WEIGHT AND BODY COMPOSITION CHANGES IN FIRST SEMESTER

COLLEGE FRESHMEN

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WEIGHT AND BODY COMPOSITION CHANGES IN FIRST SEMESTER COLLEGE FRESHMEN

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WEIGHT AND BODY COMPOSITION CHANGES IN FIRST SEMESTER COLLEGE FRESHMEN

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Desiree Saunders, daughter of Tim and Marisela Saunders, was born in Miami, FL on April 2, 1984. Upon graduating from Bob Jones High School in Madison, AL, Desiree chose to attend Auburn University where she graduated cum laude with a Bachelor of Science degree in Nutrition and Food Science with an emphasis in Dietetics. In May of 2007, Desiree continued her education at Auburn University's Graduate School by pursuing 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 AND BODY COMPOSITION CHANGES IN FIRST SEMESTER COLLEGE FRESHMEN

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The "freshman 15" is a common phenomenon that is thought to occur to first year college students. It is the popular idea that college freshmen, due to various reasons, gain 15 pounds during their first year at school. Although this belief is common, there is little scientific evidence to support it. This study examined weight and body composition changes and factors influencing weight change during the first semester of college in a sample of the 2007-08 Auburn University freshman class.

Anthropometric measurements were collected for 240 college freshmen (156 females, 84 males) at the beginning of fall semester 2007. Measurements included height and body weight assessed by standard techniques and body composition assessed by bioelectrical impedance analysis. Subjects also completed questionnaires regarding diet and lifestyle choices.

Of the 240 initial participants, 214 (89.2%) were reassessed at the end of fall semester 2007. Weight change for the group ranged from a 15.8 lb weight loss to a 16.2 lb weight gain. The average weight gain was 2.1 lbs. Forty-five (21%) of the 214 students gained 5 lbs or more. Seven students (3.3%) gained 10 lbs or more fall semester. Weight gain did not differ among subjects who were underweight, normal weight, or at risk of/overweight. Mean body fat increased significantly by 1.8 lbs, and mean percent body fat increased significantly by 0.9% between the beginning and the end of fall semester. Males gained significantly more body fat mass than females. Mean body mass index (not lean body mass) also increased significantly by 0.3 kg/m^2 over fall semester with no differences between males and females. Of the 214, 68.7% (147; 94 females, 53 males) gained weight. The weight gain group gained an average of 4.1 lbs (range 0.2 to 16.2 lbs) and the average body fat gain was 2.4 lbs. Males who gained weight gained significantly more weight than females who gained weight (4.8 lbs versus 3.7 lbs respectively). Of the dietary and lifestyle factors examined, students living in campus housing tended to gain more weight (2.4 ± 3.5 lbs) than those who lived in non-campus housing (1.5 ± 5.0 lbs), and students who dined with more than two companions at campus all-you-can-eat facilities gained more weight (3.9 ± 3.2 lbs) than those who dined with two or fewer companions (1.8 ± 3.5 lbs). The results of this study suggest that weight gain is a problem for most college freshmen, during their first semester, and selected lifestyle habits associated with campus life may contribute to the problem. Weight change tended to be associated with number of on campus dining companions ($r=0.285$; $p=0.052$) and alcoholic drink consumption ($r=0.111$; $p=0.106$), and tended to be inversely associated with fruit and vegetable consumption ($r=-0.110$; $p=0.108$).

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CHAPTER 1

INTRODUCTION

Overweight and obesity are growing problems facing the United States. Nearly two thirds of adults living in the U.S. are overweight or obese (CDC 2007g). According to the 2007 Behavioral Risk Factor Surveillance System (BRFSS), 36.6% of adults in the U.S. are overweight, and 26.3% are obese (CDC 2007g). The problem of overweight and obesity is not just facing adults; children are also affected. The 2003-2004 National Health and Nutrition Examination Surveys (NHANES) show increases in the number of overweight children and teens. In 2003-2004 13.9% of children aged 2–5 years were overweight, 18.8% of children aged 6–11 years were overweight, and 17.4% of children aged 12–19 years were overweight (CDC 2007b).

There are several major adverse consequences that arise from being overweight or obese. The increasing rates of overweight and obesity are of major concern because of their implications for Americans' health. Being overweight or obese increases the risk of many diseases and health conditions, including hypertension, dyslipidemia, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea, respiratory problems, and some cancers (CDC 2007b). The high obesity rates have economic consequences as well. Obesity comes with increased health risks, and therefore increased medical care and disability costs (Seidell 1995, Wolf and Colditz 1996). The total cost attributable to obesity amounted to $117 billion in 2005. Approximately 61 billion of these dollars were direct medical costs associated with diseases attributable to obesity (Ulrich 2005).

A population group particularly at risk for weight gain may be college freshmen. First-year students entering college may be at a greater risk for weight gain than in prior years due to the many life changes they will be experiencing in the new college environment. Stress about schoolwork, social pressures, roommate issues, money, or jobs, among others, may contribute to alterations in eating and exercise habits and could lead to weight gain. Unhealthy eating, sleeping, and exercising habits may also play a role in changes in body weight and/or composition. Many studies have found that college freshmen gain weight during their first-year of school, but the weight gained is well under 15 pounds that is highly popularized in the press (Anderson and others 2003; Butler and others 2004; Economos and others 2008; Graham and Jones 2002; Gropper and others 2008; Hajhosseini and others 2006; Hodge and others 1993; Hoffman and others 2006; Hovell and others 1993; Jung and others 2008; Kasparek and others 2008; Levitsky and others 2004; Megal and others 1994; Mihalopoulos and others 2008; and Racette and others 2005). Few of these studies, however, have examined both males and females and few have assessed body composition. Moreover, the major study, that has been conducted in the South, a region where prevalence of obesity is among the highest in the United States, used self-reported height and weight information. It is important to determine whether college freshmen may be predisposed to weight gain, because if freshman weight gain can be managed or prevented, it is possible that some of the unwanted consequences can be minimized or avoided. This study examined changes in body weight and composition among first-semester college freshmen, as well as factors associated with these changes.

CHAPTER 2

REVIEW OF LITERATURE

This literature review will discuss the definitions of obesity, constitution and composition of weight change, prevalence of obesity, health and economic consequences of obesity, and causes of obesity. The section about causes of obesity is subdivided into behavioral factors associated with weight change and dietary related environmental factors associated with weight change. Topics discussed in the behavioral factors associated with weight change section include physical activity, sleep, and smoking. Dietary related environmental factors associated with weight change discussed include alcohol consumption, breakfast skipping, convenience dining, restaurant or on-campus dining, and social dining. Finally, studies examining weight change among college freshmen are discussed.

Definition of Obesity

The Centers for Disease Control and Prevention (CDC) define obesity as "a label for ranges of weight that are greater than what is generally considered healthy for a given height" (CDC 2007a). The term also identifies ranges of weight that have been shown to increase the likelihood of certain diseases and other health problems. The CDC uses body mass index (BMI) to define the overweight and obesity ranges. For many people, BMI is an indicator of body fatness (CDC 2007a). There are many different ways to determine

body fatness, such as total body water, total body potassium, bioelectrical impedance, and dual-energy X-ray absorptiometry. These methods are often time consuming and costly, so BMI is usually used for epidemiological studies (NHLBI 1998). BMI is calculated by dividing body weight in kilograms (kg) by height squared in meters (m) (CDC 2007a). The calculation of BMI is the same for adults as it is for teens and children, however, the interpretation is different (CDC 2007c). An adult, irrespective of age and gender, who has a BMI between 25 and 29.9 kg/m^2 is considered overweight, and an adult who has a BMI of 30 kg/m^2 or higher is considered obese (CDC 2007a).

BMI for children and teens is sex and age specific. After BMI is calculated for children and teens, the BMI is plotted on the gender specific BMI-for-age growth charts to obtain a percentile ranking. The percentile indicates the relative position of the child's BMI among children of the same sex and age. The growth charts show the weight status categories used with children and teens (underweight, healthy weight, at risk of overweight, and overweight). Individuals aged 2 to 20 years are considered at risk of overweight at a BMI for age at or greater than the 85^{th} percentile, and are considered overweight at or greater than the 95^{th} percentile. Healthy weight is indicated by a BMI for age at or greater than the 5^{th} percentile to less than the 85^{th} percentile. Underweight is represented by a BMI for age less than the 5^{th} percentile (CDC 2007d). There are significant differences between results when BMI cutoffs of 25 and 30 kg/m^2 are used to calculate weight status, verses when BMI percentiles of 85 and 95 are used. In a study conducted on college students aged 18-27 years, Huang and others found a lower overall prevalence of overweight and obesity (16.2% and 4.2%, respectively) when using BMI

percentile cutoffs for students aged ≤19 years than when using BMI directly (21.6% overweight, 4.9% obese) (Huang and others 2003).

Although BMI may provide an accurate prediction of body fatness for some, it may be completely invalid for others. For instance, athletes with a high body weight due to muscle mass who have a low percentage of body fat, may have a BMI that denotes a weight classification of "overweight" or "obese". The CDC notes that the correlation between BMI and body fatness is fairly strong; however, the correlation varies by sex, race, and age. At the same BMI, women tend to have more body fat than men, and at the same BMI, older adults tend to have more body fat than younger adults (CDC 2007c).

Constitution of Body Weight, Weight Gain, and Weight Loss

The major components of body weight are water, fat, and body cell mass. In humans, weight varies over time, even with fat stores remaining relatively constant (Stevens and others 2006). The body of a healthy weight, 25-year-old male weighing 80 kg is usually composed of 18.1 kg of fat, 45.3 liters of water, and 33.5 kg of body cell mass. The body of a healthy weight, 25-year-old female weighing 60 kg is usually composed of 29.5 kg of fat, 37.0 liters of water, and 21.2 kg of body cell mass (Pike and Brown 1984).

As body weight increases, body fat mass increases, even in healthy adults. Although body fat comprises the largest portion of weight gain, water, body cell mass, and cell solids also contribute to weight gain. In adults, increases in body cell mass can occur with intensive physical activity (Pike and Brown 1984). The mean composition of weight gained is 75% adipose and 25% lean mass (Jéquier and Tappy 1999). Forbes estimates that the composition of weight gain in adults due to overeating was 62% fat

mass and 38% fat free mass (Forbes 1988). When a young adult male weighing 80 kg gains 20 kg to become an obese 100 kg male, he gains relatively 51% fat, 15% extracellular water, 26% body cell mass, and 8% other. When a young adult female weighing 60 kg gains 30 kg to become an obese 90 kg female, she gains relatively 63% fat, 13% extracellular water, 18% body cell mass, and 6% other (Pike and Brown 1984). An increase in body fat can become unhealthy if it gets too high. The amount (as a percentage) of body fat that is considered unhealthy for young adults varies, with ranges from about 31 to 36% for females and 21 to 28% for males, reported in the literature (Lee and Nieman 2007; Manore and Thompson 2000; Williams 2005; McArdle and others 2005).

Body weight loss is also attributed mostly to loss of body fat, but also to loss of body water, lean body mass, and body cell mass. Obese individuals tend to lose more body fat, while lean individuals lose mostly lean body mass (Forbes 2002). Weight lost by obese young men was composed of 64% fat, 4% extracellular water, and 32% body cell mass (Pike and Brown 1984).

The National Institute of Health (NIH) describes the initial goal of weight loss for obese people to be approximately 10% from baseline body weight, and a reasonable time for this weight loss is about six months. After this goal is reached, further weight loss therapy can continue to meet new goals (NHLBI 1998).

Prevalence of Obesity

After adjusting for age and height, mean body weights have increased by nearly 10% in two decades, and the prevalence of obesity has just about doubled (Jeffery and Utter 2003). Since the mid-seventies, the prevalence of overweight and obesity has

increased greatly for both adults and children (CDC 2007b). An estimated 97 million adults in the U.S. are overweight or obese (NHLBI 1998). According to the 2007 Behavioral Risk Factor Surveillance System (BRFSS), 36.6% of adults in the U.S. are overweight, and 26.3% are obese (CDC 2007g). Data from two National Health and Nutrition Examination Surveys (NHANES) show that among adults (aged ≥20 years) the prevalence of obesity increased from 15.0% (in the 1976–1980 survey) to 32.9% (in the 2003–2004 survey) (CDC 2007b).

The two surveys also show increases in overweight among children and teens. For children aged 2–5 years, the prevalence of overweight increased from 5.0% to 13.9%; for those aged 6–11 years, prevalence increased from 6.5% to 18.8%; and for those aged 12–19 years, prevalence increased from 5.0% to 17.4%." (CDC 2007b). Huang and others, using BMI directly, found that among college students, aged 18-27 years, 21.6% were overweight, and 4.9% were obese (Huang and others 2003).

