Perceived Stress, Eating Regulation, Body Mass Index, Weight, and Percent Body Fat Relationships over the First Two Years of College

by

Amanda Kaye Watts

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Approved by

Sareen S. Gropper, Chair, Professor of Nutrition, Dietetics and Hospitality Management
Suresh T. Mathews, Associate Professor of Nutrition, Dietetics and Hospitality Management
Karla P. Simmons, Assistant Professor of Consumer and Design Sciences

Abstract

Objective: To assess the associations among perceived stress, eating regulation and body mass index, weight, and percent body fat in college students during the first two years of college.

Methods: Participants were recruited at the beginning of their college freshman year (2007 and 2008), and were assessed 2 to 3 times during the freshman and sophomore years. At each assessment, weight and height (using standard techniques), body composition (using bioelectrical impedance analysis), perceived stress (using the Perceived Stress Scale) and eating behavior (using the Regulation of Eating Behavior Scale) were examined. Of the 535 participants recruited at the beginning of the study, 319 participants (110 males, 209 females) were included in statistical analysis.

Results: Individuals with high autonomous, high intrinsic motivation, high integrated, high identified, or low amotivation eating regulation behaviors and high perceived stress exhibited greater BMI, weight, and/or percent body fat than those individuals with these same eating regulation behaviors and low perceived stress. No gender differences were observed.

Conclusions: College students with high perceived stress and high intrinsic motivation, high identified, high integrated, and low amotivation eating regulation behaviors may benefit from programs to help reduce or manage stress during the first two years of college.

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"Therefore, my dear brothers and sisters, stand firm. Let nothing move you. Always give yourselves fully to the work of the Lord, because you know that your labor in the Lord is not in vain."

~ 1 Corinthians 15:58

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Chapter 1

Introduction

Obesity affects more than one-third (35.7%) of adults in the United States (CDC 2012). The condition is associated with multiple adverse health problems including premature heart disease, hypertension, adverse lipid concentrations, type 2 diabetes mellitus, sleep apnea, osteoarthritis, metabolic syndrome, and stroke (CDC 2011a, NIH 1998). Obesity is particularly a problem in the state of Alabama, which has the nation's third highest percentage of obese residents at 33.2% (CDC 2010a). Data from the 2010 Behavioral Risk Factor Surveillance System found the nationwide prevalence of overweight and obesity in 18 to 24 year olds was 23.8% and 16.7%, respectively (CDC 2010b). Increases in the rates of obesity have been shown to disproportionately affect young adults, 18-24 years of age, more than other age groups (Mokdad and others 1999). In 2008, the prevalence of obesity among young adults in Alabama was 30% (CDC 2008).

Stress is another common problem among Americans, especially young adults entering college. Stress often accompanies change. Factors found most often to be positively associated with stress in college students include: sleeping habits, vacations/breaks, eating habits, new responsibilities, increased class workload, examinations/academics, too much to do, amount to learn, need to do well, essays or projects, alcohol use, low self-efficacy, and a pessimistic attitude (Abouserie 1994, Chemers and others 2001, Dusselier and others 2005, Ross and others 1999).

How a person copes or deals with stress varies among individuals. However, the effects of stress are often negative. The American College Health Association National College Health Assessments reports that 27.5% of college student's academic performance has been affected by stress; 36.8% of men and 40.0% of women in college experiences 'more than average' stress (ACHA 2011). Stress is widely thought to lead to overeating (Greeno and Wing 1994, Oliver and Wardle 1999), altered food patterns (Oliver and Wardle 1999, Pollard and others 1995), and cause weight gain (Serlachius and others 2007). Overeating in response to stress appears to be more prevalent among females than among males (Pollard and others 1995, Serlachius and others 2007). Restrained eaters (that is those who display intentional efforts to achieve or maintain a desired weight through reduced energy/caloric intake) (Stice and others 1997) tend to overeat more in response to stress than those who are non-restrained eaters (Oliver and Wardle 1999). This overeating response is often due to the undermining of restrained eaters' self-control (e.g., through experience of stressors). Control is diminished and the "suppressed behavior is disinhibited," leading to excessive food intake (Heaven and others 2001). When stressed, restrained eaters are willing to "give into" the immediate reward of food rather than wait for the more delayed reward of a healthy weight (Tice and others 2001). The additional situational demand of stress overwhelms the individual's self-regulatory resources and the individual loses the self-control to maintain dietary restraint (Vohs and Heatherton 2000). Additionally, the food environment at college may facilitate overeating due to greater food selection variety and choices, decreased parental influence on diet, and the different social circumstances that promote eating (Pliner and Saunders 2008).

Weight gain is common among college students, especially during the freshman year (Anderson and others 2003, Butler and others 2004, Crombie and others 2009, Delinsky and Wilson 2008, Economos and others 2008, Graham and Jones 2002, Gropper and others 2009, Hajhosseini and others 2006, Hodge and others 1993, Hoffman and others 2006, Holm-Deoma and others 2008, Hovell and others 1985, Jung and others 2008, Kasparek and others 2008, Levitsky and others 2004, Lloyd-

Richardson and others 2008, Lowe and others 2006, Mihalopoulos and others 2008, Morrow and others 2006, Pliner and Saunders 2008, Racette and others 2005, Racette and others 2008, Serlachius and others 2007) . The popularized “freshman 15”, however, appears to be more accurately the “freshman three” (Crombie and others 2009, Hajhosseini and others 2006), “four” (Pliner and Saunders 2008, Racette and others 2005), “five” (Holm –Deoma and others 2008), or “six” (Gropper and others 2009, Hoffman and others 2006), or if only those freshmen who gained weight are included, the “freshman seven” (Economos and others 2008, Hodge and others 1993, Kasparek and others 2008, Mihalopoulos and others 2008). The “freshman 15” refers to belief commonly reported in the popular press that students gain 15 lbs during the freshman year of college. While several studies have examined factors associated with weight gain, few studies have examined the impact of stress on weight gain among college students or the impact of various regulatory eating behaviors on weight gain among college students (Delinsky and Wilson 2008, Lowe and others 2006). The purpose of this study was to investigate relationships among perceived stress, eating regulation and body mass index (BMI), weight, and percent body fat in female and male students during the first two years of college.

Chapter 2

Literature Review

This review of literature is divided into six main sections including the definition of stress, the response to stress, instruments used to assess stress, stress and college, and stress and eating behaviors. The section on stress and eating behaviors is further sub-divided to discuss in more detail stress, restrained eaters, and eating behaviors. The last main section addresses weight gain in college students with sub-sections on stress and weight change, and restrained eating and weight change in college students.

Definition of Stress

Stress refers to an external stimulus including physical, chemical or emotional factors that disrupts or alters an existent equilibrium. Hans Selye (1956), the first to produce a working explanation for stress, states that it is the "*consequence of the failure of an organism - human or animal - to respond adequately to mental, emotional or physical demands, whether actual or imagined*" and "*the non-specific response of the body to any demand for change*" (Selye 1956). The term stress is highly specific to each individual with differences in how the body responds, what triggers the physiological response, and how an individual copes or adapts. Stress can be beneficial by helping people develop the skills they need to cope with and adapt to new potentially threatening situations throughout life (CDC 2011b). But, stress may also bring about harmful effect

Physiological Response to Stress "General Adaptation Syndrome"

Stress typically disrupts homeostasis. The brain controls the stress response by releasing a cascade of hormones. The body's response to stress has been referred to as the 'general adaptation syndrome' (Selye 1956). The hypothalamus-pituitary-adrenal axis mediates the stress response. Corticotropin-releasing factor, the principle regulator of the hypothalamus-pituitary-adrenal axis, is synthesized and released from the hypothalamus when stress is detected. In response to stress, corticotripin-releasing factor is released into the hypophysial portal vessels that access the anterior pituitary gland. Once bound to the pituitary receptors, the pituitary will release adrenocorticotropic hormone into systemic circulation. The adrenal cortex is the principle target of circulating adrenocorticotropic hormone, which stimulates glucocorticoid synthesis and secretion from the zona fasciculate. The hypothalamus-pituitary-adrenal axis is regulated by a glucocorticoid negative feedback mechanism, whereby high plasma cortisol concentrations inhibit the production of adrenocorticotropic hormone and corticotropin-releasing factor to limit the hypothalamus-pituitary-adrenal axis response time.

Catecholamines

There are several "stress hormones." One group is the catecholamines including epinephrine (adrenaline), norepinephrine (noradrenaline), and dopamine. Catecholamines bind to external receptors on target tissues (primarily muscle). This effect increases blood glucose concentrations by indirectly stimulating glucagon release and inhibiting the uptake of blood glucose by the muscle tissue. This process is mediated by cAMP and protein kinase A phosphorylase.

Epinephrine is secreted from the adrenal medulla located on the kidneys and from sympathetic nerve endings. Low amounts of this hormone are released continuously from the adrenal medulla by exocytosis, but sympathetic stimulation dramatically accelerates the rate of exocytosis. Epinephrine makes up approximately 75%-80% of the secretions from the adrenal medulla with the remaining 20%-25% being norepinephrine. Epinephrine increases metabolic rate, respiratory rate, cardiac activity, heart rate, blood pressure, and blood glucose levels (Martini 2006). Additionally the secretion and binding of epinephrine to alpha and beta receptors on target cells mobilizes nutrient stores. Specifically this hormone stimulates skeletal muscle glycolysis and glycogenolysis, hepatic glycogenolysis and gluconeogenesis, and adipose tissue lipolysis. The glucose released from muscle glycogen stores is used within muscle for energy while that synthesized in the liver is released into the blood for extrahepatic tissue use. Free fatty acids released from adipose tissue are also used for energy by tissues.

Norepinephrine is secreted from secretory cells within the adrenal medulla on the kidneys and functions mainly as a neurotransmitter. Like epinephrine, however, norepinephrine induces many of the same responses including increasing metabolic rate, respiratory rate, cardiac activity, heart rate, blood pressure, and blood glucose concentrations. Both epinephrine and norepinephrine produce a positive inotropic effect on the heart, producing an increase in contraction force and degree of output. When present in normal concentrations, norepinephrine has a stimulating effect that fosters alertness and plays a regulatory role in long-term memory and learning. It also inhibits premature catabolism of endorphins and stimulates a sense of wellbeing. Yet excess norepinephrine can fuel the physiological expressions of fear and anxiety like those experienced in the “flight-or-fight” syndrome of the stress response. Norepinephrine, as a hormone and neurotransmitter, binds to alpha and beta receptors on target tissues and remains active until it is reabsorbed or inactivated by monoamine oxidase. Much like epinephrine, norepinephrine stimulates skeletal muscle glycolysis and glycogenolysis, hepatic glycogenolysis, and adipose tissue lipolysis. The peak activities of these hormones, including dopamine, are seen at approximately 30 seconds after adrenal stimulation and persist for several minutes while bound to receptors. Free circulating epinephrine, norepinephrine, and dopamine typically remain active for less than one hour (Martini 2006).

