)		
< 2.5	8	2.3 ± 4.1
≥ 2.5	7	2.3 ± 5.3

[a] Data are presented as mean ± SD

** Approached statistical significance p = 0.05 – 0.10

Table 7: Differences in activity, alcohol consumption, sleep, restaurant dining, on-campus dining, breakfast consumption, restaurant dining companions, and on-campus dining companions among freshmen who gained weight versus those that lost/no change at the end of spring semester

Parameters	Weight Gain Group[a] (n = 17)	Weight Loss/No Change Group[a] (n = 12)
Strength training (days/wk)	2.4 ± 1.5	1.5 ± 1.6
Vigorous activity (days/wk)	2.5 ± 1.4	2.5 ± 2.0
Moderate activity (days/wk)	5.1 ± 1.9	5.0 ± 2.2
Alcoholic drink consumption (no./month)	5.6 ± 3.4[+]	3.7 ± 0.9[+]
Sleep (hr/wk)	48.2 ± 6.2[**]	43.8 ± 6.7[**]
Restaurant dining (no. times/day)	0.7 ± 0.5	0.9 ± 0.9
On-campus dining (no. times/day)	1.4 ± 0.7[+]	1.2 ± 0.4[+]
Breakfast consumption (no./wk)	4.8 ± 2.0	4.7 ± 2.4
Restaurant dining companions (no.)	2.5 ± 1.1[+]	3.1 ± 2.4[+]
On-campus dining companions (no.)	2.2 ± 1.3[+]	3.8 ± 3.2[+]

[a] Data are presented as mean ± SD

[+] For weight gain and weight loss/no change groups, alcoholic drink consumption n = 14 and n = 12, respectively; for restaurant dining companions n = 14 and n = 8, respectively; for on-campus dining companions n = 7 and n = 6, respectively; for on-campus dining n = 9 and n = 6, respectively

[*] $p < 0.05$

[**] Approached statistical significance p = 0.05-0.10

Table 8: Weight change among subjects based on differences in place of residence, frequency of strength training, vigorous activity, moderate activity, alcoholic drink consumption, sleep, restaurant dining, on-campus dining, breakfast skipping, restaurant dining companions, and on-campus dining companions for spring semester

Parameter	(n)	Weight Change[a] (lbs)
Place of residence		
Apartment/House	6	3.2 ± 5.0
Dorm (on or off campus)	23	1.5 ± 3.9
Strength training		
≤ 2 days/wk	18	1.3 ± 3.9
> 2 days/wk	11	2.8 ± 4.4
Vigorous training		
≤ 2 days/wk	17	1.1 ± 3.4
> 2 days/wk	12	3.0 ± 4.9
Moderate activity		
≤ 4 days/wk	10	1.8 ± 4.1
> 4 days/wk	19	1.9 ± 4.2
Alcoholic drink consumption (no./month)		
≤ 3.5	12	0.1 ± 2.7
> 3.5	14	2.5 ± 4.6
Sleep (hr/wk)		
≤ 46	17	0.7 ± 3.3
> 46	11	3.8 ± 4.8[**]
Restaurant dining (no. times/day)		
≤ 0.5	11	0.8 ± 4.5
> 0.5	18	2.6 ± 3.8
On-campus dining (no. times/day)		
≤ 1	11	1.2 ± 3.9
> 1	4	3.5 ± 4.1
Breakfast skipping (no./wk)		
≥ 3	13	2.2 ± 4.9
< 3	16	1.7 ± 3.5
Restaurant dining companions (no.)		
≤ 2	12	1.8 ± 3.9
> 2	15	1.4 ± 4.4
On-campus dining companions (no.)		
< 2.5	7	1.3 ± 2.5
≥ 2.5	6	1.1 ± 4.6

[a] Data are presented as mean ± SD
[**] Approached statistical significance p = 0.05-0.10

CHAPTER 4

SUMMARY OF FINDINGS

Body weight significantly increased from the beginning of fall semester to the end of spring semester. This finding supports research hypothesis one. Body fat also significantly increased from the beginning of fall semester to the end of spring semester which also supports research hypothesis one.