Alabama is the second most obese state in the U.S. In the 2007 BRFSS, 35.7% of adults in Alabama were overweight, and 30.9% were obese. This is much greater than twenty years earlier, when less than 10% of Alabamians were obese. Among young adults (18-24 years) in Alabama, 47% are overweight or obese (CDC 2007g).

Health and Economic Consequences of Obesity

The increasing rates of overweight and obesity raise major concern because of their implications for Americans' health. Being overweight or obese increases the risk of many diseases and health conditions, including hypertension, dyslipidemia, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea, respiratory problems, and some cancers (CDC 2007b). As BMI increases, so does

mortality. As BMI increases, death rates from all causes increase for both men and women in all age groups. The lowest death rates are found in people with BMIs of 22-25 kg/m^2 (Calle and others 1999).

The health consequences for children and adolescents due to overweight and obesity are serious. Type 2 diabetes accounts for up to 45% of new cases of diabetes in children and adolescents (Rubenstein 2005). Childhood obesity causes concurrent morbidity and morbidity, and mortality in adulthood (Cole 2007).

The high obesity rates have economic consequences as well. Obesity comes with increased health risks, and therefore increased medical care and disability costs (Seidell 1995; Wolf and Colditz 1996). The total cost attributable to obesity amounted to $117 billion in 2005. Approximately 61 billion of these dollars were direct medical costs associated with diseases attributable to obesity. Tax payers fund a great portion of these costs, as nearly one-half of medical costs due to obesity are financed by Medicare and Medicaid (Ulrich 2005). Among children and adolescents, annual hospital costs related to obesity were $127 million during 1997-1999, up from $35 million during 1979-1981 (CDC 2005a). In addition to the economic losses due to direct medical costs, obese people demonstrate less productivity at work, less income due to time lost at work, and early retirement (Ulrich 2005).

Causes of Obesity

Obesity is generally thought to be caused by a simple mathematical equation: calories consumed > calories expended = weight gain. The majority of the time obesity is a preventable disease that is brought about by a multitude of contributing factors. Diet,

physical activity, behavioral and psychosocial environment, and genetics all contribute to obesity (Astrup and others 2004; Cole 2007).

Behavioral Factors Associated with Weight Change

Physical Activity

Physical activity is very similar to, but not the same as, exercise. Physical activity is defined as "any bodily movement produced by skeletal muscles that results in energy expenditure". Exercise is a subset of physical activity that is planned, structured, and repetitive (Caspersen and others 1985).

Being physically active is known to have positive effects on many parameters of health. Physical activity positively influences weight control, mental health, and cardiovascular health. Regular physical activity reduces the risk for developing coronary heart disease, type 2 diabetes, hypertension, and some cancers. It also reduces symptoms of anxiety and depression, and contributes to the development and maintenance of healthier body weight, bones, muscles, and joints (CDC 1996b). Despite the known positive effects of being physically active, millions of US adults remain essentially sedentary (CDC 2003). Epidemiologic studies have shown that sedentary lifestyles are associated with increased mortality rates (Paffenbarger and others 1986).

In order to reduce sedentary behaviors, promote health, psychological well-being, and a healthy body weight, it is recommended that adults engage in at least 30 minutes of moderate-intensity physical activity, above usual activity, on most days of the week and children engage in at least 60 minutes of physical activity on most days of the week (USDA 2005). It is recommended that adults participate in regular vigorous physical activity for at least 20 minutes per day for at least 3 days per week (CDC 1996a). Yet,

less than half of American adults are physically active (CDC 2007e). In 2005, only 43% of Alabamians met the recommendations for physical activity (CDC 2005c).

Several reasons for inactivity have been documented in the literature. The technological booms we have experienced over the past two decades have made living a sedentary lifestyle very common. More children are growing up with televisions, computers, and video games in their homes and in their bedrooms. Twenty-six percent of U.S. children watch four or more hours of television per day, and 67% watch at least two hours per day. Those children who watched at least four hours of television per day had significantly greater body fat and BMI than those who watched less than two hours per day (Andersen and others 1998). It is common sense that if children's free time that was once spent running around outside playing tag, is replaced with video games and television, the lack of physical activity will have adverse consequences. This sedentary way of life during childhood can easily transition to a sedentary lifestyle in adolescence and adulthood. Jeffrey and others found that among adults, television viewing was positively correlated with BMI in women, but not men (Jeffrey and French 1998). Hetherington found that among adults, energy intake significantly increased by 14% due to television watching (Hetherington and others 2006). An increased calorie intake could lead to weight gain. Buckworth and Nigg reported that of the sedentary behaviors, computer use for men and television watching for women were negatively correlated with physical activity (Buckworth and Nigg 2004).

While the technological boom has contributed in part to children's physical inactivity, concerns for safety of children also has been shown to be associated with physical inactivity. Parents rank safety as the most important factor when deciding

whether to let their children play in a certain area (Sallis and others 1997). Parley and colleagues found that when a safe play area was provided to children of an inner-city neighborhood, physical activity was 84% higher among children in that neighborhood than children residing in surrounding neighborhoods (Parley and others 2007). Physical inactivity is particularly prevalent among the socioeconomically disadvantaged and the less educated (Hills and others 2007). The results of NHANES I (1971-1974), NHANES II (1976-1980), NHANES III (1988-1994), and the first six years of the continuous NHANES (1999-2004) examinations indicate that physical inactivity, high consumption of sweetened beverages, and breakfast skipping all contribute to adolescents below the poverty line becoming overweight (Miech and others 2006).

As a child enters adolescence, interests shift from physical activities to other interests and behaviors (Hills and others 2007). Physical activity declines again in the shift from high school to college years (Kilpatrick and others 2005). A study conducted on 145 first-year students (39 males; 106 females) showed that participation in vigorous activity significantly declined from the last two months of high school to the first two months of college (Bray and Born 2004). In a study conducted on 738 college students (384 males; 354 females), on average, the students reported engaging in aerobic exercises on only 2.8 ± 2.1 days in the previous seven days (Huang and others 2003). Huang and coworkers also found male students were significantly more likely to report participating in aerobic activity than female students. Haberman and Luffey found that only 39% of college students ($n = 301$; 140 males, 161 females) reported exercising 3 or more times per week, and 12.3% reported not exercising at all (Haberman and Luffey 1998). Racette and colleagues looked at exercise patterns of 764 college freshmen (359 males; 405

females), and found that 29% of freshmen reported not exercising (Racette and others 2005). In a summary of the results of the 1995 National College Health Risk Behavior Survey, researchers found that 62.6% of female college students and 42.3% of male college students reported exercising to lose or keep from gaining weight (Douglas and others 1997).

Sleep

A good night's rest is very important to the body. Inadequate sleep is associated with several chronic diseases and conditions such as diabetes, cardiovascular disease, obesity, and depression (CDC 2007f). It was reported in a clinical review by Knutson and others that sleep restriction may affect energy balance and result in weight gain because of an upregulation of appetite, more time to eat and a decrease in energy expenditure (Knutson and others 2007). Paralleling the rise in overweight and obesity in the U.S. is the decline in sleep times (Patel and others 2006). Knutson and coworkers found that in 1960, the average sleep duration to be 8-8.9 hours. In 2007, more than 30% of adults between the ages of 30 and 64 years sleep less than 6 hours per night (Knutson and others 2007).

Several studies have been conducted to determine the effects of sleep on body weight. In a comprehensive review of more than 20 recent large epidemiological studies from seven different countries, a significant negative correlation (no r value given) was found between sleep duration and BMI in both adults and children (Knutson and others 2007).

Patel and researchers analyzed questionnaire data regarding sleeping habits and weights of 68,183 nurses involved in the Nurses' Health Study (originally established by

Dr. Frank Speizer in 1976). They found that nurses who slept less than 7 hours per night were slightly older, drank less alcohol, but were more likely to smoke and consume more caffeine. Patel and others found a relationship between sleep duration and weight. After age adjustment, those sleeping 5 hours or less weighed an average of 5.3 lbs more than those sleeping 7 hours, and those sleeping 6 hours weighed 2.7 lbs more than those sleeping 7 hours. Not only were baseline weights of those who slept less higher, but they also gained weight at a faster rate and gained more weight than those who slept more. Over the 16 years considered on the questionnaire, subjects who slept 5 hours or less were 32% more likely to gain over 30 pounds, and those who slept 6 hours were 12 % more likely to gain over 30 pounds (Patel and others 2006).

A study that examined the relationship between sleep and weight among adolescents showed that among males, but not females, sleep duration significantly predicted BMI z-score and risk of overweight. According to the results of this study, every hour increase in sleep duration was associated with a 10% reduction in risk of overweight in male adolescents (Knutson 2005).

The American College Health Association-National College Health Assessment (ACHA-NCHA) analyzed data collected during previous studies on college students (n=18,339; 5,989 males; 12,350 females). About 24% of students (n=4,565) ranked sleep difficulties third on the list of reported health impediments to academic performance (ACHA-NCHA 2003).

Smoking

Smoking is the leading cause of morbidity and mortality in the U.S., responsible for over 430,000 deaths each year (CDC 2006). Smoking is responsible for health

problems such as cancers of the lung, bladder, oral cavity, stomach, and others, chronic obstructive pulmonary disease, stroke, and coronary heart disease (CDC 2005b). Yet, despite these health concerns, during the 1990s, cigarette smoking increased by nearly 30% among college students (Reed and others 2007). In 2002, 28.9% of Alabamians between the ages of 18 and 34 years smoked (CDC 2002).

Over 30% of smokers admitted to using smoking as a strategy to maintain or lose weight (Klesges and Klesges 1988). Smoking is often thought of as a way to keep from gaining weight. Klesges and others reviewed 29 cross-sectional studies and found that 83% of the studies showed that smokers weighed less than nonsmokers (Klesges and others 1998). There is much speculation of the mechanisms by which cigarette smoking influences energy intake and expenditure, and the data regarding these phenomena are mixed.

In contrast to other studies showing smokers weigh less than nonsmokers, Carroll and colleagues found that compared to nonsmokers, smokers ate significantly more at restaurants serving high calorie foods, ate more frequently in front of the TV, exercised less and had significantly higher BMIs and body fat than nonsmokers (Carroll and others 2006). These findings may contradict the thoughts of the common college student that smoking will keep the weight off.

Douglas and coworkers (1997) analyzed survey data from the 1995 National College Health Risk Behavior Survey (NCHRBS) which included 4,838 college students from 2- and 4-year institutions. Almost one third (31.3%) of students reported smoking cigarettes daily at some time during their lives, 29% were current smokers (had smoked one or more cigarettes per day during the 30 days preceding the survey), and 16.5% were

currently frequent cigarette smokers (had smoked cigarettes on at least 20 of the 30 days preceding the survey) (Douglas and others 1997).

Despite the findings that smoking may pack on the pounds, or keep the pounds off, one seemingly clear finding is that smoking cessation is often associated with weight gain (Carroll and others 2006). Significant correlations have been shown between smoking cessation and increased food intake, and decreased metabolism (Filozof and others 2004).

In summary, several changes occur in the shift from high school to college that can adversely affect health. Stress about schoolwork, money, or jobs may alter exercise, diet, and sleep patterns, and can contribute to weight gain. Despite the known positive outcomes brought about by exercise, most people in the U.S. (including college students) do not meet the recommended amount of exercise for a healthier life. There are several side effects from cigarette smoking that are detrimental to health, yet many people continue to smoke. A good night's sleep is very important for the body to recover from the stresses of the day. It is important that college students not lose track of these behaviors that can so notably affect their health.

Dietary Related Environmental Factors Associated with Weight Change

Alcohol Consumption

Alcohol consumption among college students has been addressed in several studies. Results of the National College Health Risk Behavior Survey (NCHRBS) show that over a third of college students participating in the survey had consumed five or more alcoholic drinks on at least one occasion in the previous month (Douglas and others 1997). The 2007 BRFSS data show that 53.1% of adults aged 18-24 years in the U.S.

have had at least one drink in the past 30 days, and 44.3% of adults aged 18-24 years in Alabama have had at least one drink in the past 30 days. The 2007 BRFSS data also show that 27.4% of adults aged 18-24 years in the U.S. are considered binge drinkers, and 18% of adults aged 18-24 years in Alabama are considered binge drinkers. They define binge drinking as males having five or more drinks on one occasion, and females having four or more drinks on one occasion (CDC 2007h).

Each gram of alcohol contains 7.1 calories. The alcohol alone in an average 12 ounce can of beer, jigger of liquor, or 4 ounce glass of wine contributes 70-90 calories. This is not including the drinks' non-alcoholic calories (Rumpler 1995). According to a study conducted by Yanovitzky, college students (predominantly freshmen) report drinking an average of 3 drinks in one sitting when drinking at social settings (Yanovitzky and others 2006). This is equivalent to about 300 calories consumed from alcoholic beverages in one night. Alcohol consumption can also have indirect effects on caloric intake due to its appetite-enhancing effects (Suter 2005).