Dopamine, released from the hypothalamus secondary to sympathetic nervous system stimulation, functions as a neurotransmitter and mediates the activity of areas of the hypothalamus that govern feeding behavior, cognition, voluntary movement, motivation, punishment and reward, sleep, mood, attention, working memory, and long-term memory and learning. It does not impact nutrient metabolism like epinephrine and norepinephrine.

Glucocorticoids

The main glucocorticoid found in humans is cortisol, also referred to as hydrocortisone and corticosterone. Cortisol is released from the adrenal cortex of the kidneys. The liver converts some of the circulating cortisol into cortisone, another active glucocorticoid. Cortisol is secreted during the postabsorptive/fasted states and stressful states primarily in response to falling blood glucose levels and adrenocorticotropic hormone release. Adrenocorticotropic hormone, released from the anterior pituitary gland, targets the adrenal cortex and stimulates the release of glucocorticoids as a result of signaling from the central nervous system responding to stress; this hormone also may suppress appetite. As glucocorticoid levels rise, the rates of corticotropin-releasing hormone (secreted from the hypothalamus) and adrenocorticotropic hormone release decline. Corticotropin-releasing hormone stimulates adrenocorticotropic hormone release.

Glucocorticoids affect the body's immune and metabolic responses. Glucocorticoids produce an anti-inflammatory response by inhibiting some actions of white blood cells and other components of the immune system. Other anti-inflammatory responses include the slowing of the migration of phagocytic cells to the injury site, causing phagocytic cells already present in the injury area to become less active, decreasing the permeability of capillaries, decreasing the release of histamine and other agents that promote inflammation, inhibiting interleukin secretion, and decreasing the rate of wound healing.

Metabolic responses to cortisol include increased skeletal muscle glycogenolysis, increased hepatic gluconeogenesis, increased adipose tissue lipolysis, and protein catabolism. Cortisol also stimulates the release of glucagon from alpha-cells in the pancreas, inhibits the uptake and use of glucose in muscle and adipose tissue, and alters glucose metabolism.

Instruments Used to Assess Stress as well as Traits Often Associated with or Affected by Stress

Several instruments, surveys, and/or questionnaires are used to assess stress levels in humans. This section of the literature review provides information on some of these instruments, including how the instrument is scored when such information was available. Additionally, instruments, surveys, and questionnaires addressing factors such as self-esteem, eating regulation, and anxiety that may be related to stress, are also briefly discussed.

The Student Stress Survey consists of 40 items that are divided into four categories of potential sources of stress: six items representing interpersonal, 16 items representing intrapersonal, eight items representing academic and 10 items representing environmental sources of stress. Interpersonal sources of stress result from interactions with other people while intrapersonal sources result from internal sources, such as, changes in eating or sleeping habits. Within these divisions, the stressors are identified as either daily hassles or major life events. Daily hassles comprise six interpersonal, seven intrapersonal, three academic, and seven environmental stressors (Insel and Roth 1985, Ross and others 1999).

The Academic Stress Questionnaire assesses 34 potential academic causes of stress covering students' learning, examinations and results, conflicts with lecturers and peers, situational variables such as accommodation, financial problems, and family crisis. Respondents indicate the degree of stress experienced in response to each item on a scale of 0-7, with 0 indicating 'no stress' and 7 indicating 'extreme stress' (Abouserie 1994).

The Life Stress Questionnaire, developed from the Professional Life Stress Scale, assesses a student's life stress level. The questionnaire covers different aspects and symptoms of psychological stress and consists of 54 alternative choice items yielding a total stress score that can be classified by levels such as low, moderate, serious and very serious stress (Abouserie 1994, Fontana and Abouserie 1993).

The Undergraduate Stress Questionnaire is a 10 item version of the original 83 item survey based on events/hassles that students are likely to experience. Participants report each stressor's occurrence within the last two weeks and rate the severity of each stressor on a scale from 0 — "not at all stressful" to 2 – "very stressful" (Crandall and others 1992, Serlachius and others 2007).

The Perceived Stress Scale measures the degree to which one perceives aspects of one's life as uncontrollable, unpredictable, overloading, or stressful. Each item is scored on a five-point Likert scale. The total score ranges from 0-40, with higher scores indicative of greater perceived stress. Scores are obtained by reversing the scores on the four positive items, (e.g., 0=4, 1=3, 2=2, etc) and then summing across all 10 items. Items 4, 5, 7 and 8 of the survey are the positively states items (Cohen and Cohen 1983, Cohen 1988, Roberti and others 2006).

The Life Events Questionnaire consists of 20 potentially stress inducing situations. The questionnaire includes items which measure the occurrence of major life events as well as the incidence of less traumatic experiences. Items are scored on a five-point scale (Lewis and others 1984, Norbeck 1984, Sarason and others 1978).

The Multiple Affect Adjective Check List measures the degree to which situations in individuals' lives are appraised as stressful. Respondents indicate which of 132 adjectives describe the way they generally feel, focusing on anxiety, depression, and hostility (Norris and others 1991, Zuckerman 1960).

The Positive and Negative Affect Schedule is a measure of emotional experience. Two measures assess the effects of the stress manipulation on eating behavior and food choice: 1) appetite for a range of foods immediately before eating the meal and 2) food intake during the meal (Oliver and others 2000).

Instruments used to Assess Other Traits Often Associated with or Affected by Stress

Many studies assessing stress also investigate general habits and/or other traits that directly or indirectly may contribute to stress, or may accompany stress such as anxiety, changes in eating behaviors, and amount of pressure felt from others, etc. Some of these additional instruments are described in this sub-section of the literature review

The American College Health Association National College Health Assessment assists college health service providers, health educators, counselors, and administrators in collecting data about students' habits, behaviors, and perceptions on the most prevalent health topics. This survey provides a comprehensive data set on the health of college students. Survey questions cover general health, disease and injury prevention, academic impacts, violence, abusive relationships and personal safety, alcohol, tobacco and other drug use, sexual behavior, nutrition and exercise, mental health, sleep, and demographics (ACHA 2011, Dusselier and others 2005) .

The Social Support Questionnaire measures social support and consists of six items (i.e., “Who can you really count on to help you feel more relaxed when you are under pressure or tense?”). Participants responded by naming family members or friends and rated their satisfaction with the level of support on a 6 – point Likert scale (Pollard and others 1995, Siegert and others 1987).

The Life Orientations Test measures general optimism. Participants rate eleven items on a 5-point scale of agreement ranging from 1 (strongly agree) to 5 (strongly disagree). High scores on the measure indicate, for example, that respondents “believe that things usually work out well for them,” “expect things to go their way,” “are always optimistic” (Chemers and others 2001, Scheier and others 1985, Siegert and others 1987).

The State-Trait Anxiety Inventory measures both state anxiety - the amount of anxiety a person feels in a certain situation, and trait anxiety - the anxiety levels of that person at any particular given time. Items from the trait form include “I feel nervous and restless” and “I am happy”. Items from the state form are similar, but are answered in terms of how the respondent felt during the specific reported stressful experience (Pollard and others 1995, Spielberge and others 1983, Weinstein and others 1997).

The Cognitive Restraint and Disinhibition Scale examines two aspects of eating behavior. Cognitive restraint measures dietary restraint, that is, control over food intake in order to influence body weight and body shape. Disinhibition measures episodes of loss of control over eating. The Restraint Scale, as well as the Revised Restraint Scale, also measures the level of dietary restraint. Sample items include “How often are you dieting?” and “Do you have feelings of guilt after overeating?” Higher scores reflect more dietary restraint. The Restraint Scale consists of 11 items that index dieting behavior and restraint in the consumption of food “Do you eat less at meal-times than you would like to eat". Each item is scored on a 5-point scale from *never* to *very often*, with higher scores indicating greater restraint and averaged to derive the restraint score (Herman and Polivy 1975, Lowe and others 2006, Weinstein and others 1997).

The Eating Inventory separates eating behavior into three factors; cognitive restraint, disinhibition, and perceived hunger. Items include "I deliberately take small helpings as a means of controlling my weight" (cognitive restraint), "I usually eat too much at social occasions, like parties and picnics" (disinhibition) and "I am usually so hungry that I eat more than three times a day" (perceived hunger). Higher scores on these tests indicate higher levels of the three factors (Stunkard and Messic 1985, Weinstein and others 1997).

The Eating Attitudes Test includes assessment of food preoccupation, body image for thinness, vomiting and laxative abuse, dieting, slow eating, clandestine eating, and perceived social pressure to gain weight. Items included "Am terrified about being overweight" and "feel that food controls my life." Higher scores reflected more disordered eating patterns. The instrument measures a tendency toward eating disorders, specifically anorexia nervosa, but also has subscales for dietary restraint and bulimic. Higher scores reflect more disordered eating symptoms patterns (Epel and others 2001, Garner and Garfinkel 1979, Weinstein and others 1997).

The Binges Scale measures the severity of binge eating episodes. Sample items on this survey include "Do you ever vomit after a binge?" and "How much are you concerned about your binge eating?" A higher score on this test indicates more binging episodes. The Binge Scale also provides information on feelings of guilt and concern about binge eating and behavioral aspects of binge eating (Dusselier and others 2005, Gormally and others 1982).

Dutch Eating Behavior Questionnaire consists of 33 items that measure external, emotional, and restrained eating behaviors. Participants indicate the frequency of dieting behaviors using 5-point scales ranging from 1 (never) to 5 (always); items were averaged. The English version of the Dutch Eating Behavior Questionnaire assesses restrained eating and consists of 11 items that index dieting behavior and restraint in the consumption of food (Dusselier and others 2005, Heaven and others 2001, Pollard and others 1995, Van Strein and others 1986).

The General Health Questionnaire measures emotional well-being using a 28-item questionnaire. The questionnaire assesses emotional distress in community samples. It refers to respondent's experience over the past week and produces scores ranging from 0 to 28 (Goldberg 1978, Pollard and others 1995, Wardle and others 2000, Weinstein and others 1997).

The Food Choice Questionnaire assesses motive (such as health, convenience, cost, sensory appeal) for food choice, and consists of 36 items covering different issues that are taken into account in food choice. Each is rated on a 4-point scale (Pollard and others 1995, Steptoe and others 1995).

The Mood Scale measures the extent to which food choice is influenced by its effect on mood. Participants were asked to rank the importance placed on food in helping them to cope with stress, cheering the person up, and maintaining alertness. The scale consisted of six items (Pollard and others 1995, Norris and others 1991).

The Rosenberg Self-Esteem Scale measures global self-esteem using a 10-item measure. The Body Shape Questionnaire assesses concerns about body shape and appearance using a 34-item measure. Questions ask subjects how often they felt a particular way about her appearance during the past four weeks. Subjects respond to each item on a 6-point scale ranging from never (1) to always (6) (Delinsky and Wilson 2008, Rosenberg 1965).