There was no significant difference in weight change between subjects who consumed alcohol and those that did not consume alcohol. These finding do not support research hypothesis two. Alcohol consumption did not differ between weight gainers or weight losers/no gain, therefore this fails to support research hypothesis three.

There was no significant difference in weight change between subjects who slept less (less than 46 hours/week) versus those that slept more (more than 46 hours/week), this finding does not support research hypothesis four. Amount of sleep did not differ between weight gainers or weight losers/no gain, therefore this fails to support research hypothesis five.

There was no significant difference in weight change between subjects who consumed breakfast versus those that did not consume breakfast. This finding does not support research hypothesis six. Consumption of breakfast did not differ between weight gainers or weight losers/no gain; therefore, this fails to support research hypothesis seven.

Subjects who engaged more often in physical activity (vigorous) gained significantly more weight than subjects who engaged in physical activity (vigorous) less often. This finding fails to support research hypothesis eight. There was no significant difference in weight change between subjects who engaged more often in physical activity (strength training, moderate activity) versus those that engaged less often in physical activity (strength training, moderate activity).

The number of days in which exercise was performed did not differ between weight gainers and weight losers/no gain, therefore this fails to support research hypothesis nine.

There was no significant difference in weight change between subjects who dined out at restaurants more frequently than subjects who dined out at restaurants less frequently. This does not support research hypothesis ten.

The number of times subjects dined out at restaurants did not significantly differ between weight gainers and weight losers/no gain. This finding fails to support research hypothesis eleven.

There was no significant difference in weight change between subjects who ate with fewer (≤ 2) people at restaurants versus those who ate with more (> 2) people. This finding does not support research hypothesis twelve.

The amount of people present while dining out at a restaurant did not significantly differ between weight gainers or weight losers/no gain. This finding does not support research hypothesis thirteen.

There was no significant difference in weight change between subjects who ate at on-campus dining facilities more frequently versus subjects who ate at on-campus dining facilities less frequently. This finding does not support research hypothesis fourteen.

The number of times subjects ate at on-campus dining facilities did not significantly differ between weight gainers or weight losers/no gain. This finding fails to support research hypothesis fifteen.

There was no significant difference in weight change between subjects who ate with more (≥ 2.5) people at on-campus dining facilities versus those that ate with fewer (<2.5) people. This finding does not support research hypothesis sixteen.

The number of people present while dining at on-campus facilities did not significantly differ between weight gainers or weight losers/no gain. This finding does not support research hypothesis seventeen.

Weight change did not significantly differ between subjects who lived in on- or off-campus dorms versus those that lived in apartments/houses. This finding does not support research hypothesis eighteen.

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APPENDICES

APPENDIX A: INFORMED CONSENT FORMS

1856 2006
AUBURN
UNIVERSITY
Sesquicentennial

COLLEGE OF HUMAN SCIENCES

DEPARTMENT OF CONSUMER AFFAIRS

INFORMED CONSENT FOR A RESEARCH STUDY ENTITLED,
"Longitudinal Study of Changes in Body Composition and Shape in College Students"

You may be aware that as a population, the US is currently experiencing an epidemic related to weight. There is some evidence that when students move to a college setting, they gain weight although some students lose weight. Your student is being invited to participate in a study at Auburn University to help researchers understand the potential for weight gain among college students during their freshmen year. This study is being conducted by Drs. Lenda Jo Connell and Sareen Gropper of the College of Human Sciences. We explore the potential for weight gain by taking body measurements using traditional measures and a new technology involving a 3D body scanner. Your son or daughter was selected to participate because they are an entering freshman attending Auburn University.

If your son or daughter decides to participate, we will take body measurements using a standard scale and the 3D body scanner. Your son or daughter will be asked to enter a private dressing room where they will put on standard clothing for body scanning which consists of bicycle shorts for males and or a sport bra and bicycle shorts for females. The scans are done with a non-invasive white light and will be conducted in a private area with a trained technician. The software projects only a data image and subjects are not identifiable. Please see the attached example of a body scan.