Alcohol consumption is thought to contribute extra calories to the diets of its consumers, as alcohol energy is usually added to total food energy intake. Alcohol drinkers usually do not compensate for calories consumed from alcohol by decreasing calories consumed from food (Jequier 1999). According to a study conducted on 7,608 middle-aged men, the mean BMI increased significantly from 25.33 kg/m^2 to 25.83 kg/m^2 in light-moderate alcohol consumers (n=2,502) over a five year time period (Wannamethee and Shaper 2003).

Alcohol consumption among college students varies. The American College Health Association National College Health Assessment (ACHA-NCHA) analyzed data

collected during previous studies on college students (n=18,339; 5,989 males; 12,350 females). In this sample, 17.5% of students (n=3,388) reported never using alcohol, 14.5% (n=2,799) of the students reported having at least 9 alcoholic drinks the last time they partied, 27.7% (n=5,331) reported drinking 5-8 alcoholic drinks, and 36.3% (n=6,987) reported having 1-4 drinks (ACHA-NCHA 2003).

Breakfast Skipping

Breakfast is typically touted as the most important meal of the day, yet it is the meal most often missed (Affenito 2007). Breakfast is considered the most important meal of the day for many reasons including its contribution to daily nutrient intake, cognitive function, and weight control. It has been hypothesized that those who skip breakfast tend to over consume calories at later meals, possibly contributing to weight gain.

Trends in breakfast consumption have decreased over the past several decades. Siega-Riz and researchers found that from 1965 to 1991 breakfast consumption among older adolescents (aged 15-18 years) declined significantly (Siega-Riz and others 1998). Breakfast skipping increased during the transition to adulthood (Niemeier and others 2006). A study conducted by Song *et al* showed that the rate of breakfast consumption increased with age from 62.8% among participants aged 19-29 years to 92.5% among participants aged 70 years and older (Song and others 2005). Breakfast skipping is highly prevalent in the U.S., ranging from 10% to 30% (Rampersaud and others 2005).

Could there be a correlation between this lack of breakfast consumption and the weight gain that has plagued our country over the past decades? Evidence supporting a link between breakfast consumption and body weight is mounting (Affenito 2007). A

longitudinal study conducted by Berkey and others analyzed questionnaire data from 1996-1999, and found that skipping breakfast was associated with overweight, cross-sectionally. Specifically, normal weight children (n= 421; 134 males; 287 females) who never ate breakfast gained weight relative to peers (n= 8,961; 4,216 males; 4,745 females) who ate breakfast nearly every day. However, overweight children who never ate breakfast (n = 113; 45 males, 68 females) exhibited decreases in BMI over the year (Berkey and others 2003).

Breakfast consumers tended to have a higher total daily intake of energy compared with breakfast skippers (Berkey and others 2003; Nicklas and others 1993 and 2000), but were less likely to be overweight (Rampersaud and others 2005). Song and colleagues analyzed data from the 1999-2000 NHANES (n= 4,218; 2,097 males; 2,121 females), and found that daily energy intake was higher among women who consumed breakfast, but also found that women who ate breakfast were significantly less likely to have BMI $\geq$ 25 kg/m^2 when compared to women who did not consume breakfast (Song and others 2005).

Eating Habits

There is little known about the contents of the mini-fridges in the freshman dorms, but one can speculate they are not filled with fruits and vegetables. So what are the freshmen eating? A few of the dozens of published studies are reviewed hereafter.

Hajhosseini and coworkers conducted a small study on college freshmen (n=27; 5 males; 22 females) to assess body weight and composition, but also dietary habits. They found that the average weight gained over the first semester was 3.0 lbs. They also found that over the fall semester, caloric intake increased from 1,905 calories per day at the

beginning of fall to 1,960 calories per day at the end of fall. This difference in caloric intake (55 calories) could contribute to a several pound weight gain over time (Hajhosseini and others 2006). Levitsky and researchers assessed weight changes in college freshmen and factors associated with those changes. They found that freshmen gained an average of 4.18 lbs over the fall semester and attributed 24% of the variance to the consumption of evening snacks and high fat foods. The consumption of "junk" foods explained another 8% of the variance. The term "junk" food was not defined in the questionnaire, but left to the subject to define (Levitsky and others 2004). Butler also looked at freshman weight changes and factors associated with those changes. They found that freshmen significantly gained weight (1.59 lbs) over the first five months of freshman year. This was somewhat surprising because the subjects' caloric intake significantly decreased from 2,205 calories at the beginning of the year to 1,856 calories at the end of the five month period. Their intakes of vegetables, bread, pasta, milk, and meat also significantly decreased. Intake of fruits, fats, and oils also decreased, but not significantly (Butler and others 2004).

In a study conducted by Haberman and others, 80% of college students reported consuming inadequate quantities of fruits, vegetables, and grains (Haberman and Luffey 1998). The NCHRBS found that only a quarter of the students participating in the study met the guidelines for fruit and vegetable consumption in their diet the day preceding the study. They also found that freshmen were more likely to consume high fat foods than upper classmen (Douglas and others 1997). The ACHA-NCHA analyzed data collected during previous studies on college students (n=18,339; 5,989 males; 12,350 females). Only 6.9% of students reported eating 5 or more servings of fruits and vegetables daily

(ACHA-NHA 2003). In a study conducted by Racette and colleagues, fruit and vegetable consumption was significantly inversely correlated (r = -0.43) with high-fat fast food intake in a group (n= 764) of college freshmen (Racette and others 2005). French and coworkers also found that fruit and vegetable consumption was significantly inversely correlated with high frequency of fast food consumption (no r value given) (French and others 2000).

Fast Food Dining

College freshmen may not be used to cooking for themselves or may find it easier to quickly grab some convenience (ready-to-eat) foods. College students choose fast food restaurants because the selection and cost of the food, convenience, and the opportunity to socialize with friends (Driskell and others 2005). Fast food consumption has increased significantly over the past decade (Niemeier and others 2006). College students have been reported to eat meals at fast food restaurants 6 to 8 times weekly (Driskell and others 2005). A study conducted by Nielsen and others found that both adolescents and young adults are obtaining less of their energy intake at home, and more from restaurants and fast food dining (Nielsen and others 2002). Between 1977-78 and 1994-96, consumption of food prepared away from home jumped from 18% to 32% of total energy intake (Guthrie and others 2002). Survey data from 9919 adolescents analyzed by Niemeier and researchers showed that on average young adults aged 18-27 years consumed fast food on approximately 2.5 days during the week prior to the survey (Niemeier and others 2006). A study conducted by Driskell and colleagues in a group (n=226) of college students, found that 84% of men and 58% of women reported

typically eating fast foods for lunch at least once weekly, and 82% of subjects typically ate dinner at fast food restaurants at least once weekly (Driskell and others 2006).

Several studies have found a positive correlation between the number of fast food meals consumed and total energy intake and percentage of calories from fat (French and others 2000, 2001; Jeffery and French 1998; McCrory and others 1999). Fast food eating was significantly positively associated with BMI in a sample of 3,394 black and white young adults (no r value given) (Duffey and others 2007). Jeffery and French examined data from a longitudinal cohort study (n = 1,059; 198 males; 861 females) and found a positive association of fast food eating with BMI in women (r = 0.50), but not men (Jeffery and French 1998). French and coworkers found that frequency of fast food consumption was positively associated with greater body weight (French and others 2000). Frequency of consuming food from the sum of three restaurant types (burger, fried chicken, and fried fish) yielded a significant association (r = 0.37) with body fatness (McCrory and others 1999). Many aspects of fast food consumption may affect body weight and fatness including types of foods eaten, method of food preparation, and portion sizes. Portion sizes and energy intake for specific food types have increased significantly with greatest increases for food consumed at fast food restaurants and in the home (Nielsen and Popkin 2003).

Restaurant and On-Campus Dining

As previously mentioned, dollars spent on food prepared away from home have steadily increased over the past several decades. Restaurant dining is accountable for many of these dollars spent. In 1999, money spent on dining out accounted for 47.5% of food expenditures (Clauson 2000). In 1977 only 18% of calories were attributed to foods

prepared away from home, while in 1995 34% of calories came from foods prepared away from home (Lin and others 1999). This high frequency of dining at restaurants may be contributing to the obesity epidemic seen in the U.S.

Many restaurants are specifically known for their great portion sizes. Does the portion size given to restaurant patrons affect the amount of food eaten? Diliberti and others altered the portion sizes of a pasta entrée at a restaurant. They found that in a restaurant setting, increasing the portion size of the entrée resulted in a significant increase in energy intake of the entree by 43% and of the entire meal by 25% in 85 subjects (41 males; 44 females) (Diliberti and others 2004). A study conducted by McCrory and colleagues on 73 adult males and females found that frequency of consuming restaurant food was significantly positively associated ($r = 0.36$) with energy intake and body fatness. They also found that men consumed restaurant food nearly twice as often as women (McCrory and others 1999).

On-campus, cafeteria style dining is often used by freshmen and other college students living on campus. Bryant and Dundes found that most (88%) college students ($n = 42$) believed that cafeteria-style dining contributed to taking and eating larger portions (Bryant and Dundes 2005). Hovell and researchers compared a sample ($n=158$) of female university freshmen to a sample of age-matched female college freshmen who were attending a community or state college. The university freshmen all lived on campus and had access to cafeteria food services, while only 15% of the community counterparts lived on campus. Hovell and colleagues found that during the freshman year, the university women gained weight 36 times faster ($p<0.001$) than comparison women. The university women gained significantly more weight than their counterparts

who lived off campus. The university women gained a projected 8.8 lbs the entire 12 months of their freshman year, while the community women gained less than 1 lb. This difference in weight gain between the two groups was attributed by the researchers to the easy access to cafeteria style dining. Many women in the study reported the cafeteria dining was the probable cause of weight gain, as the availability of high calorie foods and the communal setting made overeating very easy (Hovell and others 1985). Levitsky and others assessed weight changes in college freshmen and factors associated with those changes. They found that freshmen gained an average of 4.18 lbs and contributed 20% of the variance to eating breakfast and lunch in "all-you-can-eat" dining halls.

Social Dining

There are several factors associated with social dining that can affect food intake including number of dining companions, mood, and meal duration. Herman conducted a review of literature on social dining issues and concluded that there are three distinct issues that contribute to the social influences on food intake: modeling, impression management, and social facilitation. Modeling describes when people eat in the presence of models that consistently eat a lot or a little, these people likewise tend to eat a lot or a little, respectively. Impression management refers to the idea that when people eat in the presence of others who they believe are observing or evaluating them, they tend to eat less than they do when alone (Herman and others 2003). Social facilitation represents the idea that when individuals eat in groups, they tend to consume more food than when eating alone. Much research indicates that people consume more food when dining with companions than when dining alone (Clendenen and others 1994; de Castro 1994;

Hetherington and others 2006; Patel and Schlundt 2001; and Stroebele and de Castro 2006).

Stroebele and de Castro found that a sample (n=133) of undergraduate college students reported feeling significantly more elated and excited as the number of eating companions increased. They also consumed significantly more energy, carbohydrate, fat, and protein as the number of dining companions increased (Stroebele and de Castro 2006).

Pliner and others conducted a study to test the effects of dining with companions and duration of eating on amount of food consumed. They found that participants (n = 132; 70 males; 62 females) eating a longer duration meal ate more food than those eating a shorter duration meal, but there was no effect of group size on amount of food consumed (Pliner and others 2006). It is possible that social dining increases the amount of food consumed because as group size increases, so does the duration of the meal. Hence, it is meal duration, not number of dining companions that increases food consumption. Clendenen and colleagues conducted a similar study on a sample (n=120) of female college undergraduate students, and found that subjects in pairs and groups of four ate significantly more than subjects that ate alone. They also found that those who dined in pairs and groups of four had longer meal durations than those who dined alone. They found no difference in amount of food consumed between pairs of two and groups of four (Clendenen and others 1994). Pliner and coworkers, examining 132 students (70 males; 62 females), and Clendenen and colleagues, examining 120 females, in separate studies, found that the subjects who dined with friends rather than strangers ate significantly more dessert (Clendenen and others 1994; Pliner and others 2006).

A study conducted by de Castro on a sample of adults (n=515) examined whether there were differences in social facilitation of food intake between family and friends and other dining companions (de Castro 1994). Like other researchers, de Castro found that the presence of dining companions resulted in increased food intake and longer meal duration regardless of the relationship between the subject and the dining companion. When the dining companion was a family member or spouse, meals were larger and eaten faster, while meals eaten with friends were larger and of longer duration (de Castro 1994). Hetherington and others also found that energy intake was significantly increased while dining with familiar companions (Hetherington and others 2006).