The Regulation of Eating Behavior Scale measured the different behavioral regulatory styles proposed by Deci and Ryan (1985). Items are presented in random order. This scale consists of 24 items divided into six subscales (intrinsic motivation, integrated regulation, identified regulation, introjected regulation, external regulation, and amotivation). The first three subscales can be grouped together to form a global autonomous regulation subscale. The latter three subscales can be used to form a global score of controlled regulation. Intrinsically motivated behaviors are engaged in for one's own sake; for the pleasure, interest, and the satisfaction gained from the activity itself. Integrated regulation results when a behavior becomes consistent with other priorities in one's life. With identified regulation, external regulatory processes have been internalized into one's sense of self. The activity is valued and perceived as being chosen by one's self, and the activity is chosen because it parallels to their own values and congruent with their own values and goals. With introjected regulation, the external source of control is no longer needed to initiate behavior because the individual has internalized that source; instead the control stems from within the person in the form of self-imposed pressures such as guilt or anxiety. External regulation encompasses regulation that is controlled by external sources of control. These behaviors are compelled by reward and punishment in order to avoid negative consequences and obtain reward. Amotivation is the lowest level of the self-determined eating regulation styles, and results from a failure to perceive contingencies between actions and the outcomes of those actions. This type of regulation is associated with ignorance or lack of control. The response scale on the questionnaire ranges from 1 – Does not correspond at all to 7 – Corresponds exactly (Deci and Ryan 2000).

Stress and College Students

The 2010 National College Health Assessment found that stress is the foremost impediment to academic performance, outranking the other top 10 impediments to learning, including academics, career-related issues, family problems, intimate relationships, other social relationships, finances, health problems of family member or partner, personal appearance, personal health issues (cold, flu, sore throat), and sleep difficulties (ACHA 2011). In the college population, stress is attributed to fatigue, mood swings, insomnia, stomachaches, headaches, depression, anxiety, an inability to cope, academic content, relationships, finances, relocation, the death of a friend or family member, sex, the day-to-day rigors of being in college; stress can also permeate socialization, independence/autonomy, and responsibility (ACHA 2011). Overexposure to stressors can lead to an increased probability of physical and psychological impairment (Roberti and others 2006). Excessive stress reduces work effectiveness, contributes to bad habits, and may result in poor academic performance, school dropout, professional burnout, and ultimately, career failure (Dusselier and others 2005).

The following three smaller studies that are presented examine some additional contributors to stress in college students. A fourth study that is presented assessed stress, along with other factors, associated with adjustment to college.

Sources of stress most prevalent among college students were studied in 100 undergraduate students (20 males, 80 females) using the Student Stress Survey (Ross and others 1999). Participants varied in year in school, age, gender, and major. The study found that 38% of stressors were intrapersonal which comprised 100% of daily hassles, 28% environmental, 19% interpersonal, and 15% academic. Daily hassles accounted for 88.2% of the environmental stressors, 77.3% of intrapersonal, and 67.2% of academic stressors. Overall, 81.1% of the identified stress sources could be classified as daily hassles. In this study, intrapersonal sources of stress were the most common. The six most frequently reported stressors were: change in sleeping habits, change in eating habits, vacations/breaks, new responsibilities, and increased class workload. The five least frequently reported stressors were: quitting one's job, death of a friend, severe injury, transferred schools, engagement/marriage, and divorce between parents. Missing too many classes and arguing with an instructor comprised 15% of the total responses. Students also reported that receiving lower test grades than expected produced stress. First-year students scored higher for stress than sophomore, junior, and senior students (Ross and others 1999).

Abouserie (1994) investigated the academic and life sources of stress in 675 (202 males, 473 females) second-year undergraduate students. Students completed the Academic Stress Questionnaire and the Life Stress Questionnaire. In addition, locus of control was measured by the Multidimensional Multi-attributional Causality Scale and self-esteem was measured using the Self-Esteem Scale. The most significant sources of stress were: examinations, too much to do, amount to learn, need to do well, and essays or projects. Less significant sources consisted of problems with housing, conflict with college systems, and sexual problems. Over three-quarters, 77.6%, of the students were in a moderate range of stress, with 10.4% in the category of serious stress and 12% with no stress problems. Academic stress levels and life stress scores in females were significantly higher than those in males. There was a significant positive correlation between locus of control (i.e. the extent to which individuals believe that they can control events that affect them) and academic stress. Students with external control beliefs were more stressed than those with internal. A significant negative correlation was found between self-esteem and both academic and life stress, which suggested that students with high self-esteem were less stressed in both academic matters and life than those with low self-esteem (Abouserie 1994).

Dusselier and others (2005) studied contributors of stress among undergraduate residence hall students using a 76-item survey consisting of personal, health, academic, and environmental questions and one qualitative question asking students about the “one item, you feel causes the greatest stress during the semester”. Participants consisted of 416 students (25% freshmen, 22% sophomores, 22% junior, 29% senior, and 2% special students) from a land grant university in the Midwestern United States. Depression (including anxiety disorder and seasonal affective disorder) was a significant predictor of the reported frequency of stress. Greater concern for a troubled friend or family member and greater perceived conflict with a faculty or staff member significantly increased students’ perceived frequency of stress. Students who used alcohol more frequently and had more self-reported sleep difficulties also reported a greater frequency of experiencing stress. Three items related to residence hall atmosphere were statistically significant. Students who were more comfortable living in their house reported a lower frequency of stress. Students who felt that members of the house respected each other and each other’s beliefs were less likely to perceive stress, and students who felt they could study in the residence halls reported less frequent stress. Women and U.S. citizens also reported more frequent stress than did men and non-US citizens. Students with more fall semester hours reported more frequent stress. Of those who mentioned academics as a stressor, most cited tests, classes, homework, or examinations as a cause of stress. Twenty-five percent of the respondents mentioned personal issues. Many students indicated that procrastination caused them stress and others indicated adjustment issues as their major stressor. One student related stress to “just the newness of the college experience, and living in a much bigger community than I’m used to.”

Other stressors mentioned included time or time management issues, environmental issues (mostly roommate problems or noise concerns) and financial issues (Dusselier and others 2005).

Chemers and others (2001) examined adjustment to college in a group of 373 students (78 males, 295 females) aged 17-20 years during the first week of winter quarter and in a group of 256 students (46 males, 210 females) during the last week of spring quarter. Students completed self-report questionnaires regarding their perceived academic self-efficacy, social self-efficacy, general optimism, expected academic performance, social adjustment, social support, and stress. There was a significant effect of self-efficacy on challenge-threat evaluations, academic expectations, and academic performance. Students who reported less stress and had high levels of self-efficacy perceived academic work demand to be more of a challenge than a threat, had greater academic expectations, performed higher academically, and had less stress. Highly optimistic students tended to have higher self-efficacy. Students who viewed academics as a challenge rather than a threat had significantly higher academic expectations and experienced significantly less stress. Students who experienced more stress had significantly higher health problems and worse adjustment. Students with better academic performance experienced significantly less stress and were better adjusted. Optimism led to less stress, which in turn led to less health problems and better adjustment. Student who entered into college with confidence in their ability to perform academically did significantly better than less confident students (Chemers and others 2001).

Stress and Eating Behaviors in College Students

Two studies are presented that have examined the effects of stress on eating behaviors (without specifically addressing restrained eating) in college students. Following the discussion of these two studies is a sub-section focusing on stress and restrained eating behaviors.

Oliver and Wardle (1999) gathered information on stress, eating behaviors, and food choices from 212 undergraduate students (63 males, 149 females) from three colleges in England. The purposes of the study were three-fold: (a) evaluate the frequency of self-reported, stress-induced hyperphagia and hypophagia; (b) assess the association of stress eating with gender and dieting status; and (c) test the hypothesis that hyperphagia is more pronounced for highly palatable foods and more likely to be reported for snack-type than meal-type foods. Participants completed a one-time questionnaire. Dieting status was assessed in relation to the question "Are you trying to lose weight at present?" Stress-induced eating was measured by questions covering the perceived influence of stress on (a) overall amount of food eaten; (b) amount of snacking, and (c) amount eaten of each of a list of specific types of foods. Most participants self-reported that stress influenced the overall intake of food: 40.3% of women reported eating "more than usual" and 33.9% of men reported "less than usual." Women were slightly more likely than men to report a hyperphagic response to stress. Dieters (58%) were found significantly more likely to report hyperphagia when stressed than were non-dieters (36%); these effects were not due to gender differences mainly because there were too few male dieters to provide a robust test in men. Women were more likely to report hyperphagia for sweets and chocolate, and hypophagia for meat and fish, fruits, and vegetables. Dieters were significantly more likely to report hyperphagia for bread, and less likely to report hyperphagia for fruits and vegetables than non-dieters. This study showed that stress influences eating patterns, with approximately equal numbers reporting eating more or less in response to stress. Stress altered dietary intake patterns towards more snacks, and food choices towards more high energy-dense, snack-type foods. This pattern emerges regardless of gender or dieting status (Oliver and Wardle 1999).

Pollard (1995) and others examined stress, anxiety, social support, and food consumption in a group of 180 students (80 males, 100 females) attending a university in London, England. Students were divided into two groups, those who were taking end-of-semester exams (exam-stress group) and those students at the same university taking courses that did not have examinations over this time period (control group). The exam-stress group consisted of 115 (64 males, 51 females) students and the control group included 64 (16 males, 48 females) students. Sixty-six participants (63%) were in their first year of study, 48 (27%) in their second year, and 65 (36%) in their third year. There were two measurements taken, one 2 to 3 months prior to exam time (baseline session) and one within 2 weeks of the start of the exam week or at an equivalent time in the control group (exam session). At each session, measurements of perceived stress, emotional well-being, diet, body weight, and motives for food choice were collected. Questionnaires and surveys used include; The Dutch Eating Behavior Questionnaire, The State Trait Anxiety Inventory, The Food Choice Questionnaire, The Mood Scale, The Perceived Stress Scale, The General Health Questionnaire, and The Social Support Questionnaire. Dietary intake information was collected at each of the two sessions by 24-hour recall. Dietary restraint scores and social support availability were significantly higher in women than in men. Women were significantly more psychologically stressed on exam day than men in the exam-stress group. The Perceived Stress Scale and General Health Questionnaire scores increased from baseline to examination but remained constant in the control group. The exam-stress group and control groups did not differ at baseline. Responses to the General Health Questionnaire across occasions showed that those in the exam-stress group had significantly higher (53.9%) scores than the control group (23.8%). Examinations were associated with increased perceived stress and emotional disturbance in comparison with the control condition. The rating of the importance of mood in food choice rose in the exam-stress group between baseline and exam-sessions, but remained constant in controls. Foods that were chosen during exam-session were important to mood regulation during the stressful exam period. Students who took end-of-semester examinations (exam-stress group) and had high trait anxiety and low social support exhibited a significant increase in the amount of energy (kcal) eaten, an average increase of 355 kcal during the exam-session. Between baseline and the exam-session, there was an increased intake in total fat by an average of 19.0 g (Pollard and others 1995).

Stress, Restrained Eating Behavior, and Eating Habits

Like the aforementioned two studies, the next nine studies examined stress and eating habits, but also addressed the effects of restrained versus unrestrained eating and stress on eating habits. Restrained eating has been defined as the "intentional efforts to achieve or maintain a desired weight through reduced caloric intake" (Stice and others 1997). Restrained eaters have been shown to indulge in excessive overeating; control is diminished and the "suppressed behavior is disinhibited," leading to excessive food intake. Restrained eating is not simply dieting but the cognitive attempt to restrict weight gain; it may be associated with depression, neuroticism, and low self-efficacy (Heaven and others 2001). When stressed, restrained eaters may give into the immediate reward of food (Tice and others 2001). The additional situational demand of stress overwhelms the self-regulatory resources and the individual loses the control to maintain dietary restraint (Vohs and Heatherton 2000).