Body fat and body composition will be measured using bio-electrical impedance (BIA). For BIA, students will be asked to lie down on a towel on the floor. Two self-adhesive disposable electrodes will be placed on their right hand and two on their right foot. A safe, battery generated electrical signal will pass through the electrodes enabling the calculation of body fat. They will feel no discomfort, however, freshmen who have a pace-maker or an implantable electronic device can not participate.

In addition to the body scanning, we will ask your son or daughter to fill out a questionnaire about their eating habits and about their feelings about their body image and lifestyle factors which may impact body weight. This process will take approximately 30-45 minutes. They will need to participate in three measurement and questionnaire sessions. The first session will be held during

_____ _____
Parent/Guardian's Initials Participant's Initials
(if participant is under 19 years)

308 SPIDLE HALL
AUBURN, AL 36849-5501

TELEPHONE:
334-844-4084

FAX:
334-844-1340

www.auburn.edu

the first two weeks of the fall semester. The second session will be conducted during the last two weeks of the fall semester. And a third will be conducted in late April. They will receive a total of $75.00 ($25.00 after each session) as incentive to participate. Analysis of data from the three body measurement sessions and questionnaires should enable us to better understand any changes in body size and students' feelings regarding their weight during their first year in college.

Any information obtained in connection with this study will remain anonymous. Only researchers will have access to the data, which will be identified by numbers, not names. Data will be stored in a secure site and your student will only be identified by number. Information collected through their participation may be used to fulfill educational requirements, published in a professional journal, and/or presented at a professional meeting. If so, none of their identifiable information will be used.

Your son or daughter may withdraw from participation at any time, without penalty, and you may withdraw any data which has been collected about them that is confidential. Your decision to allow your son or daughter to participate or not to participate will not jeopardize your future relations with Auburn University or the Departments of Consumer Affairs and Nutrition and Food Science.

If you have any questions, you may contact us at (334) 844-3789 and we will be happy to answer them. Your son or daughter will be provided a copy of this form to keep.

For more information regarding your son or daughter's rights as a research participant, you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334) 844-5966 or e-mail at hsubjec@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU AND YOUR SONS OR DAUGHTER MUST DECIDE WHETHER OR NOT THEY WILL PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS FOR YOUR SON OR DAUGHTER TO PARTICIPATE. THEY MUST ALSO INDICATED THEIR WILLINGNESS TO PARTICIPATE.

Parent/Guardian signature Date Date	Participant's signature
Print Name	Print Name
Investigator Obtaining Date Consent	

1856 2006
AUBURN
UNIVERSITY
Sesquicentennial

COLLEGE OF HUMAN SCIENCES

DEPARTMENT OF CONSUMER AFFAIRS

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"Longitudinal Study of Changes in Body Composition and Shape in College Students"

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_____ _____
Parent/Guardian's Initials Participant's Initials
(if participant is under 19 years)

HUMAN SUBJECTS
OFFICE OF RESEARCH
PROJECT # 06-137 EP 0608
APPROVED 8-17-06 TO 8-16-07

308 SPIDLE HALL
AUBURN, AL 36849-5501

TELEPHONE:
334-844-4084

FAX:
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www.auburn.edu

the first two weeks of the fall semester. The second session will be conducted during the last two weeks of the fall semester. And a third will be conducted in late April. You will receive a total of $75.00 ($25.00 after each session) as an incentive to participate. Analysis of data will be analyzed as a group and from the three body measurement sessions and questionnaires we should better understand any changes in body size and students' feelings regarding their weight during their first year in college.

Any information obtained in connection with this study will remain anonymous Only researchers will have access to the data, which will be identified by numbers, not names. Data will be stored in a secure site and you will only be identified by number. Information collected through your participation may be used to fulfill educational requirements, published in a professional journal, and/or presented at a professional meeting. If so, none of your identifiable information will be used.

You may withdraw from participation at any time, without penalty, and you may withdraw any data which has been collected about yourself that is confidential. Your decision to participate or not to participate will not jeopardize your future relations with Auburn University or the Departments of Consumer Affairs and Nutrition and Food Science.