Krantz conducted a study to determine if there was a difference in social facilitation effects on food intake between obese and nonobese individuals. A sample of 197 (101 obese and 96 normal-weight) patrons of a university cafeteria were observed to determine if the presence of dining companions had different effects on obese and nonobese subjects. Krantz found that obese individuals consumed significantly fewer calories when dining with companions than when dining alone, and nonobese individuals consumed significantly more calories when dining with companions than when dining alone (Krantz 1979).

Weight Change among College Freshmen

The coined phrase "the freshman 15" popularized in the press may be more myth than truth. Many studies have found that the weight gained (if any) during the freshman year of college is well under 15 pounds (Anderson and others 2003; Butler and others 2004; Economos and others 2008; Graham and Jones 2002; Gropper and others 2008; Hajhosseini and others 2006; Hodge and others 1993; Hoffman and others 2006; Hovell

and others 1985; Jung and others 2008; Kasparek and others 2008; Levitsky and others 2004; Megal and others 1994; Mihalopoulos and others 2008; Racette and others 2005). This section of the literature review will present these studies.

Hoffman and others analyzed changes in body weight and fat mass in a sample of college freshmen (n = 67; 32 males; 35 females) attending Rutgers, the State University of New Jersey. This sample was taken from a list of 217 volunteers who had participated in a college-wide health assessment in the dining halls during the last 3 weeks of September. Only 67 students returned to be remeasured during the last 2 weeks of April, so the sample was not random and may have introduced self-selection bias. Weight was measured via standard methods, and body fat was assessed via bioelectrical impedance (BIA). They found that weight gain did occur during the freshman year; however, the mean weight change for the entire group was only 2.86 pounds, and was only 6.82 lbs for the students who gained weight only. They found no differences between males and females, or between different racial or ethnic groups (Hoffman and others 2006).

Jung and colleagues examined weight change in a sample (n=133) of female college freshmen in Ontario, Canada. They found that over the course of a whole year, the average weight gain for the entire sample was 3.08 lbs, and the average weight gain for those who gained weight was 7.54 lbs. Those who gained weight significantly increased their percent body fat. These weight gains are much less than the "freshman 15"; in fact 34% of the sample lost weight during freshman year (Jung and others 2008).

Hajhosseini and coworkers used a convenience sample of 27 freshmen students (5 males; 22 females) attending San Jose State University for a study to examine changes in body weight and body composition in first-year university freshmen. Body weight was

measured via standard methods, and body composition was measured via BIA. They found that body weight increased significantly by 3 lbs and percent body fat increased significantly by 2.1% over the 16 week period. Sixteen subjects (59%) gained ≥ 3.0 lbs, while 6 subjects (22%) gained ≥ 6 lbs. Mean BMI significantly increased from 23.5 kg/m^2 to 24.1 kg/m^2. There was a significant decrease in lean body mass from 69.9% to 67.8%. Two (7.4%) subjects lost weight (Hajhosseini and others 2006).

Kasparek and researchers conducted a survey-based study in Winthrop, South Carolina. They used self-reported height, weight, diet, and physical activity data from a sample (n=193; 24 males; 169 females) to determine freshman weight change. They found that overall 57% of participants reported gaining an average of 2.5 lbs (range 1 to 35 lbs) over the 6 months of the study. For those that gained weight, the average weight gain was 7.1 lbs, and weight loss was reported by nearly a quarter (23.8%) of the subjects.

Gropper and coworkers conducted a small study on first-year freshmen (n=36; 10 males; 26 females) at Auburn University, a major public university in the Southeast. They measured weight, body composition, and select dietary and lifestyle habits. Over the fall semester, the average weight gained for the sample (n=35; 10 males; 25 females) was 1.9 lbs with no difference between males and females. BMI and percent body fat also increased significantly increased over the fall semester. Twenty-five (71.4%) of the freshman gained weight and 10 (28.4%) lost weight fall semester. The mean weight gain for the weight gain group was 3.7 lbs with no difference between males and females. For the 29 that returned at the end of spring semester, the average weight gain over the

academic year was 3.8 lbs. BMI and percent body fat also significantly increased over the academic year (Drawdy 2007; Gropper and others 2008).

Mihalopoulos and others used survey-based techniques to assess freshman weight gain. They relied on self-reported heights and weights from 126 college freshmen (64 males; 62 females). Approximately half (52%) of the students reported gaining weight. Mihalopoulos and colleagues observed a significant increase in weight by an average of 2.7 lbs over the fall semester.

Hodge and coworkers set out to test the hypothesis that the "freshman 15" may be more fantasy than fact. They also examined personal characteristics associated with weight change. A sample of 110 female college freshmen were weighed during their first month at Michigan State University and again 6 months later. They had a return rate of 64%. Of the 61 subjects that returned to be reweighed, 18 subjects (29%) gained weight, and 11 subjects (18%) lost weight. The mean weight gain was 0.88 lbs overall, and 7 lbs for weight gainers. Participants were considered to have gained weight if they gained 4 lbs or more (Hodge and others 1993).

Levitsky and researchers measured the weight of freshmen (n=60; 9 males; 51 females) at the beginning of freshman year at Cornell University. Subjects were also given an initial questionnaire regarding their lifestyle during high school years. A second questionnaire was given at the second visit, 12 weeks later, which gathered information related to eating, sleeping, and exercising habits during their first semester at college. They found that the mean weight gain was 4.18 lbs ($p<0.01$) at the end of the first semester (the percentage of students who gained weight was not given). They found that some of the variance could be attributed to the consumption of evening snacks, high-fat

foods, and junk food. Eating breakfast and lunch in the "all-you-can-eat" dining halls, and recent dieting also accounted for some of the variance (Levitsky and others 2004).

Megel and others looked at the relationships between self-esteem, health promotion, nutrition, and weight among female college freshmen (n=57) at a small private women's college in the Midwest. Of the 57 females, 62% gained weight, while 38% maintained or lost weight. Over the academic year, weight gain ranged from 0.2 to 16.7 lbs and averaged 2.45 lbs. The greatest weight loss was 9.7 lbs. The majority of the subjects (40%) rated their level of satisfaction at their present weight as dissatisfied (Megel and others 1994).

Butler and colleagues examined the dietary, fitness/physical activity, and body weight changes among 52 female college freshmen in a large Midwestern university. They found that the subjects gained an average of 1.59 lbs ($p<0.001$) over the course of the five month study (The percentage of students that gained weight was not given). Body fat also significantly increased by 1.79%. Fat mass significantly increased by 2.89 lbs, and lean body mass decreased significantly by 1.35 lbs. According to their dietary intake records, total calorie intake per day significantly decreased from 2,205 calories in the beginning of the year to 1,857 calories at the post test 5 months later (Butler and others 2004).

Graham and Jones examined a sample (n=49; 10 males; 39 females) of incoming freshmen at a small Midwestern liberal arts college. They investigated whether the perception that freshmen gain 15 lbs during their first year of college is related to either actual or perceived weight gain. They found no significant change in actual weight, but there was a significant change in reported weight. Participants thought they had gained

on average 4.1 lbs, when they actually lost an average of -1.5 lbs over the academic year (Graham and Jones 2002).

Anderson and coworkers collected weights and heights for 192 college freshmen at the beginning (September) of their freshman year. At the end of fall semester (December) 135 subjects (58 males; 77 females) returned to be remeasured, and 46 returned at the end of spring semester (May) for a third reassessment. There was a significant weight gain of 2.86 lbs (range -7.9 lb loss to 11.4 lb gain) over the fall semester with no gender effect. Seventy-four percent of the students gained weight and 20% lost weight fall semester. The weight change from December to May was not significant. The mean overall weight gain from September to May was 3.74 lbs. They found that most freshmen have a significant, but modest, weight gain (Anderson and others 2003).

Hovell and others examined weight change over three years in first-year female students at a large private university. The initial group of freshmen consisted of 158 females. Height and weight were collected in October and again in March. They found that the freshmen gained weight at an average of 0.73 lbs/month over the five month period. They projected this weight gain over 12 months, and concluded that the freshmen women would gain 8.8 lbs over the entire year. They also compared this rate of weight gain to freshmen women attending local community or state colleges and not living on campus. They found that university freshmen living on campus gained weight at a rate 36 times faster than community comparison women (Hovell and others 1985).

Racette and researchers looked at weight changes, exercise, and dietary patterns during freshman and sophomore years of college in a sample of 764 freshmen attending

Washington University in St. Louis, Missouri. They analyzed changes during the freshman year in a subset (n=118) of the original sample. They found a significant increase in body weight by an average of 5.5 lbs, and 88 of the subjects (75%) showed an increase in BMI, which tended (p=0.12) to increase more in women than in men (Racette and others 2005).

Economos and others conducted a survey based study examining weight change and factors associated with weight change, particularly stress, on a sample (n=396; 140 males; 256 females) of college freshmen attending a private East Coast New England university. The heights and weights were self-reported for the first measurement in August. For the follow-up measurement in April, subjects reported their heights and weights, and had their heights and weights measured via standard methods. Economos and others found good agreement ($r = 0.997$; $p<0.001$) between reported height and weight and measured height and weight ($p<0.001$). They found that 80% of students gained weight, and the average weight gained for the entire sample was 5.3 lbs during the freshman year. There were no statistically significant differences in weight change between males and females. Weight gain was found to be associated with alcohol consumption in males ($p=0.014$) and increased workload (class assignments, studying) in females ($p<0.001$). There are health implications of weight change during the freshman year, as 7.9% of males and 4.9% of females who were underweight or normal weight at the beginning of the year, moved into at-risk or overweight status by the end of the year (Economos and others 2008).

Conclusions and Justification

Obesity raises serious concerns regarding its effects on health and the economy. Overweight and obesity are on the rise in the U.S., particularly in Alabama, and the need for attention to this problem is great. The lifestyle changes that occur in the transition from high school to college are thought to put many college freshmen at risk for weight gain that could lead to obesity.

Studies, although few in number, have shown that college freshmen gain weight, but it is on average much less than the popularized 15 pounds. Of the 15 studies conducted, some (n=7) used relatively small sample sizes, some (n=5) only used female subjects, and some (n=3) used survey-based techniques and did not measure bodyweight and composition. Most of the studies were conducted in the West, the Midwest or Northeast. Yet of the two conducted in the Southeast, where the prevalence of obesity is greatest, one used self-reported data and the other was a small pilot study. The purposes of this study were to examine weight and body composition changes among freshmen and factors associated with these changes during the first semester of college.

Research Hypotheses:

1. Freshmen will significantly gain weight during their first semester 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 consume less than or equal to two servings of fruits and vegetables will gain significantly more weight than those who consume more than two servings of fruits and vegetables.
5. Weight gainers will consume significantly fewer servings of fruits and vegetables than weight losers.
6. Individuals who consume more than three servings of "junk" foods will gain significantly more weight than those who consume three or fewer servings of "junk" foods.
7. Weight gainers will consume significantly more servings of "junk" foods than weight losers.
8. Individuals who sleep less than 49 hours per week will gain significantly more weight than individuals who sleep 49 hours or more per week.
9. Weight gainers will sleep significantly less than weight losers.
10. Individuals who consume breakfast less than or equal to four times per week will gain significantly more weight than individuals who consumer breakfast more than four times per week.
11. Weight gainers will consume breakfast significantly less often than weight losers.
12. Individuals who engage in physical activity less than 425 minutes per week will gain significantly more weight than those who engage in such activities for at least 425 minutes per week.
13. Weight gainers will exercise significantly less than weight losers.

14. Individuals who dine on campus or at restaurants more than six times per week will significantly gain more weight than those who dine on campus or at restaurants six or less times per week.
15. Weight gainers will dine on campus or at restaurants significantly more often than weight losers.
16. Individuals who dine with more than two people will gain significantly more weight than those who eat with two or fewer people.
17. Weight gainers will dine 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 off campus in apartments/houses/trailers/duplexes.

CHAPTER 3

WEIGHT AND BODY COMPOSITION CHANGES IN FIRST SEMESTER COLLEGE FRESHMEN

ABSTRACT

The "freshman 15" is a common phenomenon that is thought to occur to first year college students. It is the popular idea that college freshmen, due to various reasons, gain 15 pounds during their first year at school. Although this belief is common, there is little scientific evidence to support it. This study examined weight and body composition changes and factors influencing weight change during the first semester of college in a sample of the 2007-08 Auburn University freshman class.

Anthropometric measurements were collected for 240 college freshmen (156 females, 84 males) at the beginning of fall semester 2007. Measurements included height and body weight assessed by standard techniques and body composition assessed by bioelectrical impedance analysis. Subjects also completed questionnaires regarding diet and lifestyle choices.