Three studies, by Wardle and others (2000), by Epel and others (2001), and by Oliver and others (2000), evaluated stress, restrained eating, and food intake in non-college students. These studies are presented first and are followed by the results of four studies that were conducted in college students.

Wardle and others (2000) evaluated associations between stress (high versus low), dietary restraint, and daily food intake in 95 volunteers (32 males, 58 females) between 34 and 36 years of age, that were recruited from the staff of a large department store in London. Participants completed a 24-hour recall and were weighed; in addition ratings of subjective stress and emotional well-being were taken. Workload was measured objectively in terms of hours of work in the last 7 days, and subjectively in terms of the extent to which work interfered with home life. Participants' sense of being under stress over the past 4 weeks was assessed with a 10-item version of the Perceived Stress Scale. To measure emotional well-being this study used the 28-item version of the General Health Questionnaire. Restrained eating was assessed using the English version of the Dutch Eating Behavior Questionnaire. Hunger and appetite were measured on a relative scale assessing how often they felt hungry over the past week, and how often they ate certain foods or snacked throughout the day. Participants who worked an average of 15 hours more per week in the high work-stress session reported significantly more interference between work and home and had higher perceived stress scores. Restrained eaters had higher energy, fat, and saturated fat intake in the high- versus the low-work – stress session, but non-restrained eaters did not. In addition, the percentage of energy derived from saturated fat was also greater in the high- than low-work-session in the restrained eaters group. Restrained eaters ate more overall, especially more sweet and fatty foods in the high-work-stress session; the hyperphagic response was greater among those who had a larger increase in perceived stress between the low-and high-workload sessions, implicating emotional reactions in the response. Restrained eaters typically show a characteristically hyperphagic response; the unrestrained show no average change in food intake (Wardle and others 2000).

Epel and others (2001) studied eating habits and habituation to stress in 59 healthy women aged 30-45 years. Women were exposed to four consecutive days of three-hour laboratory sessions. The first three sessions were stressful sessions, and the fourth was a rest or control session. Salivary cortisol samples were collected at the same time intervals throughout each session, during a half hour baseline period (15 and 30 minutes), before stress (45min), during stress (60 min,70 min), at the cessation of stress (90 min), and two recovery samples at 30 and 60 minutes after stress. Participants were exposed to the stressor for 45 minutes, including performing three challenging tasks, designed to be stressful by giving unrealistic time constraints to meet the expected goals: (1) visuospatial puzzles, (2) serial subtraction of a prime number from a high number, and (3) deliverance of a videotaped speech, with a supposed research committee evaluating her behind a one-way mirror. Mood reactivity was measured using the Profile of Mood States, including depression/dejection, anger/hostility, and tension/anxiety. Dietary restraint was measured using the Eating Attitudes Test. After the stressors, and on rest day after reading, participants were given a basket of snacks and left in the room with the snacks for 30 minutes. Participants were not pressured to eat but invited to eat and they were not aware that the study was measuring their food intake. The snacks included two higher fat sweet and salty snacks, chocolate granola bars and potato chips and two low-fat sweet and salty snacks, flavored sweetened rice cakes and salty pretzels. Negative mood was measured by changes in anxiety, anger, and depression. Increases in negative mood during the stress session were related to dietary restraint. Salivary cortisol concentrations were significantly higher during the stress session than the control session. Individual participants, who were high cortisol reactors, producing high amounts of cortisol as a result of the stressor, consumed more calories on the stress day than low reactors. Participants consumed significantly more sweet foods during the stress session. There was also a significant positive correlation between the consumption of sweet, high-fat foods and the stress session (Epel and others 2001).

Oliver and others (2000) studied the effects of stress on appetite in 68 participants (27 males, 41 females) aged 18-46 years. Participants, who were asked to refrain from eating for 4 hours prior to the study, were randomly selected to the stress manipulation group or the control group. Participants in the stress manipulation group were told they would be making a 4-minute speech that would be recorded by video equipment. Unknown to subjects in the stress manipulation group was that they were not actually required to make a speech and there was no mention of a speech of any kind to the control group. The control group was given a non-stressful task to listen to a passage of emotionally neutral text of comparable duration to the stress group. The stress manipulation group received a meal prior to the supposed speech and the control group received their meal after relaxing and listening to the passage. A self-reported measure of mood and the Positive and Negative Affect Schedule were completed upon arrival to the laboratory and 10 minutes after stress induction. The State-Trait Anxiety Inventory, the Restraint, Emotional and External Eating Scale, and the Dutch Eating Behavior Questionnaire also were completed. Food appetite ratings were taken by having participants look at a photograph of each of the 34 foods. For each food participants were asked, “How much do you fancy eating some of this food at the moment?” and indicated their response on a scale from 1 (“I definitely don’t want to eat this food at all at the moment”) to 7 (“Right now I really want to eat this food”). Participants were allowed to eat for 15 minutes from a buffet style lunch consisting of foods from three taste categories, sweet, salty, and bland. Within these categories, foods were additionally divided into low- and-high-fat-groups. The foods were weighed before and after the meal to determine the amount consumed. Post-study, participants were asked to rate the perceived stressfulness of the study on a seven-point Likert scale (1= “not at all stressful” and 7= “extremely stressful). Dietary restraint scores were significantly higher in women, and women scored higher than men on the emotional eating scale. There were no significant differences between stress and control groups in dietary restraint, emotional eating, or external eating. Participants in the stress group rated their experience as significantly more stressful than the control group. Those who were classified as restrained eaters scored significantly higher for emotional eating, and consistently ate more under stress. Energy densities of the meals eaten varied by the stress condition and emotional eating status; in the stress group, the energy density of high emotional eaters’ intake was significantly greater than that of low emotional eaters, whereas among the control the high emotional eater ate less energy–dense meals on average. Snack consumption appeared to be more susceptible to stress than meals (Oliver and others 2000).

The next four studies that are presented focus on stress, restrained eating, and eating habits in college-aged males and females. Weinstein and others (1997) examined overeating during stress in a group of 49 males and 52 females, 18-35 years of age, enrolled in an introductory psychology class and an ongoing eating study. The response to stress was measured by two questions. The first question asked participants to describe a recent specific experience in which he/she felt stressed for at least a day. Participants were then given five choices to indicate changes in their eating related to the stressful event: stopped eating, ate less than usual, ate the same as usual, ate more than usual, and binged. The second question asked them to report, using the same choices, how their eating habits changed in relation to stress, in general. In addition to these questions, the State-Trait Anxiety Inventory was used to measure both state anxiety and trait anxiety. A revised version of the Restraint Scale was used to measure the level of dietary restraint. Other surveys also administered included the Eating Inventory, the Eating Attitudes Test, and the Binge Scale. Females with higher scores on disinhibition and the Restraint Scale, reported eating more than usual during stressful experiences. Women who reported more behaviors associated with binge eating disorders and more severe binge episodes also reported overeating during stressful experiences. Higher scores for women on the trait anxiety inventory and on the hunger scale indicated that they ate more than usual during stressful experiences. For females, disinhibition correlated significantly with cognitive restraint and with scores on the Restraint Scale. Scores on the Restraint Scale also correlated significantly with cognitive restraint; cognitive restraint was the only variable significantly correlated with eating response to stress in males. These results indicated that overeating under stressful situations is a complex behavior associated with several eating behavior characteristics. Overall, both males and females varied their changes in intake during stress, with males tending to report eating less more often than they reported eating more (Weinstein and others 1997).

Kandiah and others (2006) surveyed 272 female college students, aged 17-26 years, from a mid-western university to determine the effects of stress on appetite and eating habits. A 45-itemized stress-eating survey was used and provided information on current distress, eating habits, foods eaten when not under stress, and foods eaten when under stress. Participants were classified as restrained or unrestrained based upon their response to the question, “How much effort do you put forth to control your eating?” Participants classified as restrained eaters (47%, n=128) chose either “great effort” or “considerable effort”, whereas unrestrained eaters (53%, n=143) chose either “some effort” or “little or no effort” as an answer. Stressors that were used to evaluate level of stress were: family, social, individual, environment, work, and college. Students taking 17-18 credit hours had significantly higher levels of environmental stress as compared with students taking fewer credit hours. In response to the question, "do you experience a change in appetite when stressed," 81% (n=221) of participants said yes, and of those, 63% (n=139) had increased appetite, whereas 37% (n=82) had decreased appetite. Subjects with an increased appetite when stressed chose significantly more types of sweet foods and mixed dishes than those with a decreased or no change in appetite. Under normal conditions, 80% (n=218) reported they typically made healthy eating choices. When stressed, however, only 33% (n=91) of them ate healthfully. A significant decrease in the variety of food selected for each of the categories (mixed dishes, salty/crunchy foods, sweet foods, creamy foods, beverages) was observed with stress. There was also a significant difference between restrained and unrestrained eaters' selection for the beverage group (Kandiah and others 2006).

Tanofsky-Kraff and others (2000) examined if the eating behavior of restrainers differed compared with non-restrainers based on the type of stress in a group of 82 female college freshmen and sophomores aged 16-23 years. Participants, who included those who were restrained eaters and non-restrained eaters, were randomly assigned to one of four conditions (control group, n = 21; puzzle failure, n = 18; anticipatory speech, n = 21; interpersonal manipulation, n = 22); all four restrained groups did not significantly differ in the degree of dietary restraint. The four manipulations were designed to give the participants a sense of stress, anxiety, failure, and social alienation. Participants were told that they were the last subject and could eat as much ice cream as they wanted. Tubs of ice cream were weighed before and after consumption by participants. Restrained eaters in the interpersonal manipulation group ate significantly more than the unrestrained eaters; the greater the level of restraint, the more the participants ate. This study demonstrated that individuals with higher levels of dietary restraint ate more under stressful conditions than the control group (Tanofsky-Kraff and others 2000).

Heaven and others (2001) investigated external, emotional, and restrained eating behaviors in a group of 167 undergraduate students (41 males, 126 females) aged 17-57 years. Each participant self-reported their height and weight and completed the Dutch Eating Behavior Questionnaire and the International Personality Item Pool. Participants with higher body mass indices were significantly more likely to engage in emotional and restrained eating than those with lower body mass indices. Women were more likely to report emotional and restrained eating than men. Restrained eating was significantly associated with self-reports of depression. Restrained eating correlated significantly and negatively with external eating, suggesting that restrained eaters are not as likely to be susceptible to particular eating cues such as hunger or satiety (Heaven and others 2001).