If you have any questions, you may contact us at (334) 844-3789 and we will be happy to answer them. You will be provided a copy of this form to keep.

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HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WILL PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO PARTICIPATE.

_____

Participant's signature Date

_____

Print Name

_____

Investigator Obtaining Date
Consent

APPENDIX B: QUESTIONNAIRE

Study of Changes in Body Composition and Shape among College Students
Beginning of first semester

Name (full)_____
First Middle Last

Address _____

_____

Email address _____

Phone (home) _____

(cell) _____

- - - - -- - - - - - - - - - - - -- - - -- - - - -- - - - -- - - - - - - - -- - - - -- - - - -- - - -- - - - -- - -

For department use only

Code _____

Study of Changes in Body Composition and Shape among College Students Questionnaire

What is your Date of Birth? (give month/day/year) _____

What is your Race?

____Caucasian ____African American/Black ____Asian ___Hispanic ____Other

What is your gender? _____ Male _____ Female

Where is your Permanent Residence? (give city, state) _____

What is your place of residence during the academic school year?

_____Apartment ____On-campus Residence Hall _____House or The Commons

_____ Fraternity house _____With parents _____Other

Are you married? ____ yes _____ no

If yes, do you live with your spouse? ____ yes _____ no

Do you have children? ____ yes _____ no

If yes, are the children living with you in your household? ____ yes _____ no

Does your place of residence have a working stove? ____ yes _____ no

Does your place of residence have a working refrigerator? ____ yes _____ no

Does your place of residence have a working microwave oven? ____ yes _____ no

Does your place of residence have a working oven? ____ yes _____ no

If you do not live with your parents, do you have any room mates? ____yes ____no

If you have room mates, how many? (circle the correct #) 1 2 3 4 5 6 or more

How many total credit hours including currently enrolled hours do you have?_____

Have you or are you taking any college courses that discuss nutrition or health?

____ yes ____ no If yes, name the course(s) _____

(Males only) Do you eat at a fraternity house? ____ yes ____ no

If yes, about how many times per day do you usually eat at the frat house? _____

If yes, which meal(s) are usually eaten at the fraternity house?
_____breakfast _____lunch _____dinner _____ other

When you eat at the fraternity house, do you eat alone or with others?
_____alone _____with others

If you eat with others, how many other people do you usually eat with? _____

Do you eat on-campus at any of the dining facilities / halls? ____ yes ____ no

If yes, about how many times per day do you usually eat on campus? _____

If yes, which meal(s) are usually eaten at one of the dining facilities on campus?
_____breakfast _____lunch _____dinner _____ other

When you eat on campus, do you eat alone or with others? ____alone ___with others

If you eat with others, how many other people do you usually eat with? _____

How many times per day do you usually eat at a restaurant (including fast food

restaurants)? _____

Name the restaurants you most frequently eat at?

_____

_____

_____

_____

If yes, which meal(s) are usually eaten at restaurants? (check all that apply)

_____breakfast _____lunch _____dinner _____ other

When you eat at restaurants, do you eat alone or with others? ___alone __with others

If you eat with others, how many other people do you usually eat with? _____

How many times per week do you regularly consume

Breakfast? (circle the correct response) 0 1 2 3 4 5 6 7

Lunch? (circle the correct response) 0 1 2 3 4 5 6 7

Dinner? (circle the correct response) 0 1 2 3 4 5 6 7

Yesterday, how many times did you

Eat fruit (circle the correct response) 0 1 2 3 4 or more

Drink fruit juice (circle the correct response) 0 1 2 3 4 or more

Eat green salad (circle the correct response) 0 1 2 3 4 or more

Eat cooked vegetables (circle the correct response) 0 1 2 3 4 or more

Drink milk (circle the correct response) 0 1 2 3 4 or more

Eat cheese (circle the correct response) 0 1 2 3 4 or more
(not including cream cheese or cottage cheese)