Of the 240 initial participants, 214 (89.2%) were reassessed at the end of fall semester 2007. Weight change for the group ranged from a 15.8 lb weight loss to a 16.2 lb weight gain. The average weight gain was 2.1 lbs. Forty-five (21%) of the 214 students gained 5 lbs or more. Seven students (3.3%) gained 10 lbs or more their first

semester of college. Weight gain did not differ among subjects who were underweight, normal weight, or at risk of/overweight. Mean body fat increased significantly by 1.8 lbs, and mean % body fat increased significantly by 0.9% between the beginning and the end of fall semester. Males gained significantly more body fat mass than females. Mean body mass index (but not lean body mass) also increased significantly by 0.3 kg/m^2 over fall semester with no differences between males and females. Seven students (3.3%) that were initially classed as normal weight using CDC adult BMI guidelines were classified as overweight by the end of fall semester. Of the 214, 68.7% (147; 94 females, 53 males) gained weight. The weight gain group gained an average of 4.1 lbs (range 0.2 to 16.2) and the average body fat gain was 2.4 lbs. Males who gained weight gained significantly more weight than females who gained weight (4.8 lbs versus 3.7 lbs respectively). Of the dietary and lifestyle factors examined, students living in campus housing tended to gain more weight (2.4 ± 3.5 lbs) than those who lived in non-campus housing (1.5 ± 5.0 lbs), and students who dined with more than two companions at campus all-you-can-eat dining facilities gained more weight (3.9 ± 3.2 lbs) than those who dined with two or fewer companions (1.8 ± 3.5 lbs). The results of this study suggest that weight gain is a problem for most college freshmen, during their first semester, and selected lifestyle habits associated with campus life may contribute to the problem. Weight change tended to be associated with number of on campus dining companions ($r=0.285$; $p=0.052$) and alcoholic drink consumption ($r=0.111$; $p=0.106$), and tended to be inversely associated with fruit and vegetable consumption ($r=-0.110$; $p=0.108$).

INTRODUCTION

Overweight and obesity are growing problems facing the United States. Nearly two thirds of adults living in the U.S. are overweight or obese. According to the 2007 Behavioral Risk Factor Surveillance System (BRFSS), 36.6% of adults in the U.S. are overweight, and 26.3% are obese (CDC 2007a). The problem of overweight and obesity is not just facing adults; children are also affected. The 2003-2004 National Health and Nutrition Examination Surveys (NHANES) show increases in overweight among children and teens. In 2003-2204 13.9% of children aged 2–5 years were overweight, 18.8% of children aged 6–11 years were overweight, and 17.4% of children aged12–19 years were overweight (CDC 2007b).

There are several major adverse consequences that come about from being overweight or obese. The increasing rates of overweight and obesity raise major concern because of their implications for Americans' health. Being overweight or obese increases the risk of many diseases and health conditions, including hypertension, dyslipidemia, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea, respiratory problems, and some cancers (CDC 2007b). The high obesity rates have economic consequences as well. Obesity comes with increased health risks, and therefore increased medical care and disability costs (Seidell 1995, Wolf and Colditz 1996). The total cost attributable to obesity amounted to $117 billion in 2005. A Approximately 61 billion of these dollars were direct medical costs associated with diseases attributable to obesity (Ulrich 2005).

A population group particularly at risk for weight gain may be college freshmen. First-year students entering college may be at a greater risk for weight gain than others

due to the many life changes they will be experiencing in the upcoming year. Stress about schoolwork, money, or jobs may contribute to weight gain. Unhealthy eating, sleeping, and exercising habits may also play a role in changes in body weight and/or composition. Huang and colleagues, using BMI directly, found that among college students aged 18-27 years 21.6% were overweight, and 4.9% were obese (Huang and others 2003). Many studies have found that college freshmen gain weight during their first-year of school, but the weight gained is well under 15 pounds (Anderson and others 2003; Butler and others 2004; Economos and others 2008; Graham and Jones 2002; Gropper and others 2008; Hajhosseini and others 2006; Hodge and others 1993; Hoffman and others 2006; Hovell and others 1985; Jung and others 2008; Kasparek and others 2008; Levitsky and others 2004; Megal and others 1994; Mihalopoulos and others 2008; and Racette and others 2005). It is important to determine whether college freshmen may be predisposed to weight gain, because if freshman weight gain can be managed or prevented, it is possible that some of the unwanted consequences can be minimized or avoided. This study examined the changes in body weight and composition among first-year college freshmen, as well as factors associated with these changes.

SUBJECTS AND METHODS

Subjects

Freshmen were recruited from Auburn University's incoming freshman class via email, fliers, and class announcements in introductory level courses typically taken by first year students at the beginning of fall semester 2007. Auburn University's 2007 incoming freshman class consisted of 4,191 students. The freshman class was 53% female and 47% male. The freshman class was mostly Caucasian (81.7%), followed by

African American (11.3%), Hispanic (2.9%), Asian (1.9%), and Native American (0.8%). Most Auburn University freshmen had permanent residences in Alabama (57%), but about 43% had permanent residences elsewhere. Several states contributed more students to Auburn University than others: 18.3% of students came from Georgia, 6.1% from Florida, 3.8% from Tennessee, and 2.7% of students were from Texas. The rest of the freshmen came from other states across the U.S. Freshman volunteers were excluded from participation if they were older than 19 years, pregnant, married, had children, or a diagnosed eating disorder. Freshmen were also excluded if they had attended the previous summer semester at the university, and were not "true" first-semester freshmen.

A total of 240 students (156 females, 84 males) volunteered for the study at the start of the fall semester. This represents a convenience sample. Of the original 240 subjects, 214 (73 males; 141 females) returned at the end of fall for reassessment. This provided a return rate of 89%. Table 1 shows selected demographic information for the sample population. An informed consent from parents and students for subjects aged 19 years or younger was obtained prior to participation in the study. Subjects received $25 compensation at the first visit and $20 at the second visit upon completion of requirements.

Study Design

Participants were assessed at three points during their freshman year: at the beginning (about the first four weeks) of the fall semester (2007), at the end (about the last three weeks) of the fall semester (2007), and at the end of the spring semester (2008). Subjects' appointments for assessments were scheduled in advance. Subjects' weight and body composition were measured at all three assessments; height was measured only at

the initial and end of the year assessment. Subjects also completed a questionnaire regarding environmental, behavioral, and lifestyle habits. Only data from fall semester 2007 were examined in this thesis. This study was part of a larger study which included measurement of body size and shape and an additional questionnaire regarding body image and satisfaction, stress, and depression.

Approval

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

Questionnaire

At each assessment appointment, subjects answered a questionnaire which asked questions about their environmental, behavioral, and lifestyle choices. Selected parts of the questionnaire were examined in this study. The questions specifically addressed each subject's place of residence, food choices, frequency of dining out, frequency of dining hall use, cigarette smoking, consumption of alcohol, physical activity, and sleeping patterns.

Anthropometric Assessment

Weight was measured to the nearest two tenths of a pound using a digital scale (Healthometer, Pelstar, LLC, Model 500KL, Bridgeview, IL). Subjects wore their own light clothing with no belts, shoes or outer garments. In addition, subjects were asked to empty the contents of their pockets. Weight measurements on the Healthometer scale varied by less than 0.05% with repeated measurements of the same subject. Accuracy of the scale was checked with external weights. Height was measured using standard techniques to the nearest one-quarter inch using a height rod (Healthometer, Pelstar,

LLC, Model 500KL, Bridgeview, IL). Subjects wore no shoes or hats while height was being measured.

Body mass index (BMI) was calculated from each subject's height and weight. The standard formula (weight (kg)/height^2 (m)) was used to calculate BMI. Each subject's BMI was categorized as underweight, normal, overweight, or obese based on the Center for Disease Control and Prevention definitions for adults and for those with a BMI > 25 kg/m^2 also classified based on the CDC BMI-for-age percentile growth curves for 2 to 20 year olds (CDC 2007a).

Bioelectrical impedance analysis (BIA) was used to measure the subject's percent body fat, body fat mass, and lean body mass (including water). The device measures the impedance of an electrical current (50kHz) through body tissues. The BIA instrument (BodyStat, BioVant Systems, Detroit, MI) generates the current which is passed through the body via four electrodes place on the right hand and wrist and the right foot and ankle. Prior to measurement each subject was instructed to lay with their body flat on a mat with arms abducted at a 35-40 degree angle from the trunk to allow the body water to distribute evenly throughout the body. Since hydration status affects BIA accuracy, subjects were instructed prior to their scheduled appointment for assessment not to eat for 2-4 hours prior to assessment, not to drink caffeine or alcohol or engage in strenuous exercise for 12 hours prior to assessment. Information entered into the instrument prior to measurement includes the subject's gender, age, height, and weight. BodyStat has been validated for accuracy against underwater weight (densitometry) which is considered a gold standard for body composition measurements. Measurements using BodyStat BIA varied by less than 0.5% with repeated measurements on the same subject.

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-tests were used to compare subject's differences in weight, BMI, lean body mass, body fat mass, and percent body fat between the beginning of fall semester and end of fall semester. Repeated measures analysis of variance (ANOVA) was used to compare weight change among subjects classified as underweight, normal weight, overweight, and obese. 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, BMI, lean body mass, body fat mass, and percent body fat changes between males and females.

The student's t-test was used to examine differences in physical activity, alcoholic drink consumption, sleep duration, fast food dining, restaurant dining, on-campus dining, fast food dining companions, restaurant dining companions, on-campus dining companions, breakfast consumption, fruit and vegetable consumption, dairy consumption, sugar sweetened drink consumption, and junk food consumption between those who gained weight versus those who lost weight or remained the same. Statistical significance was set at p value of <0.05.

A student's t-test was also used to examine differences in weight change based on places of residence (on campus versus off), physical activity duration ($<$ 425 minutes of total exercise per week versus $\geq$ 425 minutes per week), alcoholic drink consumption number per month), number of hours of sleep per week ($<$ 49 hours per week versus $\geq$ 49

hours per week), frequency of dining out including fast food, restaurant, and on-campus dining (< 6 times per week versus ≤ 6 times per week), number of companions when dining at fast food, restaurant, and on-campus all-you-can-eat establishments (≤ 2 companions versus >2 companions), frequency of breakfast consumption (> 4 times per week versus ≤ 4 times per week). The student's t-test was also used to compare differences in weight change based on fruit and vegetable consumption (> 2 servings versus ≤ 2 servings per day), dairy consumption (> 2 servings versus ≤ 2 servings per day), consumption of sugar sweetened drinks (> 2 servings versus ≤ 2 servings per day), and "junk" food (salty snack foods, candy bars, baked goods, sugar sweetened drinks) consumption (> 3 servings versus ≤ 3 servings per day).

Pearson correlations were conducted between weight change and several factors including physical activity, sleep, alcoholic drink consumption, frequency of dining at fast food establishments and full service restaurants, number of fast food dining companions, number of restaurant dining companions, number of on-campus dining companions, frequency of breakfast consumption, fruit and vegetable consumption, dairy consumption, sugar sweetened drink consumption, and junk food consumption.

RESULTS

Anthropometric Findings

Mean weight, lean body mass, body fat, and percent body fat for the 141 females and 73 males who where assessed at both the beginning and end of fall semester 2007 are shown in Table 2. Mean initial weight and height of the females were 133.0 ± 29.7 lbs and 64.7 ± 2.4 inches, respectively. By the end of the first semester, the females' mean weight significantly increased by 1.7 lbs to 134.7 ± 30.1 lbs. Mean body fat mass

increased significantly by 1.4 lbs from 31.3 ± 18.8 lbs to 32.7 ± 19.4 lbs. Mean percent body fat increased significantly by 0.7% from 22.4 ± 6.2% to 23.2 ± 6.2%. Mean BMI significantly increased by 0.3 kg/m^2 from 22.3 ± 4.5 kg/m^2 to 22.6 ± 4.6 kg/m^2. Mean lean body mass increased, but not significantly from 101.6 ± 13.6 lbs to 102.0 ± 13.3 lbs (Table 2).

Using CDC definitions for adults, of the 141 females, 10 females (7.1%) were initially categorized as underweight, 114 (80.8%) were normal weight, nine (6.4%) were overweight, and eight (5.7%) were obese. By the end of fall semester, three of the females classified by adult BMI as normal weight at the beginning of fall semester were classified as overweight. Using CDC BMI percentiles for females ages 2 to 20 years, nine females (6.4%) were considered at risk for overweight and seven (5.0%) were classified as overweight at the beginning of the fall. Of the nine females considered at risk for overweight, five had over 31% body fat, and of the seven considered overweight, six had over 31% body fat. Using CDC BMI percentiles for females ages 2 to 20 years, at the end of fall semester, nine were still considered at risk of overweight; however, six of the nine had over 31% body fat and all seven females classified as overweight had over 31% body fat.