Weight Gain Among College Students

The transition from high school to college is considered a critical period and represents a time period for young adults (aged 18-24 years) in which stress and change in weight often occurs. Student behaviors may put them at risk of becoming overweight by altering energy balance. Environmental and lifestyle changes, such as easy or increased access to fast-food, increased alcohol consumption, altered sleep patterns, among others, have been cited as significant contributors to weight gain during college (Heaven and other 2001, Economos and others 2008). Findings from the many studies which have examined changes in weight during the first year of college show that freshman year weight gain affects about 70% of college students and ranges from about 1.7 lbs to 29 lbs, with most studies reporting weight gain ranging from 2.5 lbs to 7.4 lbs (Economos and others 2008, Gropper and other 2009, Hajhosseini and others 2006, Hoffman and others 2006, Kasparek and others 2008, Mihalopoulos and other 2008).

Stress and Weight Change in College Students

While weight gain among college students has been widely studied over the last decade, only one study to date has focused on stress and weight change among college students. Serlachius and others (2007) examined stress and weight gain during the first year of college in 268 (100 males, 168 females) first year undergraduate students, aged 18-25 years. The majority of students lived in a university hall residence (74%) with others lived at home (12.5%) or in private accommodations (13%). Assessments were done by a survey that included questions from the International Health and Behavior Survey. Weight, weight change, and health behaviors were self-reported. Stress was assessed with the Undergraduate Stress Questionnaire. On average, students reported a significant weight increase of 3.36 ± 5.94 lbs; 55% reported gaining weight, 12% lost weight, and 33% neither losing nor gaining weight. A higher proportion of women (61%) than men (44%) reported gaining weight. Stress frequency and severity scores were significantly greater among the weight loss and weight gain groups compared with the weight stable group. There were significant gender by stress interactions found for stress frequency and severity, indicating a stronger association between weight change and stress in women. The weight gain group also reported consuming significantly more snacks between meals. Stress scores were positively correlated with weight change, and stress severity was associated with both a greater risk of weight gain or weight loss (Serlachius and others 2007).

Restrained Eating and Weight Change in College Students

These studies have been identified in the literature addressing restrained eating and weight change in college students. These studies are presented hereafter.

Delinsky and Wilson (2008) assessed relationships among weight gain, disordered eating, and dietary restraint in a group of 336 female freshmen students, age 17.92 ± 0.50 years.

Participants completed questionnaires assessing eating disorders, dietary restraint, body image, and self-esteem. Height and weight measurements along with the completion of the questionnaires were conducted in September and April of the freshman year. Dietary restraint was not significantly correlated with weight or BMI change. However, although dietary restraint did not predict prospective weight gain, it did predict disordered eating, which increased significantly over the course of the freshman year (Delinsky and Wilson 2008).

Lowe and others (2006) examined eating behaviors and weight gain in a group of 72 undergraduate female freshmen aged 18-19 years. Data on restrained eating, overeating, emotional eating, dieting, and weight history were collected through self-report measures including the Revised Restraint Scale, the Dutch Eating Behavior Questionnaire, and the Cognitive Restraint and Disinhibition Scale. None of the measures of restraint or overeating predicted weight change, nor did BMI at baseline predict weight change. When participants were divided into high (n = 34) vs. low (n = 35) weight suppression groups, those who were high in weight suppression showed a higher weight gain trajectory (gaining an average of 6.53 lbs) compared to those who were low in weight suppression (gaining an average of 2.64 lbs) . Weight suppression (which reflects the long-term maintenance of weight loss) was a significant predictor of weight gain; those who were in high weight suppression and reported a history of dieting gained more weight than those of the other group (Lowe and others 2006).

Pliner and Saunders (2008) examined freshman year weight gain in a small group of college students attending an urban Canadian university. Weight gain along with eating behaviors, using the Herman/Polivy Restraint Scale (Herman and Polivy 1975), were assessed in eight males living on-campus, seven males living at home, 39 females living on-campus, and 18 females living at home in October and in March of the freshman year. Those who were classified as restrained eaters, especially those living on-campus, were the most likely to gain weight (Pliner and Saunders 2008).

Justification

Obesity affects more than one-third (35.7%) of adults in the United States and Alabama ranks third in the nation in the prevalence of obesity (CDC 2008, CDC 2012). The condition is associated with multiple adverse health problems including premature heart disease, hypertension, dyslipidemia (adverse cholesterol), type 2 diabetes mellitus, sleep apnea, osteoarthritis, metabolic syndrome, and some cancers, and stroke (CDC 2011, NIH 1998). Increases in the rates of obesity have been shown to disproportionately affect young adults more than other age groups (CDC 2008).

Causes of weight gain among young adults, including college students, are not well-studied, but stress has been linked with both weight loss and weight gain among college freshman as well as changes in food intake (Kandiah and others 2006, Lowe and others 2006, Oliver and Wardle 1999, Oliver and others 2000, Pollard and others 1995, Serlachius and others 2007, Wardle and others 2000, Weinstein and others 1997). Some of the observed changes in food intake in response to stress include: a hyperphagic response (Oliver and Wardle 1999, Weinstein and others 1997), a tendency to over-eat (Oliver and Wardle 1999, Oliver and others 2000, Wardle and others 2000), changes in food preference (Kandiah and others 2006, Pollard and others 1995, Wardle and others 2000), increases in snack consumption (Oliver and others 2000), and appetite change (Kandiah and others 2006).

Overeating in response to stress appears to be more prevalent among females than among males (Pollard and others 1995, Serlachius and others 2007). Moreover, females who are restrained eaters (that is those who display intentional efforts to achieve or maintain a desired weight through reduced caloric intake) tend to overeat more in response to stress than females who are non-restrained eaters (Heaven and others 2001, Lowe and others 2006, Oliver and others 2000, Pollard and others 1995, Tanofsky-Kraff and others 2000, Weinstein and others 1997). Yet, while stress and eating behaviors have been investigated (ACHA 2011, Dusselier and others 2005, Epel and others 2001, Heaven and others 2001, Kandiah and others 2006, Oliver and Wardle 1999, Oliver and others 2000, Pollard and others 1995, Scheier and others 1985, Tanofsky-Kraff and others 2000, Wardle and others 2000, Weinstein and others 1997) and while stress and weight change have been investigated (Serlachius and others 2007) in first year college students, studies have not examined stress, eating regulation, and weight change in college students beyond the freshman year. Moreover, studies that have been conducted examining stress and weight gain have not examined the composition of the weight gain. Normal weight obesity, that is a normal body mass index but high percentage body fat, has also been shown to be associated with increased health risks (Romero-Corral and others 2010, Zeratsky 2012); thus, gains in percent body fat even in the absence of weight gain may pose health problems. The purpose of this study was to investigate relationships among perceived stress, eating regulation, body mass index (BMI), weight, and percent body fat in female and male students during the first two years of college.

Chapter 3

Perceived Stress, Eating Regulation, Body Mass Index, Weight, and Percent Body Fat Relationships over the First Two Years of College

Abstract

Objective: To assess the associations among perceived stress, eating regulation and body mass index, weight, and percent body fat in college students during the first two years of college.

Methods: Participants were recruited at the beginning of their college freshman year (2007 and 2008), and were assessed 2 to 3 times during the freshman and sophomore years. At each assessment, weight and height (using standard techniques), body composition (using bioelectrical impedance analysis), perceived stress (using the Perceived Stress Scale) and eating behavior (using the Regulation of Eating Behavior Scale) were examined. Of the 535 participants recruited at the beginning of the study, 319 participants (110 males, 209 females) were included in statistical analysis.

Results: Individuals with high autonomous, high intrinsic motivation, high integrated, high identified, or low amotivation eating regulation behaviors and high perceived stress exhibited greater BMI, weight, and/or percent body fat than those individuals with these same eating regulation behaviors and low perceived stress. No gender differences were observed.

Conclusions: College students with high perceived stress and high intrinsic motivation, high identified, high integrated, and low amotivation eating regulation behaviors may benefit from programs to help reduce or manage stress during the first two years of college.

Introduction

Obesity affects more than one-third (35.7%) of adults in the United States (CDC 2012). The condition is associated with multiple adverse health problems including premature heart disease, hypertension, adverse lipid concentrations, type 2 diabetes mellitus, sleep apnea, osteoarthritis, metabolic syndrome, and stroke (CDC 2011a, NIH 1998). Obesity is particularly a problem in the state of Alabama, which has the nation's third highest percentage of obese residents at 33.2% (CDC 2010a). Data from the 2010 Behavioral Risk Factor Surveillance System found the nationwide prevalence of overweight and obesity in 18 to 24 year olds was 23.8% and 16.7%, respectively (CDC 2010b). Increases in the rates of obesity have been shown to disproportionately affect young adults, 18-24 years of age, more than other age groups (Mokdad and others 1999). In 2008, the prevalence of obesity among young adults in Alabama was 30% (CDC 2008)[7].

Stress is another common problem among Americans, especially young adults entering college. Stress often accompanies change. Factors found most often to be positively associated with stress in college students include: sleeping habits, vacations/breaks, eating habits, new responsibilities, increased class workload, examinations/academics, too much to do, amount to learn, need to do well, essays or projects, alcohol use, low self-efficacy, and a pessimistic attitude (Abouserie 1994, Chemers and others 2001, Dusselier and others 2005, Ross and others 1999).

How a person copes or deals with stress varies among individuals. However, the effects of stress are often negative. The American College Health Association National College Health

Assessments reports that 27.5% of college student's academic performance has been affected by stress; 36.8% of men and 40.0% of women in college experiences 'more than average' stress (ACHA 2011). Stress is widely thought to lead to overeating (Greeno and Wing 1994, Oliver and Wardle 1999), altered food patterns (Oliver and Wardle 1999, Pollard and others 1995), and cause weight gain (Serlachius and others 2007). Overeating in response to stress appears to be more prevalent among females than among males (Pollard and others 1995, Serlachius and others 2007). Restrained eaters (that is those who display intentional efforts to achieve or maintain a desired weight through reduced energy/caloric intake) (Stice and others 1997) tend to overeat more in response to stress than those who are non-restrained eaters (Oliver and Wardle 1999). This overeating response is often due to the undermining of restrained eaters' self-control (e.g., through experience of stressors). Control is diminished and the "suppressed behavior is disinhibited," leading to excessive food intake (Heaven and others 2001). When stressed, restrained eaters are willing to "give into" the immediate reward of food rather than wait for the more delayed reward of a healthy weight (Tice and others 2001). The additional situational demand of stress overwhelms the individual's self-regulatory resources and the individual loses the self-control to maintain dietary restraint (Vohs and Heatherton 2000). Additionally, the food environment at college may facilitate overeating due to greater food selection variety and choices, decreased parental influence on diet, and the different social circumstances that promote eating (Pliner and Saunders 2008).