Eat yogurt (circle the correct response) 0 1 2 3 4 or more

Drink milk/yogurt based smoothie (circle the correct response) 0 1 2 3 or more

Do you smoke cigars, cigarettes or a pipe? _____ yes _____ no

If yes, which one(s) do you smoke? _____

If yes, during the past 30 days, on how many days did you smoke? _____ days

If yes, how many years have you smoked? _____ years

If yes, how many cigarettes, cigars or pipes do you smoke per day? _____

During the past 30 days, on how many days did you drink one or more drinks of an

alcoholic beverage?_____

On the days that you drank during the past 30 days, how many drinks did you usually have?
_____

During the past 30 days, on how many days did you have 5 or more drinks on the same occasion?
_____

Are you currently employed for less than 40 hours a week? _____ yes _____no

Are you currently employed for 40 hours a week or more? _____ yes _____no

Are you working in a food establishment? _____ yes _____no

If yes, do you eat food from your work establishment? _____ yes _____no

How do you travel to and from Auburn University? (check all that apply)

_____ car _____ transit system bus _____bike _____walk

Other, please specify _____

If you work, how do you get to work? (check all that apply)

_____ car _____ transit system bus _____bike _____walk

Other, please specify _____

How do you describe your weight?

_____ Very underweight _____ Slightly overweight

_____ Slightly underweight _____ Very overweight

_____ About the right size

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

_____ Lose weight _____ Stay the same weight

_____ Gain weight _____ Do nothing about my weight

Are you taking any medications, vitamins, or supplements? _____yes _____no

If yes, name both prescribed and over-the-counter products?

_____

Has a physician ever told you that you have? (circle all that apply)

Asthma	Cancer	High blood cholesterol	Heart murmur
Anemia	Diabetes	High blood triglycerides	Eating disorder
Allergies	Hypertension	High blood sugar	Other: _____

What is your mother's highest level of education?

_____8th grade _____high school degree _____some college ____college degree

_____graduate degree

What is your mother's occupation? _____

How would you classify your mother's body size?

_____underweight _____ normal weight _____overweight/obese

What is your father's highest level of education?

_____8th grade _____high school degree _____some college ____college degree

_____graduate degree

What is your father's occupation? _____

How would you classify your father's body size?

_____underweight _____ normal weight _____overweight/obese

What is your family's yearly household income?

_____ < $10,000/year _____ $70,000 to 90,000

_____ $10,000 to 30,000 _____ $90,000 to 110,000

_____ $30,000 to 50,000 _____ $110,000 to 130,000

_____ $50,000 to 70,000 _____ $130,000 to 150,000

_____ more than $150,000 _____ don't know

How many <u>days per week</u> do you participate in vigorous physical activity? (circle the correct number)

0 1 2 3 4 5 6 7

Vigorous activities are those that cause you to sweat and breathe hard

How many <u>minutes per week</u> do you spend doing vigorous physical activity? _____

How many <u>days per week</u> do you participate in moderate physical activity? (circle the correct number)

0 1 2 3 4 5 6 7

Moderate activities include walking or bicycling

How many minutes per week do you spend doing moderate physical activity?_____

How many days per week do you participate in strengthening exercises? (circle the correct number)

0 1 2 3 4 5 6 7

Strengthening exercises include activities such as push-ups, sit-ups, or weight lifting.

How many minutes per week do you participate in strengthening exercises? _____

List the physical activities you participate in on a routine basis?

_____

_____

_____

On the night before a test, how many hours sleep at night do you usually get? (circle the correct number or leave the answer blank if you have not had any tests yet)

1–3 hours 3–5 hours 5–7 hours 7–9 hours > 9 hours

How many hours sleep at night do you routinely get on a Sunday, Monday, Tuesday or Wednesday night? (circle the correct number)

1–3 hours 3–5 hours 5–7 hours 7–9 hours > 9 hours

How many hours sleep at night do you routinely get on a Thursday night? (circle the correct number)

1–3 hours 3–5 hours 5–7 hours 7–9 hours > 9 hours

How many hours sleep at night do you routinely get on a Friday or Saturday night? (circle the correct number)

1–3 hours 3–5 hours 5–7 hours 7–9 hours > 9 hours