Mean initial weight and height of the males were 165.1 ± 29.4 lbs and 70.1 ± 2.6 inches, respectively. By the end of the first semester, the males' mean weight significantly increased by 2.8 lbs to 167.9 ± 29.5 lbs. Mean body fat mass increased significantly by 2.5 lbs from 18.5 ± 16.5 lbs to 21.3 ± 18.2 lbs. Mean percent body fat increased significantly by 1.2% from 11.0 ± 5.2% to 12.1 ± 5.5%. Mean BMI significantly increased by 0.4 kg/m^2 from 23.6 ± 4.1 kg/m^2 to 24.0 ± 4.2 kg/m^2. Mean

lean body mass increased, but not significantly by 0.6 lbs from 144.2 ± 18.6 lbs to 144.8 ± 17.6 lbs (Table 2).

Of the 73 males, using CDC adult criteria, one (1.4%) was underweight, 51 were normal weight (69.9%), 19 (26.0%) were overweight, and two (2.7%) were obese. By the end of fall semester, four (5.5%) of the males classified by adult BMI as normal weight at the beginning of fall semester were now classified as overweight. Using CDC BMI percentiles, initially 19 males (26.0%) were classified as at risk for overweight and two (2.7%) were considered overweight. Yet, none of the males at risk for overweight had greater than 21% body fat, and only one male considered overweight had greater than 21% body fat. By the end of fall semester 16 males were at risk for overweight but none had over 21% body fat, and two males remained classified as overweight with only one having greater than 21% body fat.

As shown in Table 2, for the entire group (n=214), mean weight significantly increased from 143.9 ± 33.3 lbs at the beginning of fall semester to 146.0 ± 33.7 lbs at the end of fall semester. Mean weight gain was 2.1 ± 4.2 lbs, with a median weight gain of 1.8 lbs (Figure 1). Mean body fat mass increased significantly from 27.3 ± 19.0 lbs to 29.0 ± 19.7 lbs for a mean gain of 1.8 lbs. Mean percent body fat increased significantly from 18.7 ± 8.0% to 19.6 ± 7.9%, a mean gain of 0.9%. Mean BMI significantly increased from 22.8 ± 4.4 kg/m^2 to 23.1 ± 4.5 kg/m^2 for a mean gain of 0.3 kg/m^2. Mean lean body mass increased, but not significantly from 115.4 ± 25.1 lbs to 115.7 ± 24.9 lbs, a mean gain of 0.4 lbs. Weight change ranged from a loss of 15.8 lbs to a gain of 16.2 lbs. The average number of days between measurements was 83 ± 10 days. Weight change for the females averaged 0.14 lbs/week and for the males 0.24 lbs/week and did

not significantly differ between males and females. For the group, seven (3.3%) freshmen initially classified as normal weight using adult CDC guidelines were overweight by the end of fall semester.

Weight change did not significantly differ based on adult BMI classification. Underweight subjects (n=11) gained 3.0 ± 2.1 lbs, normal weight subjects (n=165) gained 2.0 ± 3.5 lbs, overweight subjects (n=28) gained 2.4 ± 5.3 lbs, and obese subjects (n=10) gained 1.6 ± 9.8 lbs.

Table 3 and Figure 2 show weight and body composition data for the 147 subjects who gained weight fall semester. Of the 214, 68.7% (n=147; 94 females, 53 males) gained weight. Forty-five (21%) of the 214 students gained 5 lbs or more. Seven students (3.3%) gained 10 lbs or more in their first semester of college. The average weight gain in the weight gain group (n=147; 94 females, 53 males) was 4.1 ± 3.1 lbs; males gained significantly more weight than females (4.8 ± 3.2 lbs versus 3.7 ± 3.0 lbs, respectively). Mean weight in this group significantly increased from 143.6 ± 33.9 lbs at the beginning of fall to 147.6 ± 35.0 lbs at the end of fall. Mean body fat mass increased significantly from 26.8 ± 20.6 lbs to 29.2 ± 21.5 lbs, a mean gain of 2.4 ± 3.1 lbs. Mean percent body fat increased significantly from 18.3 ± 8.3% to 19.4 ± 8.2% over the semester, a mean gain of 1.1 ± 1.8%. Mean lean body mass significantly increased by 1.7 ± 2.9 lbs from 116.0 ± 25.1 lbs at the beginning of fall to 117.1 ± 25.2 lbs at the end of fall. Mean BMI significantly increased from 22.6 ± 4.6 kg/m^2 to 23.2 ± 4.7 kg/m^2, a mean gain of 0.6 kg/m^2.

Of the 214 subjects, 61 (28.5%) lost weight. The weight loss group (42 females; 19 males) lost an average of -2.5 ± 2.5 lbs with no significant difference between males

and females. Table 4 shows changes in body weight and composition for this group and by gender. Mean weight significantly decreased from 144.8 ± 32.3 lbs to 142.2 ± 31.0 lbs over fall semester. Mean percent body fat increased significantly from 19.5 ± 7.3% to 20.0 ± 7.2%. Mean lean body mass significantly decreased from 113.9 ± 25.2 lbs to 111.2 ± 23.4 lbs. Mean BMI significantly decreased from 23.2 ± 4.1 kg/m^2 to 22.7 ± 3.9 kg/m^2.

Dietary and Lifestyle Habits

Dietary and physical activity information reported for the freshmen at the end of fall reveal the following: dietary intake of the subjects revealed that 93% of freshmen did not eat at least five servings of fruits and vegetables per day; 38% consumed less than two servings of dairy products per day; 26% drank two or more servings of sugar sweetened beverages per day; and 40% consumed at least three servings of high sugar/high fat desserts, baked goods, snack chips, and/or candies per day. Further, 62% of freshmen ate at a fast food or sit down restaurant at least three times per week. Almost 12% of freshmen ate at a fast food or sit-down restaurant more than six times per week. Regarding physical activity habits, 18% did not meet moderate exercise guidelines (at least 30 minutes per day on most days of the week) and 40% did not meet vigorous exercise guidelines (at least 20 minutes per day three days a week); however, males exercised significantly more than females. Concerning sleeping habits, only 34 (16%) of subjects reported getting, on average, at least eight hours of sleep per night. Thirty-seven students (17%) reported an average of less than six hours of sleep per night; 60 (28.2%) reported an average of less than seven hours of sleep per night; and 82 (38.5%) reported sleeping an average of less than eight hours per night. Out of the 214 subjects, 116

(54.2%) reported consuming alcoholic beverages, and 75 (35%) reported drinking more than five drinks on any one occasion. Of the 214, 13 (6.1%) smoked.

Several factors shown in Table 5 were examined to determine if there were differences between those that gained weight versus those that lost weight or had no change in weight. None were found to be statistically significant between the two groups. Table 6 examined differences in weight change between subjects with differing dietary and lifestyle characteristics. Of all the factors examined one factor was found to be statistically significant. Students who dined with more than 2 companions at the all-you-can-eat dining facilities on campus gained significantly more weight (3.9 ± 3.2 lbs) than the students who dined with two or fewer companions (1.8 ± 3.5 lbs). One factor approached significance. Specifically, students who lived in campus housing tended to gain more weight (2.4 ± 3.5 lbs) than those who lived in non-campus housing (1.5 ± 5.0 lbs).

No significant correlations were found between weight change and minutes of physical activity (r=-0.008; p=0.908), sleep (r=-0.014; p=0.845), frequency of dining at fast food establishments and full service restaurants (r=0.103; p=0.133), number of fast food dining companions (r=0.030; p=0.685), number of restaurant dining companions (r=-0.016; p=0.835), frequency of breakfast consumption (r=-0.032; p=0.641); dairy consumption (r=-0.010; p=0.889), sugar sweetened drink consumption (r=0.053; p=0.440), and junk food consumption (r=0.572; p=0.405). Three findings approached significance. Weight change tended to be associated with number of on campus dining companions (r=0.285; p=0.052) and alcoholic drink consumption (r=0.111; p=0.106), and tended to be inversely associated with fruit and vegetable consumption (r=-0.110; p=0.108).

DISCUSSION

Anthropometric Findings

The "freshman 15" is a popular myth that during their first year at college, students will gain an average of 15 lbs. Studies, although few in number, have shown that college freshmen gain weight their first year. However, they also show that most of the weight gain appears to be the first semester in college and, for the year, it is typically much less than the much publicized 15 pounds (Anderson and others 2003; Butler and others 2004; Economos and others 2008; Graham and Jones 2002; Gropper and others 2008; Hajhosseini and others 2006; Hodge and others 1993; Hoffman and others 2006; Hovell and others 1985; Jung and others 2008; Kasparek and others 2008; Levitsky and others 2004; Megal and others 1994; Mihalopoulos and others 2008; and Racette and others 2005). The results of this study, which found that about 69% of students gained

weight the first semester of the freshman year, are consistent with previous reports which show that about 67% to 74% of students gain weight fall semester (Anderson and others 2003; Gropper and others 2008; Hajhosseini and others 2006; Levitsky and others 2004).

Four studies of the 15 published studies in the literature have examined weight changes of both male and female freshman college students over the fall semester (Anderson and others 2003; Gropper and others 2008; Hajhosseini and others 2006; Levitsky and others 2004). Anderson and coworkers (2003) found in a group of 135 freshmen that the average weight gain was 2.9 lbs fall semester and that 74% of students gained weight (subjects were considered to have gained weight if they gained at least 0.5 lbs). Hajhosseini and associates reported for a group of 27 freshmen that 67% gained weight and the average weight gain was 3 lbs over a 16 week period (note: weight gain was defined by a gain of more than 2 lbs) (Hajhosseini and others 2006). Gropper and coworkers (2008) found an average weight gain of 1.9 lbs for a group of 35 freshmen and of 3.7 lbs in the weight gain group; 71.4% of the freshmen gained weight the first semester. Levitsky and colleagues (2004) reported an average gain of 4.18 lbs for fall semester in a group of 60 freshmen. The findings of these four studies (weight gain range of 1.9 to 4.2 lbs for fall semester) are consistent with those of the present study which found an average 2.1 lb weight gain for the first semester. Also similar to pilot study results from Drawdy (2007) which showed that the weight gain group gained an average of 3.7 lbs fall semester, the mean weight gain of the weight gain group in this study was 4.1 lbs. Hodge and associates (1993) reported a 7 lb average weight gain in the weight gain group, but it was over a six month time period beginning the start of the freshman year. The present study also found that males gained significantly more weight

than females in the weight gain group. These findings are in contrast to those of Drawdy (2007) who in a small pilot study reported no differences in average fall semester weight gain between 7 males and 18 females.

Only a few studies have examined and reported on weight loss in college freshmen over the first semester. Anderson and others (2003) found that 20% of freshmen lost weight (defined as $\geq$ 0.5 lb loss) fall semester, and Hajhosseini and coworkers (2008) found that 7% of freshmen lost more than one pound over the fall semester. Hodge and researchers (1993) found that 18% of female freshmen lost weight (defined weight loss as a loss of 4 lbs or more) over the first 6 months of the freshman year, and the average loss was -5.45 lbs. In the present study, 28.5% of the students lost (defined as a loss of 0.2 lbs or more) an average of -2.5 lbs. This percentage finding is slightly higher than those reported in the literature; however, the amount lost is slightly less (as expected) for a 3 month time period than that reported by Hodge and associates (1993) for a six month time period.

Of the published literature, two studies examined changes in body composition over the fall semester in both male and female college freshmen (Gropper and others 2008; Hajhosseini and others 2006). Hajhosseini and others found that for 27 male and female college freshmen that, on average, percent fat mass increased significantly by 2.1%, and percent lean body mass decreased significantly by -2.1% (Hajhosseini and others 2006). Gropper and colleagues (2008) found that over the fall semester, percent body fat significantly increased by 1.0% and BMI significantly increased by 0.4 kg/m^2 in a group of 35 college freshmen. Similar to the findings by Gropper and coworkers (2008), the present study found that percent body fat, fat mass, and BMI increased

significantly (0.9%, 1.8 lbs, and 0.3 kg/m^2, respectively), and that males gained significantly more fat mass than females. In the weight gain only group, lean body mass, percent body fat, fat mass, and BMI increased significantly with no differences between males and females. Nearly 60% of the weight gained in the weight gain group was body fat. This finding is consistent with average body composition changes that occur with weight gain (Forbes 1988). While these gains in weight and body fat are modest, concerns exist should these gains continue in subsequent semesters. Excess body weight and fat are associated with numerous health risks.

When examining body composition changes in those freshmen that lost weight fall semester, it is of concern that this group significantly lost lean body mass and significantly gained percent body fat. No studies to date have reported changes in body composition among college students who have lost weight the first semester. This shift in body composition could lead to decreases in metabolic rate and ultimately make it harder to maintain weight or to keep excess weight off. In addition, excess body fat, especially if placed in the abdominal region, is associated with health risks.