Weight gain is common among college students, especially during the freshman year (Anderson and others 2003, Butler and others 2004, Crombie and others 2009, Delinsky and Wilson 2008, Economos and others 2008, Graham and Jones 2002, Gropper and others 2009, Hajhosseini and others 2006, Hodge and others 1993, Hoffman and others 2006, Holm-Deoma and others 2008, Hovell and others 1985, Jung and others 2008, Kasparek and others 2008, Levitsky and others 2004, Lloyd-Richardson and others 2008, Lowe and others 2006, Mihalopoulos and others 2008, Morrow and others 2006, Pliner and Saunders 2008, Racette and others 2005, Racette and others 2008, Serlachius and others 2007) . The popularized "freshman 15", however appears to be more accurately the "freshman three" (Crombie and other 2009, Hajhosseini and others 2006), "four" (Pliner and Saunders 2008, Racette and others 2005), "five" (Holm–Deoma and others 2008), or "six" (Gropper and others 2009, Hoffman and others 2006), or if only those freshmen who gained weight are included, the "freshman seven" (Economos and others 2008, Hodge and others 1993, Kasparek and others 2008, Mihalopoulos and others 2008). While several studies have examined factors associated with weight gain, few studies have examined the impact of stress on weight gain among college students or the impact of various regulatory eating behaviors on weight gain among college students (Delinsky and Wilson 2008, Lowe and others 2006). The purpose of this study was to investigate relationships among perceived stress, eating regulation and body mass index (BMI), weight, and percent body fat in female and male students during the first two years of college.

Methods

Participants and Study Design

Two cohorts of freshmen were recruited from Auburn University's 2007 and 2008 incoming freshman class. Recruitment was conducted via email to newly admitted freshmen who attended summer advising sessions at the university. In addition, oral announcements were made and e-mails were sent to students enrolled in introductory courses typically taken by first year students. Recruited participants were 17-19 years of age, unmarried, had no children, had no reported eating disorder, and were not enrolled at the university during the summer semester prior to fall semester freshman year. An informed consent from participants, and from parents for subjects under 19 years, was obtained prior to participation in the study. This study was approved by the Institutional Review Board for the Use of Human Subjects in Research at Auburn University.

The research design was a prospective, longitudinal study that followed a convenience sample of freshmen attending Auburn University, Auburn, AL over a four year period. Recruited participants were assessed at the beginning (about the first four weeks) of fall semester/end of summer in late August and early September (Time $(T)_1$), and at the end of fall semester in late November and early December (T_2), and at the end of spring semester in late April and early May (T_3) during the first year. The second year participants were measured at the beginning of fall semester (T_4), at the end of fall semester (T_5), and once more at the end of Spring semester (T_6). Additional assessments were conducted twice a year during the junior and senior years; however, only data from the first two years were used for analysis in this study. Overall, subjects were assessed at six time points for this study. This study was part of a larger investigation also assessing body shape and size, along with other psychosocial traits.

Demographic and Anthropometric Assessments

At the initial assessment, participants completed a demographic questionnaire to obtain self-reported information regarding sex, race/ethnicity, birth date, state of permanent residence, and residence location at college. Updated information on residence location at college and number of roommates was obtained at each assessment.

Height, weight, and body composition were measured at each assessment. Throughout all assessments, the same scale, height rod, and bioelectrical impedance equipment were used. Weight and height were measured using a digital scale with an attached height rod. (Healthometer, Plestar, LLC, Model 500KL, Bridgeview, IL). Participant's height was measured to the nearest quarter-inch. Weight was measured to the nearest 0.2 lbs. The accuracy of the scale was verified with external weights. Subjects were asked to wear similar clothing and removed shoes, hats, belts, outer garments, and emptied their pockets before being weighed. Body mass index was calculated as weight divided by height squared (kg/m^2).

Body composition was measured using bioelectrical impedance analysis (BodyStat, BioVant Systems Detroit, MI). Measurements using BodyStat varied by less than 0.5% with repeated measurements on the same subject. Since hydration status affects accuracy, participants were instructed not to eat for 2-4 hours prior to assessment, not to drink caffeine or alcohol and not to engage in strenuous exercise for 12 hours prior to assessment (NIH 1996). Prior to measurements, participants would lay on a mat on the floor for at least five minutes.

Participants' arms and legs were separated laterally from the medial axis before the attachment of the electrodes to the right hand and foot for body composition assessment.

Stress and Eating Behavior Assessments

The 10-item version of the Perceived Stress Scale, developed by Cohen and Cohen, was used to assess perceived stress (Cohen and Cohen 1983). The Perceived Stress Scale measures the degree to which one perceives aspects of one's life as uncontrollable, unpredictable, and overloading and focuses on items broadly identifying perceived self-regulation regarding stress (Roberti and others 2006). Participants self-completed the questionnaire by selecting the appropriate number from a 5 – point Likert scale ranging from 0 (never) to 4 (very often), indicating how often they have felt or thought a certain way within the past month. Scoring range from 0 – 40 with higher composite scores indicative of greater perceived stress. The Perceived Stress Scale has been shown to be a reliable and valid measure of stress; it has a coefficient alpha reliability of 0.85 (Cohen and Cohen 1983, Roberti and others 2006).

The 24-item version of Regulation of Eating Behavior Scale, developed by Pelletier, was used for this study to assess eating regulation (Pellitier and others 2004). Participants self-completed the questionnaire by selecting the appropriate number on a 7-point scale ranging from 1 (does not correspond at all) to 7 (corresponds exactly). Items, which are presented randomly, fall into two main areas: autonomous and controlled eating regulation (Deci and Ryan 1985, Deci and Ryan 2000, Pelletier and others 2004). Autonomous eating regulation is further broken down into three subscales in the questionnaire: intrinsic motivation, integrated regulation, and identified regulation. Controlled eating regulation is also further broken down into three subscales in the questionnaire: introjected regulation, external regulation, and amotivation. The scale has been shown to be both valid and reliable; the internal consistency alphas are 0.93 for autonomous regulation and 0.78 for controlled regulation (Pelletier and others 2004).

Statistical Analysis

A chi - squared analysis was used to assess racial/ethnic differences between the University's freshman class and study participants. A repeated measures analysis of variance (ANOVA) was used to assess differences in perceived stress scores, eating regulation, weight BMI, and percent body fat over time. Pearson correlations were used to examine associations between perceived stress scores and changes in BMI, weight, and percent body fat.

Moderated regression analysis was used to test the effects of interactions of perceived stress, eating regulation, and gender in the prediction of BMI, weight, and percent body fat (Cohen and Cohen 1983). Perceived stress was the predictor and the type (subscale) of eating regulation and gender were the moderators. Body mass index, weight, and percent body fat were the outcome variables.

Hierarchical multiple regression analyses with four steps were used to determine the main effects and interaction effects of the predictor (perceived stress) and the two moderator variables (gender and eating regulation and subscales) on each of the outcome measures (BMI, weight, or percent body fat). Predictors and moderators were centered to the mean by subtracting each variable from the mean. In order to test interaction effects, multiplicative terms were created from the centered independent variables (Cohen and Cohen 1983, Kleinbaum and others 1988).

Variables were introduced into the equation in four successive models (steps) (Aiken and West 1991, Jaccard and others 1990). In the first model (1), main effects i.e., T_6 perceived stress scores, T_6 eating regulation scores, gender, and cohort were added. This was followed by (2), the three two-way interactions (stress X gender, stress X eating regulation, and gender X eating regulation). Finally, (4) a three way interaction of stress, eating regulation, and gender was added in the fourth step. Eight hierarchical multiple regression analyses were carried out for each dependent variable (there were a total of 24 interaction models). Similarly, these analyses were also conducted with T_1 stress scores and T_1 eating regulation scores (results for T_1 measures are presented in the appendix). Specifically, separate lines of regression were generated from the regression equation to represent the stress-strain relationship at relatively high (+1 SD) and relatively low (-1 SD) levels of the moderator variable (Grau and others 2001). Finally, the significant interaction effects are represented graphically using the procedure by Aiken and West (1991).

Results

Participants

Participants included a total of 240 freshmen recruited as part of cohort 1 (beginning fall 2007) and 295 freshmen recruited as cohort 2 (beginning fall 2008) for a total of 535 students (190 males and 345 females). The majority of participants were Caucasian (85.8%), followed by African American (8.0%), Hispanic (3.0%), Asian (2.4%), and other (less than 1%). The racial/ethnic composition of the participants did not significantly differ from the university's incoming freshmen classes of 2007 and 2008. The incoming 2007 freshman class at Auburn

University (which contained subjects from the first cohort) was comprised of 4,191 students (47% male, 53%% female) who were mostly Caucasian (81.7%), followed by African American (11.3%), Hispanic (2.9%), Asian (1.9%), and other/unreported (0.8%) (Auburn University OIRA 2007-2008). The 2008 incoming freshman class at Auburn University (which contained subjects from the second cohort) consisted of 3,984 students (48% male, 52% female) who were mostly Caucasian (88.1%) followed by African American (5.6%), Hispanic (2.4%), Asian (1.9%), and other/unreported (2%) (Auburn University OIRA). Most participants had permanent residency in Alabama (62.8%), followed by Georgia (12.6%), Tennessee (5.2%), Texas (3.3%), Florida (2.6%), and Virginia (2.2%). Table 3.1 provides selected demographic and anthropometric information on the study participants.

Of the 535 recruited participants, 342 participants (64%) returned at the end of the sophomore year (T_6) for reassessment. Of the 342 participants, 225 (66%) were females and 117 (34%) were males, and 164 (48%) were from cohort 1 and 178 (62%) were from cohort 2. Of the participants who returned the majority were Caucasian (85%), followed by African American (8.0%), Asian (3.0%), Hispanic (<1%), and other/undeclared (<1%). Of the 342 participants for which anthropometric data were collected at all time points, 319 participants were used (110 males, 209 females) for statistical analysis. Data from 23 subjects were not used due to missing eating regulation or perceived stress questionnaire data or because the questionnaire scores were classified as outliers.

Both males and females exhibited significant gains in weight, BMI, and percent body fat over the two-year period (Newell 2011). These findings are shown in Table 3.2.

Perceived Stress Scores

Total scores from the Perceived Stress scale were calculated at each time period. Total perceived stress scores at beginning of freshman year (T_1) were significantly lower than those obtained at the other time points (T_2-T_6) (data not shown). Perceived stress scores at T_6 were used for all statistical analyses; however, statistical analyses were conducted at T_1 and significant results are presented in appendix. No statistically significant correlations were found between perceived stress scores (at T_6) and two-year BMI change, weight change, or percent body fat change for the male or the female participants.

Regulation of Eating Behavior

Scores on the Regulation of Eating Behavior questionnaire did not significantly differ at any of the time points (T_1 - T_6); therefore, scores at T_6 were used for statistical analyses.

Two-way interactions

Two way interactions examined perceived stress and autonomous eating regulation and its subscales (intrinsic motivation, integrated regulation, and identified regulation) and controlled eating regulation and its subscales (introjected regulation, external motivation, and amotivation) as predictors of BMI, weight, and percent body fat. Associations in participants with high versus low scores on the eating regulation questionnaire and with high versus low perceived stress scores were evaluated in relation to BMI, weight, and percent body fat. High perceived stress scores were those that were + 1 standard deviation away from the mean and low perceived stress scores were – 1 standard deviation away from the mean. Similarly, high scores on the

Regulation of Eating Behavior questionnaire were defined as +1 standard deviation away from the mean and low scores were defined as – 1 standard deviation away from the mean.