Dietary and Lifestyle Habits

Dietary and physical activity information reported for the freshmen at the end of fall reveal several poor habits. For example, 93% of freshmen did not eat at least five servings of fruits and vegetables per day; 38% consumed less than two servings of dairy products per day; 26% drank two or more servings of sugar sweetened beverages per day; and 40% consumed at least three servings of high sugar/high fat desserts, baked goods, snack chips, and/or candies per day. A negative correlation which approached significance was found between weight gain and fruit and vegetable intake. The fruit and

vegetable habits of college students in the present study were worse than those of Haberman and Luffey (1998) who found 80% of college students had inadequate fruit and vegetable intakes. They are also higher than those from a large study of college students that reported 75% did not meet fruit and vegetable intake guidelines (Douglas and others 1997).

The present study found that 62% of freshmen ate at a fast food or sit down restaurant at least three times per week and 12% ate more than six times per week. These findings are similar (but not exactly comparable) to a study of 226 college students by Driskell and others (2006) who reported 84% of men and 58% of women ate fast food for lunch at least once weekly and 82% of students ate dinner at fast food restaurants at least once weekly.

Alcoholic beverages (at least one in the past 30 days) were reportedly consumed by 54.2% of freshmen in the present study. This percentage is slightly higher than the 44.3% reported for young (age 18-24 years) adult Alabamians for 2007 by BRFSS (CDC 2007h). This study also found that 35% of freshmen reported drinking more than five drinks on any one occasion. This percentage is almost double that of 18% reported for young (age 18-24 years) adult Alabamians for 2007 by BRFSS (CDC 2007c). In the present study, a correlation which approached significance ($p=0.106$) was found between weight gain and alcoholic beverage consumption.

Regarding physical activity habits, 18% did not meet moderate exercise guidelines (at least 30 minutes per day on most days of the week) and 40% did not meet vigorous exercise guidelines (at least 20 minutes per day three days a week). These findings are similar to the results of several studies that have reported in adequate levels

of physical activity among college students (Douglas and others 1997; Haberman and Luffey 1998; Huang and others 2003; Racette and others 2005). Clearly, interventions to promote healthier eating and exercise habits may benefit first semester freshman.

Factors Associated with Weight Change

With the transition from high school to college come changes in lifestyle including dietary choices and exercise habits. The findings from the present study and the published literature support the idea that college freshmen gain weight in response to these lifestyle changes. Several studies have tried to explain freshman weight gain by examining diet and exercise behaviors (Butler and others 2004; Drawdy 2007; Hajhosseini and others 2006; Levitsky and others 2004; Racette and others 2005). Butler and others showed that in 54 female college freshmen, during the freshman year, calorie intake and food servings from all food groups decreased, yet the students gained 1.6 lbs (Butler and others 2004). Hajhosseini and coworkers found that the extra 55 calories consumed each day was in the range necessary to support the 3 lb weight gain found in the study (Hajhosseini and others 2006). Levitsky and colleagues attributed 24% of the variance of the first semester freshman 4.2 lb weight gain to an increase in the consumption of evening snacks and the consumption of high fat foods. They also found that eating in "all-you-can-eat" dining halls explained 20% of the total variance (Levitsky and others 2004). The present study found two factors that contributed to weight gain. Similar to the findings of Levitsky and others (2004), this present study found that freshmen who dined with more than two people at the on-campus "all-you-can-eat" dining facilities gained significantly more weight than those that dined with two or fewer people. Moreover, a correlation which approached significance ($p=0.052$) was found

between weight gain and number of companions present when eating at on-campus dining halls. Stroebele and de Castro found that a sample (n=133) of undergraduate college students reported feeling significantly more elated and excited as the number of eating companions increased. They also consumed significantly more energy, carbohydrate, fat, and protein as the number of dining companions increased (Stroebele and de Castro 2006). In addition, students who lived in campus housing tended to gain more weight than those who lived off-campus. Hovell and coworkers also found that freshman females who lived on campus gained weight at a rate 36 times faster than their counterparts attending community or state colleges and mostly not living on campus (Hovell and others 1985).

Overall Findings and Limitations

The present study adds important findings about freshman weight and body composition changes to the literature. It shows that first semester weight gained by freshmen attending a large public university in the South is similar to that gained by freshmen at other universities located primarily in the Midwest, Northeast, and West. In addition, it shows that both males and females gained weight, body fat, and exhibited an increase in BMI after one semester of college. Further, these findings suggest that dining with more than two companions at the all-you-can-eat dining facilities and perhaps living in campus housing may contribute to the weight gain.

These findings, however, must be interpreted with caution as self-selection bias may have occurred since only students who felt secure with their weight and were comfortable enough to be measured may have returned at the end of fall. Thus, the results may have been skewed towards smaller changes than truly occurred. In addition,

no efforts were made in this study to have subjects or the investigators record dietary and physical activity habits (for example on a log) because it was thought that this may decrease recruitment and retention among participants. Instead, this study relied on students to report accurately and honestly their consumption of certain foods and drinks, frequency of dining out, physical activity, and other lifestyle choices. Briefel and coworkers found that for 7,769 nonpregnant adults (3,956 males and 3,813 females) about 18% of the men and 28% of the women were classified as under-reporters. Underreporting of energy intake was highest in women and persons who were older, overweight, or trying to lose weight (Briefel and others 1997). Thus, poor habits of many of the freshman students may have been minimized.

CONCLUSIONS AND RECOMMENDATIONS

Weight gain over the fall semester during freshman year is a problem for most college students. This weight gain is accompanied by unhealthy changes in body fat and in BMI. College freshmen exhibited poor dietary habits. On-campus dining with more than two companions contributed to freshman weight gain.

These findings are of concern given the trends in obesity among Americans. Given the findings of this study and that many universities are or are working towards requiring freshmen to live on campus and to have campus meal plans, intervention strategies may be needed for some students. Additional studies are needed to further examine changes in weight and body composition, and factors contributing to these changes, in the college population not only during the freshman year, but also during the sophomore, junior, and senior years. Health promotion and intervention programs on campus may be needed for all college students (not just the freshmen) in order to address

some of the issues related to undesirable weight and body composition changes that may occur while in college.

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Table 1: Selected demographic characteristics of sample population

	Beginning of Fall (n=240)	End of Fall (n=214)
Mean ± SD Age (years)	18.12 ± 0.4	18.39 ± 0.5
Gender[+]		
Male	84 (35%)	73 (34%)
Female	156 (65%)	141 (66%)
Race[+]		
Caucasian	196 (81.7%)	175 (81.8%)
African American	29 (12.1%)	27 (12.6%)
Hispanic	7 (2.9%)	5 (2.3%)
Asian	4 (1.7%)	4 (1.9%)
Other	4 (1.7%)	3 (1.4%)
Parents' Income		
$ 10 -30, 000	5 (2.1%)	
$ 30 -50, 000	12 (5.0%)	
$ 50 -70, 000	20 (8.3%)	
$ 70 -90, 000	22 (9.2%)	
$ 90 -110, 000	30 (12.5%)	
$ 110 -130, 000	25 (10.4%)	
$ 130 -150, 000	11 (4.6%)	
$ >150, 000	41 (17.1%)	
Don't know	74 (30.8%)	
Permanent Residence[+]		
Alabama	149 (62.1%)	
Georgia	37 (15.4%)	
Tennessee	11 (4.6%)	
Texas	9 (3.8%)	
North Carolina	7 (2.9%)	
Florida	4 (1.7%)	
Louisiana	2 (0.4%)	
Arizona	2 (0.4%)	
Maryland	2 (0.4%)	
Illinois	2 (0.4%)	
Mississippi	2 (0.4%)	
Ohio	2 (0.4%)	
Virginia	2 (0.4%)	
Others (1 each) 22 different states	9 (3.8%)	
School Residence[+]		
Campus dorm	147 (61.3%)	131 (61.2%)
Apartment, house, duplex, or trailer	90 (37.5%)	83 (38.8%)
With parents	2 (1.2%)	0 (0%)
Smoke[+]		
No	222 (92.5%)	201 (93.9%)
Yes	18 (7.5%)	13 (6.1%)
Alcohol Consumption[+]		
No	117 (48.8)	98 (45.8%)
Yes	123 (51.2))	116 (54.2%)

[+]Data are presented as n (%)

Table 2: Body weight, body mass index (BMI), lean body mass (LBM), body fat mass, and percent body fat of college freshmen at the beginning and end of fall semester

Gender/Time	Weight[a] (lb)	BMI[a] (kg/m^2)	LBM[a] (lb)	Body fat mass[a] (lb)	Body fat[a] (%)
Females (n=141)					
Beginning of fall	133.0 ± 29.7	22.3 ± 4.5	101.6 ± 13.6	31.3 ± 18.8	22.4 ± 6.2
End of fall 2007	134.7 ± 30.1*	22.6 ± 4.6*	102.0 ± 13.3	32.7 ± 19.4*	23.2 ± 6.2*
Males (n=73)					
Beginning of fall	165.1 ± 29.4	23.6 ± 4.1	144.2 ± 18.6	18.9 ± 16.5	11.0 ± 5.2
End of fall 2007	167.9 ± 29.5*	24.0 ± 4.2*	144.8 ± 17.6	21.3 ± 18.2*[+]	12.1 ± 5.5*
All (n=214)					
Beginning of fall	143.9 ± 33.3	22.8 ± 4.4	115.4 ± 25.1	27.3 ± 19.0	18.7 ± 8.0
End of fall 2007	146.0 ± 33.7*	23.1 ± 4.5*	115.7 ± 24.9	29.0 ± 19.7*	19.6 ± 7.9*

Mean ± SD 83.3 ± 10.4 days between measurements
[a]Data are presented as mean ± SD
* When beginning of fall data were compared to end of fall data, significant changes were shown
**n=208 for all and n=67 for males for lean body mass, body fat and % body fat
[+]Significantly different than females

Table 3: Body weight, body mass index (BMI), lean body mass (LBM), body fat, and percent body fat of 147 college freshmen who gained weight from the beginning to the end of fall semester

Gender/Time	Weight[a] (lb)	BMI[a] (kg/m^2)	LBM[a] (lb)	Body fat mass[a] (lb)	Body fat[a] (%)
Females (n=94)					
Beginning of fall	132.5 ± 30.5	22.1 ± 4.6	101.4 ± 12.8	31.1 ± 20.3	22.3 ± 6.5
End of fall 2007	136.1 ± 31.6*	22.7 ± 4.7*	102.9 ± 13.3*	33.2 ± 21.0*	23.2 ± 6.4*
Males (n=53**)					
Beginning of fall	163.3 ± 30.7	23.5 ± 4.5	143.7 ± 18.4	18.8 ± 18.8	10.8 ± 5.8
End of fall 2007	168.1 ± 31.4*[+]	24.2 ± 4.6*	145.6 ± 17.6*	21.8 ± 20.6*	12.2 ± 6.0*
All (n=147**)					
Beginning of fall	143.6 ± 33.9	22.6 ± 4.6	116.0 ± 25.1	26.8 ± 20.6	18.3 ± 8.3
End of fall 2007	147.6 ± 35.0*	23.2 ± 4.7*	117.7 ± 25.2*	29.2 ± 21.5*	19.4 ± 8.2*

*Significantly ($p < 0.05$) greater than beginning fall values
**n=144 for all and n=50 for males for lean body mass, body fat and % body fat values
[+]Significantly different than females

Table 4: Change in body weight, body mass index (BMI), lean body mass (LBM), body fat, and percent body fat of 61 college freshmen who lost weight from beginning to end of fall semester

Group/Time	Weight[a] (lb)	BMI[a] (kg/m2)	LBM[a] (lb)	Body fat[a] (lb)	% Body fat[a] (%)
All Subjects (n=61**)	-2.5 ± 2.4*	-0.4 ± 0.4*	-2.8 ± 4.1*	0.3 ± 2.3	0.5 ± 1.5*
Females (n=42)	-2.5 ± 2.7*	-0.4 ± 0.4*	-2.4 ± 4.2*	0.01 ± 2.4	0.4 ± 1.6
Males (n=19**)	-2.7 ± 2.0*	-0.4 ± 0.3*	-3.6 ± 3.6*	0.9 ± 2.0	0.7 ± 1.2*

[a]Data are expressed as mean ± SD

*When beginning of fall data were compared to end of fall data, significant changes were shown

**n=58 for all and n=16 for males for LBM, body fat and % body fat

Table 5: Differences in activity, alcohol consumption, smoking, sleep, fast food dining and number of dining companions, restaurant dining and number of dining companions, on-campus dining and number of dining companions, breakfast consumption, and dietary choices among freshmen who gained weight versus those that lost weight or remained the same at the end of fall semester