Stress, autonomous eating regulation and BMI, weight, and percent body fat

BMI – There was a significant ($\beta = 0.066$, $p < 0.05$) interaction between perceived stress and autonomous eating regulation for BMI. A significant ($p < 0.01$) positive association was found between perceived stress and BMI. Figure 3.1 shows that individuals with high autonomous eating regulation and with high perceived stress had significantly higher BMIs than individuals with high autonomous eating regulation and low perceived stress. There was no significant association between perceived stress and BMI in those with low autonomous eating regulation. The interactions taken together illustrate 0.03% of the variance and the total model indicated 10.8% of the variance in BMI.

Weight – There was a significant ($\beta = 0.453$, $p < 0.05$) interaction between perceived stress and autonomous eating regulation for weight. A significant ($p < 0.05$) positive association was found between perceived stress and weight. Figure 3.2 shows that those who scored with high autonomous eating regulation and high perceived stress had higher body weight than those with high autonomous eating regulation and low perceived stress. No significant correlation was found between perceived stress and weight in individuals with low autonomous eating regulation. The interactions taken together illustrate 0.02% of the variance and the total model indicated 36.0% of the variance in weight.

Percent Body Fat – There was a significant ($\beta = 0.115$, $p < 0.05$) interaction between perceived stress and autonomous eating regulation for percent body fat. A significant ($p < 0.001$) positive association was found between perceived stress and percent body fat. Figure 3.3 shows that individuals with high autonomous eating regulation and high perceived stress scores had higher percent body. There was no relationship between perceived stress and percent body fat in individuals with low autonomous eating regulation. The interactions taken together illustrate 0.02% of the variance and the total model indicated 52.7% of the variance in percent body fat.

Stress, intrinsic motivation, and BMI, weight, and percent body fat

BMI – There was a significant ($\beta = 0.047$, $p < 0.05$) interaction between perceived stress and intrinsic motivation for BMI. A significant ($p < 0.001$) positive association was found between perceived stress and BMI. Figure 3.4 shows individuals with high intrinsic motivation and high perceived stress had higher BMIs than those with high intrinsic motivation and low perceived stress. There was no significant association between perceived stress and BMI in those with low intrinsic motivation. The interactions taken together illustrate 0.02% of the variance and the total model indicated 10.2% of the variance in BMI.

Weight – There was a trend towards a significant interaction ($p = 0.054$) between perceived stress and intrinsic motivation in predicting weight. There was also a trend towards a significant association ($p = 0.08$) between perceived stress and weight.

Percent Body Fat – There was a significant ($\beta = 0.087$, $p < 0.05$) interaction between perceived stress and intrinsic motivation for percent body fat. A significant ($p < 0.01$) positive association was found between perceived stress and percent body fat. Figure 3.5 shows individuals with high intrinsic motivation and low perceived stress had lower percent body fat than individuals with high intrinsic motivation and high perceived stress. There were no significant relationship between perceived stress and percent body fat in those with low intrinsic motivation. The interactions taken together illustrate 0.02% of the variance and the total model indicated 53.0% of the variance in percent body fat.

Stress, integrated eating regulation and BMI, weight, and percent body fat

BMI – There was a significant ($\beta = 0.044$, $p < 0.05$) interaction between perceived stress and integrated eating regulation in predicting BMI. A significant ($p < 0.01$) positive correlation was found between perceived stress and BMI. Figure 3.6 shows that individuals with high integrated eating regulation and high perceived stress had significantly higher BMI than those with high integrated eating regulation and low perceived stress. There was no significant association between perceived stress and BMI in those with low integrated eating regulation. The interactions taken together illustrate 0.02% of the variance and the total model indicated 10.0% of the variance in BMI.

Weight – A significant ($\beta = 0.319$, $p < 0.05$) interaction was found between perceived stress and integrated eating regulation in predicting weight. A trend toward significant association was found between perceived stress and integrated eating regulation in predicting weight ($p = 0.093$).

Percent Body Fat – There was a significant ($\beta = 0.067$, $p < 0.05$) interaction between stress and integrated eating regulation for percent body fat. A significant ($p < 0.01$) positive association was found between perceived stress and percent body fat. Figure 3.7 shows individuals with high integrated eating regulation and high perceived stress had greater percent body fat than those individuals with high integrated eating regulation and low perceived stress. There was no significant association between perceived stress and percent body fat in those with low integrated eating regulation. The interactions taken together illustrate 0.01% of the variance and the total model indicated 52.3% of the variance in percent body fat.

Stress, identified eating regulation and BMI, weight, and percent body fat

BMI - There was a significant (β=0.064, $p < 0.05$) interaction between perceived stress and identified eating regulation for BMI. A significant ($p < 0.001$) positive association was found between perceived stress and BMI. Figure 3.8 shows that those individuals with high identified eating regulation and high perceived stress had higher BMIs than those with high identified eating regulation and low perceived stress. There was no significant association between perceived stress and BMI in those with low identified eating regulation. The interactions taken together illustrate 0.03% of the variance and the total model indicated 13.0% of the variance in BMI.

Weight - There was a significant (β= 0.454, $p < 0.05$) interaction between perceived stress and identified eating regulation for weight. A significant ($p < 0.05$) positive association was found between perceived stress and weight. Figure 3.9 shows that individuals with high identified eating regulation and high perceived stress had a higher weight than those with high identified eating regulation and low perceived stress. There was no significant relationship between perceived stress and body weight change in those with low identified eating regulation. The interactions taken together illustrate 0.02% of the variance and the total model indicated 38.3% of the variance in weight.

Percent Body Fat - There was a significant (β = 0.115, $p < 0.05$) interaction between perceived stress and identified eating regulation for percent body fat. A significant ($p < 0.001$) positive association was found between perceived stress and identified eating regulation. Figure 3.10 shows individuals with high identified eating regulation and high perceived stress had higher percent body fat than those with high identified eating regulation and low perceived stress. There was no relationship between perceived stress and percent body fat in those with low identified eating regulation. The interactions taken together illustrate 0.02% of the variance and the total model indicated 53.0% of the variance in percent body fat.

Stress, controlled regulation, and BMI, weight, and percent body fat

No significant interactions were found between perceived stress and controlled regulation for BMI, weight, or percent body fat.

Stress, introjected eating regulation and BMI, weight, and body fat

No significant interaction was identified between perceived stress and introjected regulation in the prediction of BMI, weight, or percent body fat.

Stress, external eating regulation and BMI, weight, and percent body fat

No significant interaction was identified between perceived stress and external eating regulation in the prediction of BMI, weight, or percent body fat.

Stress, amotivation and BMI, weight, and percent body fat

BMI – There was a significant (β = -0.055, $p < 0.05$) interaction between perceived stress and amotivation for BMI. A significant ($p < 0.05$) positive association was found between perceived stress and BMI. Figure 3.11 shows that individuals with low amotivation and high perceived stress had higher BMIs than individuals with low amotivation and low perceived stress. There was no significant relationship between perceived stress and BMI in those with high amotivation. The interactions taken together illustrate 0.02% of the variance and the total model indicated 10.1% of the variance in BMI.

Weight – There was a significant ($\beta = -0.411$, $p < 0.05$) interaction between perceived stress and amotivation predicting weight. A trend toward a significant ($p = 0.092$) association was discovered between perceived stress and amotivation in the prediction of weight.

Percent Body fat – There was a significant ($\beta = -0.121$, $p < 0.05$) interaction between perceived stress and amotivation for percent body fat. A significant ($p < 0.01$) positive association was found between perceived stress and percent body fat. Figure 3.12 shows individuals with low amotivation and high perceived stress had higher percent body fat than those with low amotivation and low perceived stress. There was no significant relationship between perceived stress and percent body fat in those with high amotivation. The interactions taken together illustrate 0.02% of the variance and the total model indicated 53.0% of the variance in percent body fat.

Three-way interactions

No significant three-way interactions were found.

Discussion

This study is the first to examine interactions among stress, eating regulation, and weight, BMI, and percent body fat in males and females during the first two years of college. Because stress is common among college students and can lead to multiple adverse health effects, it is important to identify at-risk students and to provide for such students both health promotion and intervention strategies.

Stress has been shown to lead to overeating (Greeno and Wing 1994, Oliver and Wardle 1999, Weinstein and others 1997), altered food intake patterns (Oliver and Wardle 1999, Pollard and others 1995), and weight gain (Serlachius 2007). Stress-induced eating is often observed among restrained eaters (Deci and Ryan 1985). The college environment is associated with or provides for great variety and choice in food selection, a decrease in parental influence on diet, and different social circumstances involving eating, all of which contribute to weight gain in college students (Economos and others 2008, Kasparek and other 2008, Pliner and Saunders 2008). Moreover, most college on-campus dining services offer a great variety of sweet, salty, and creamy snack-like foods; it is consumption of these snack-like foods that has been shown to be preferred, especially during stressful periods (Oliver and Wardle 1999, Oliver and others, 2000, Economos and others 2008, Kasparek 2008, Mihalopoulos 2008). While many studies have focused on dietary habits of colleges students, few investigations have examined the influence of stress on body weight and composition. The results of this study showed that individuals who scored high for autonomous eating regulation and its subscales (intrinsic motivation, identified eating, regulation, and integrated eating regulation) and had high perceived stress had higher BMI, weight, and percent body fat than those with high autonomous eating regulation and its subscales and low perceived stress. In addition, those individuals with low amotivation and high perceived stress had higher BMI and percent body fat than those with low amotivation and low perceived stress. The findings of this present study are consistent with Deci and Ryan's Self-Determination Theory (Deci and Ryan 1985, Deci and Ryan 2000, Pelletier 2004) but further suggest that stress "disrupts" eating regulation, especially autonomous eating regulation which is primarily associated with healthy eating behaviors.

Individuals with high intrinsic motivation find satisfaction from eating healthy, believing it will provide them with better health (Deci and Ryan 1985, Deci and Ryan 2000, Pelletier and others 2004). Individuals with high levels of integrated eating regulation believe that eating healthy is an integral part of their lives and is part of their identity (Deci and Ryan 1985, Deci and Ryan 2000, Pelletier and others 2004). This type of eating behavior results when a behavior becomes a priority and has such a high value that that it becomes part of a person's self-definition. Individuals with high identified eating regulation believe that regulating their eating behaviors will allow them to feel better about themselves in general and may help to ensure long-term health benefits (Deci and Ryan 2000, Deci and Ryan 1985, Pelletier and others 2004). Individuals with amotivation fail to perceive contingencies between their actions and the outcomes of their actions; amotivated individuals do not foresee the consequences of their behavior (Deci and Ryan 1985, Deci and Ryan 2000, Pelletier and others 2004). From this theory of Deci and Ryan (Deci and Ryan 1985, Deci and Ryan 2000, Pelletier and others 2004), it would thus be expected that those individuals with high intrinsic, identified, and integrated eating regulation behaviors and with low amotivation would exhibit lower BMI, weight, and percent body fat. Such findings have been demonstrated in this study if perceived stress scores were low as well as in another study using this same sample of college students. Lord (2012) found that high (versus low) autonomous eating regulation, especially intrinsic and identified eating regulation, as well as high (versus low) amotivation was associated with lower BMI, weight, and percent body fat among the female study participants. The findings from this study in which higher BMI, weight, and/or percent body fat were associated with high intrinsic motivation and identified and integrated eating regulation and low amotivation but only when perceived stress was high suggests that perceived stress "overwhelms" these eating regulation behaviors. And, while dietary intake and physical activity were not evaluated as part of this study, it is speculated that energy intake was increased and/or physical activity was diminished in the study participants and contributed to the higher observed BMI, weight, and percent body fat in those with high perceived stress versus those with low perceived stress.