Parameter	Weight Gain Group[a] (n=147)	Weight Loss/No change Group[a] (n=67)
Physical activity[+] (min/week)	427 ± 327	407 ± 281
Alcoholic drink consumption* (no./month)	36.4 ± 42.1	26.0 ± 26.8
Cigarette smoking (no./month)**	3.0 ± 2.8	3.5 ± 3.1
Sleep (hr/week)	49 ± 7	49 ± 6
Dining out*** (no./week)	3.7 ± 2.4	3.7 ± 2.5
Fast food dining companions (no.)	2.7 ± 1.6	2.6 ±2.0
Restaurant dining companions (no.)	2.9 ± 1.6	2.7 ± 1.0
On-campus dining companions (no.)	2.6 ± 2.3	1.5 ± 1.0
Breakfast consumption (no./week)	4.3 ± 2.2	4.3 ± 2.2
Fruit and vegetable consumption (serving/day)	1.8 ±1.4	1.9 ±1.7
Dairy consumption (serving/day)	2.6 ±1.7	2.4 ± 1.6
Sugar sweetened drink consumption (serving/day)	1.1 ± 1.3	1.2 ± 1.5
Junk food consumption[++] (serving/day)	2.4 ±1.8	2.2 ± 1.9

[a]Data are presented as mean ± SD
[+]Physical activity included strength training, vigorous activity, and moderate activity
*116 subjects reported drinking alcohol
**13 subjects reported smoking
***Dining out included restaurant and fast food dining
[++]Junk food included high sugar/high fat desserts, baked goods, sugar sweetened drinks, snack chips, and/or candies

Table 6: Weight change among subjects based on differences in place of residence, activity, alcohol consumption, smoking, sleep, fast food dining and number of dining companions, restaurant dining and number of dining companions, on-campus dining and number of dining companions, breakfast consumption, and dietary choices for fall semester

Parameter	(n)	Weight Change[a] (lbs)
Place of residence[++]		
On campus	132	2.4 ± 3.5
Off campus	82	1.5 ± 5.0
Physical activity[+] (min/week)		
< 425	138	2.1 ± 4.0
≥ 425	76	2.0 ± 4.4
Alcoholic drink consumption (no./month)		
≤20	60	2.0 ± 3.7
>20	56	2.6 ± 4.4
Sleep (hr/week)		
< 49	97	2.1 ± 3.8
≥ 49	116	2.1 ± 4.4
Dining out* (times/week)		
≤ 6	189	1.9 ± 4.1
> 6	25	3.0 ± 4.5
Fast food dining companions (no.)		
≤ 2	134	1.9 ± 4.0
> 2	80	2.3 ± 4.4
Restaurant dining companions (no.)		
≤ 2	69	2.3 ± 3.8
> 2	145	2.0 ± 4.3
On-campus dining companions (no.) ☺		
≤ 2	30	1.8 ± 3.5
> 2	17	3.9 ± 3.2
Breakfast consumption (no./week)		
≤ 4	102	2.5 ± 4.6
> 4	112	1.6 ± 3.7
Fruit and vegetable consumption (serving/day)		
≤ 2	151	2.3 ± 4.4
> 2	63	1.6 ± 3.6
Dairy consumption (serving/day)		
≤ 2	114	2.3 ± 4.4
> 2	100	1.8 ± 3.8
Sugar sweetened drink consumption (serving/day)		
≤ 2	118	2.0 ± 4.7
> 2	36	2.8 ± 3.6
Junk food consumption (serving/day)		
≤ 3	101	2.4 ± 4.7
> 3	113	1.7 ± 3.5

[a]Data are presented as mean ± SD

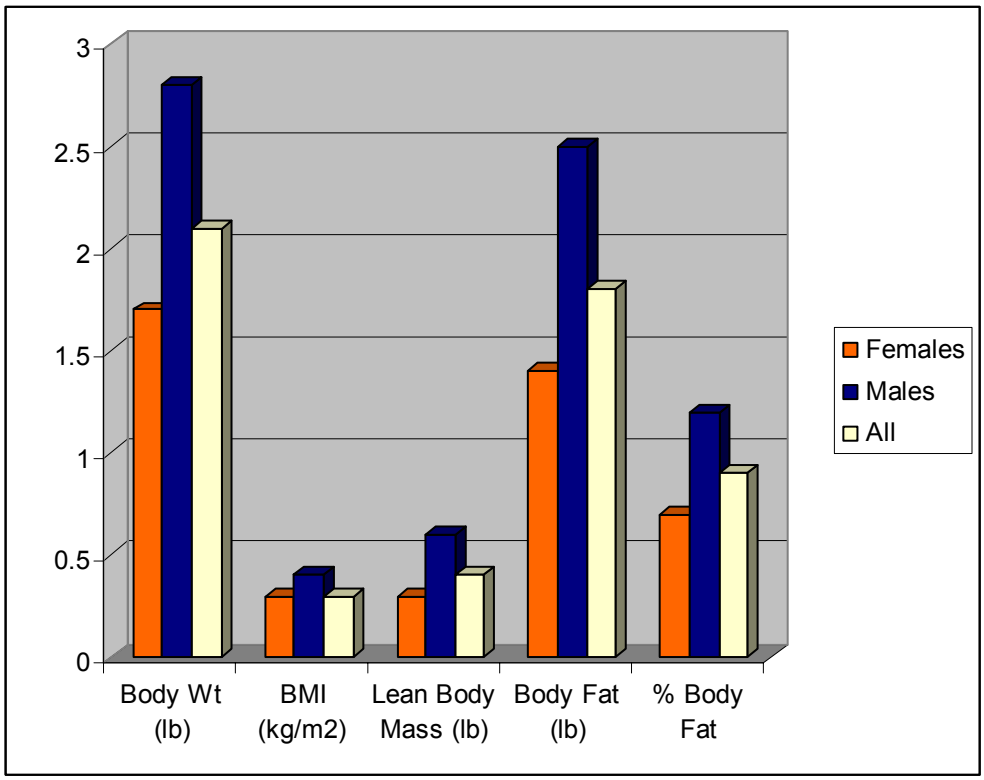
[+]Physical activity included strength training, vigorous activity, and moderate activity

*Dining out included restaurant and fast food dining

☺ Data are statistically significant ($p<0.05$)

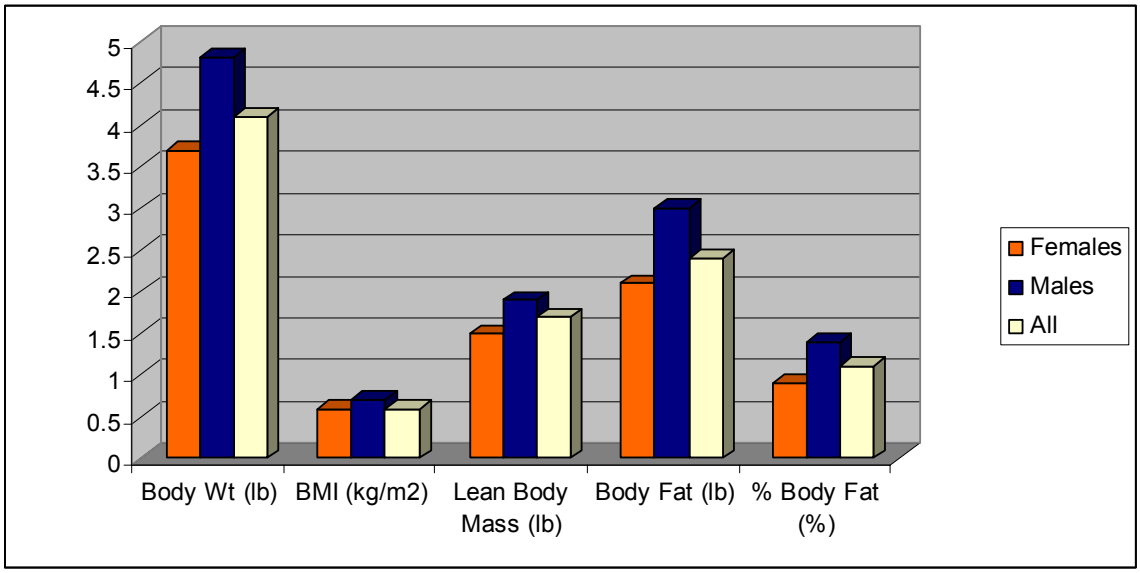
[++]Data approached statistical significance ($p=0.1021$)

Figure 1: Changes in absolute body weight, body mass index (BMI), lean body mass (lbm), body fat and percent body fat from the beginning to the end of fall semester for 214 college freshmen



*Males gained significantly more body fat mass than females ($p<0.05$)
**n=208 for all and 67 for males for lean body mass, body fat mass, and percent body fat

Figure 2: Changes in body weight, body mass index (BMI), lean body mass (LBM), body fat, and percent body fat of 147 college freshmen who gained weight from beginning to end of fall semester



*Males gained significantly more weight than females

CHAPTER 4

SUMMARY OF FINDINGS

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

There was no significant difference in weight change between subjects who consumed alcohol and those that did not consume alcohol. This finding does not support research hypothesis two. Alcohol consumption did not differ between weight gainers and weight losers. This finding does not support research hypothesis three.

There was no significant difference in weight change between subjects who consumed less than or equal to two servings per day of fruits and vegetables and those that consumed more than two servings per day. These findings do not support research hypothesis four. There was no significant difference in number of servings of fruits and vegetables between weight gainers and weight losers. This does not support research hypothesis five.

There was no significant difference in weight change between those who consumed more than three servings of "junk" food per day and those that consumed three or fewer servings per day. This finding does not support research hypothesis six. There was no significant difference in number of servings of "junk" food between weight gainers and weight losers. This finding does not support research hypothesis seven.

There was no significant difference in weight change between individuals who sleep less than 49 hours per week and those that slept 49 hours or more per week. This does not support research hypothesis eight. There was no significant difference of number of hours slept per week between weight gainers and weight losers. This finding does not support research hypothesis nine.

There was no significant difference in weight change between individuals who consume breakfast less than or equal to four times per week and those who consume breakfast more than four times per week. These findings do not support research hypothesis ten. There was no significant difference in number of days breakfast was consumed between weight gainers and weight losers. This does not support research hypothesis eleven.

There was no significant difference in weight change between individuals who engaged in physical activity for less than 425 minutes per week and those who engaged in such activity for 425 minutes or more. These findings do not support research hypothesis twelve. There was no significant difference in time spent engaging in physical activity between weight gainers and weight losers. This does not support research hypothesis thirteen.

There was no significant difference in weight gain between those that dine on campus or at restaurants more than six times a week and those that dine out six or fewer times per week. This finding does not support research hypothesis fourteen. There was no significant difference in frequency of dining out between weight gainers and weight losers. This does not support research hypothesis fifteen.

Individuals who dined with more than two people at the on-campus "all-you-can-eat" dining facilities gained significantly more weight than those that dined with two or fewer people, partially supporting research hypothesis sixteen. However, when this same statistical test was performed on number of fast food dining companions, and number of restaurant dining companions, there were no significant findings. Weight gainers did not dine with significantly more people than non-weight gainers. This does not support hypothesis seventeen.

Finally, there was no difference in weight gain between students who lived in dorms and those who lived off-campus in apartments, houses, trailers or duplexes. This finding does not support hypothesis eighteen.

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APPENDIX: APPROVAL FORM

AUBURN
UNIVERSITY

Office of Human Subjects Research
307 Samford Hall
Auburn University, AL 36849

Telephone: 334-844-5966
Fax: 334-844-4391
hsubjec@auburn.edu

July 11, 2007

MEMORANDUM TO: Dr. Sareen Gropper & Dr. Lenda Connell
Nutrition & Food Science

PROTOCOL TITLE: "Longitudinal Collegiate Study of Body Composition/Size and Related Environmental, Behavioral and Psychological Factors"

IRB AUTHORIZATION NO: 07-153 EP 0707

APPROVAL DATE: July 9, 2007
EXPIRATION DATE: July 8, 2008

The above referenced protocol was approved by IRB Expedited procedure under 45 CFR 46.110 (Category #4, #6, & #7):

> "Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing.
>
> Collection of data from voice, video, digital, or image recordings made for research purposes.
>
> Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies."

You should report to the IRB any proposed changes in the protocol or procedures and any unanticipated problems involving risk to subjects or others. Please reference the above authorization number in any future correspondence regarding this project.

If you will be unable to file a Final Report on your project before July 8, 2008, you must submit a request for an extension of approval to the IRB no later than June 24, 2008. If your IRB authorization expires and/or you have not received written notice that a request for an extension has been approved prior to July 8, 2008, you must suspend the project immediately and contact the Office of Human Subjects Research for assistance.

A Final Report will be required to close your IRB project file. You are reminded that you must use the stamped, IRB-approved informed consent/assent (enclosed) when you consent your participants. Please remember that you must keep signed informed consents for three years after your study is completed.

If you have any questions concerning this Board action, please contact the Office of Human Subjects Research at 844-5966.

Sincerely,

Peter W. Grandjean, Chair
Institutional Review Board for the Use of Human Subjects in Research

Enclosure

cc: Dr. Doug White