Stress-induced "disruption or disinhibition" of eating behaviors has been shown in studies which have directly investigated stress and eating habits in individuals (Heaven and others 2001, Weinstein and others 1997, Kandiah and others 2006, Tanofsky-Kraff 2000). Other studies also have found that individuals with restrained eating behaviors appear to perhaps be more susceptible to stress-induced eating (Heaven and others 2001, Pliner and Saunders 2008). Wardle and others (2000), for example, showed that restrained eaters were particularly vulnerable to stress, exhibiting a hyperphagic response and greater intakes of foods high in sugar and fat. Pliner and Saunders (2008) found that college students, especially those living in on-campus housing, who exhibited restrained eating behaviors gained more weight the freshman year that those students without restrained eating habits. This finding by Pliner and Saunders (2008) included both males and females and is consistent with the results of this study which showed no significant differences between male and female with high autonomous eating regulation behaviors and stress in prediction of BMI, weight, or percent body fat.

Strengths and Limitations

This study's finding that stress is associated with higher BMI, weight, and percent body fat among college students with high intrinsic motivation, high identified eating regulation, high integrated eating regulation, and low amotivation further extends the scientific literature to perhaps identify college students who may be more susceptible to some of the unhealthy effects of stress. The study included a relatively large sample of college students, both males and females, and was conducted over a two year period. There are, however, limitations. Participants of this study attended a public university, thus the results may not be appropriate for individuals attending private universities or individuals who do not attend a university. This study also did not provide a control group of young adults not seeking higher education. Self-selection bias is another limitation to this study if those individuals not returning after the initial visit did so because they were not comfortable or secure enough to be measured again. Additionally, weight goals were not controlled for. Another limitation is that this study relied on subjects to self-report answers to questionnaires; consequently, the participant's honesty to accurately self-report their answers is a limitation.

Conclusions

College students with high perceived stress and high intrinsic motivation, high identified, high integrated, or low amotivation eating regulation behaviors may benefit from participation in a program to help reduce or manage stress to prevent excessive weight and/or percent body fat gains. Further studies are needed to determine peak periods of "stress" during the academic year and to identify successful approaches to stress management for this population group. Health promotion programs also may wish to consider screening incoming college freshmen to identify those at-risk for gains in weight and/or percent body fat.

References

Abouserie R. Sources and levels of stress in relation to locus of control and self esteem in university students. *Educational Psychology.* 1994;14(3):323-330.

Aiken LS, West SG. *Multiple regression: testing and interpreting interactions*. Newbury Park: Sage; 1991.

[ACHA] American College Health Association: Reference group executive summary. 2011; http://www.achancha.org/docs/ACHA-NCHA-II_ReferenceGroup_ExecutiveSummary_Spring2011.pdf. Accessed April 22, 2012.

Anderson DA, Shapiro JR, Lundgren JD. The freshman year of college as a critical period for weight gain: An initial evaluation. *Eating Behaviors.* 2003;4(4):363-367.

[Auburn University OIRA] 2007-2008. Auburn University Office of Institutional Research and Assessment. Available at (https://oira.auburn.edu/). Accessed 4/15/10.

Butler SM, Black DR, Blue CL, Gretebeck RJ. Change in diet, physical activity, and body weight in female college freshman. *American Journal of Health Behavior.* 2004;28(1):24-32.

[CDC] Centers for Disease Control and Prevention. Press release. 2008; http://www.cdc.gov/media/pressrel/2008/r080717.htm. Accessed March 20, 2012.

[CDC] for Disease Control and Prevention: Prevalence trends data, Alabama overweight and obesity (BMI). 2010a; http://apps.nccd.cdc.gov/BRFSS/display.asp?yr=2010&state=AL&qkey=4409&grp=0&SUBMIT3=Go. Accessed March 23, 2012.

[CDC] Centers for Disease Control and Prevention: Behavioral risk factor surveillance system. 2010b; http://apps.nccd.cdc.gov/BRFSS/age.asp?cat=OB&yr=2006&qkey=4409&state=UB. Accessed April 11, 2012.

[CDC] Centers for Disease Control and Prevention: About BMI for adults. 2011a; http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html. Accessed April 18, 2012.

[CDC] Centers for Disease Control and Prevention: Adult obesity. 2012; http://www.cdc.gov/obesity/data/adult.html. Accessed March 20, 2011.

Chemers MM, Hu L, Garcia BF. Academic self-efficacy and first-year college students performance and adjustment. *Journal of Educational Psychology.* 2001;93(1):55-64.

Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *Journal of Health and Social Behavior.* 1983;24(4):385-396.

Crombie AP, Ilich JZ, Dutton GR, Panton LB, Abood DA. The freshman weight gain phenomenon revisited. *Nutrition Reviews.* 2009;67(2):83-94.

Deci EL, Ryan RM. *Intrinsic motivation and self-determination in human behavior.* New York: Plenum Press; 1985.

Deci EL, Ryan RM. The "What" and "Why" of Goal Pursuits: Human Needs and the Self-Determination of Behavior. *Psychological Inquiry.* 2000;11(4):227–268.

Delinsky SS, Wilson GT. Weight gain, dietary restraint, and disordered eating in the freshman year of college. *Eating Behavior.* 2008;9(1):82-90.

Dusselier L, Dunn B, Wang Y, Shelley MC, Whalen DF. Personal, health, academic, and environmental predictors of stress for residence hall students. *Journal of American College Health.* 2005;54(1):15-24.

Economos CD, Hildebrandt ML, Hyatt RR. College freshman stress and weight change: Differences by gender. *American Journal of Health Behavior.* 2008;32(1):16-25.

Graham MA, Jones AL. Freshman 15: valid theory or harmful myth? *Journal of American College Health* 2002;50(4):171-173.

Greeno CG, Wing RR. Stress-induced eating. *Psychology Bulliten.* 1994;115(3):444-464.

Gropper SS, Simmons KP, Gaines A, Drawdy K, Saunders D, Ulrich P, Connell LJ. The freshman 15-a closer look. *Journal of American College Health* 2009;58(3):223-231.

Grau R, Salonava M, Peiro JM. Moderator effects of self-efficacy on occupational stress. *Psychology in Spain.* 2001;5(1):63-74.

Hajhosseini L, Holmes T, Mohamadi P, Goudarzi V, McProud L, Hollenbeck CB. Changes in body weight, body composition and resting metabolic rate (RMR) in first-year university freshmen students. *Jounal of the American College of Nutrition.* 2006;25(2):123-127.

Heaven PCL, Mulligan K, Merrilees R, Woods T, Fairooz Y. Neuroticism and conscientiousness as predictors of emotional, external, and restrained eating behaviors. *International Journal of Eating Disorders.* 2001;30(2):161-166.

Herman CP, Polivy J. Anxiety, restraint, and eating behavior. *Journal of Abnormal Psychology*. 1975;84(6):666-672.

Hodge CN, Jackson L, Sullivan L. The "freshmen 15" facts and fantasies about weight gain in college women. *Psychology of Women Quarterly*. 1993;17:119-126.

Hoffman DJ, Policastro P, Quick V, Lee SK. Changes in body weight and fat mass of men and women in the first year of college: a study of the "freshman 15". *Journal of American College Health.* 2006;55(1):41-45.

Holm-Deoma J, Joiner T, Vohs K. The "freshmen fifteen" (the "freshmen five" actually): predictors and possible explanations. *Health Psychology* 2008;27:S3-S9.

Hovell M, Mewborn C, Randle Y, Fowler-Johnson S. Risk of excess weight gain in university women: a three-year community controlled analysis. *Addictive Behaviors.* 1985;10:15-28.

Jaccard J, Turrisi R, Wan CK. *Interaction effects in multiple regression*. Newbury Park: Sage; 1990.

Jung ME, Bray SR, Martin Ginis KA. Behavior change and the freshman 15: tracking physical activity and dietary patterns in 1st-year university women. *Journal of American College Health.* 2008;56(5):523-530.

Kandiah J, Yake M, Jones J, Meyer M. Stress influences appetite and comfort food preferences in college women. *Nutrition Research.* 2006;26:118-123.

Kasparek DG, Corwin SJ, Valois RF, Sargent RG, Morris RL. Selected health behaviors that influence college freshman weight change. *Journal of American College Health* 2008;56(4):437-444.

Kleinbaum DG, Kupper LL, Muller, KE. *Applied regression analysis and other multivariable methods.* Boston: PWS-Kent;1988.

Levitsky DA, Halbmaier CA, Mrdjenovic G. The freshman weight gain: a model for the study of the epidemic of obesity. *International Journal of Obesity and Related Metabolic Disorders* 2004;28(11):1435-1442.

Lowe MR, Annunziato RA, Markowitz JT, et al. Multiple types of dieting prospectively predict weight gain during the freshman year of college. *Appetite.* 2006;47(1):83-90.

Lloyd-Richardson EE, Lucero ML, Dibello JR, Jacobson AE, Wing RR. The relationship between alcohol use, eating habits and weight change in college freshmen. *Eating Behaviors.* 2008;9(4):504-508.

Lord DC. Eating regulation and residency over the first two years of college: Associations with BMI, weight, and percent body fat. Auburn: Nutrition, Dietetics, and Hospitality Management, Auburn; 2012.

Lukaski HC, Johnson PE, Bolonchuk WW, Lykken GI. Assessment of fat-free mass using bioelectrical impedance measurements of the human body. *American Journal of Clinical Nutrition.* 1985;41(4):810-817.

Mihalopoulos NL, Auinger P, Klein JD. The freshman 15: is it real? *Journal of American College Health.* 2008;56(5):531-533.

Mokdad AH, Serdula MK, Dietz WH, Bowman BA, Marks JS, Koplan JP. The spread of the obesity epidemic in the United States, 1991-1998. *The Journal of the American Medical Association.* 1999;282(16):1519-1522.

Morrow ML, Heesch KC, Dinger MK, Hull HR, Kneehans AW, Fields DA. Freshman 15: fact or fiction? *Obesity.* 2006;14(8):1438-1443.

[NIH] National Institutes of Health: Bioelectrical impedance analysis in body composition measurements. National institute of health technology assessment conference. *American Journal of Clinical Nutrition.* 1996;64:524S-532S.

[NIH] National Institutes of Health. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. The evidence report. *Obesity Research.* 1998;6:51S-209S.

Newell FH. *Physical activity and body composition changes during the first two years of college*. Auburn: Nutrition, Dietetics, and Hospitality Management, Auburn University; 2011.

Oliver G, Wardle J. Perceived effects of stress on food choice. *Physiology & Behavior.* 1999;66(3):511-515.

Oliver G, Wardle J, Gibson EL. Stress and food choice: a laboratory study. *Psychosomatic Medicine.* 2000;62(6):853-865.

Pelletier LG, Dion SC, Slovinec-D'Angelo M, Reid R. Why do you regulate what you eat? Relationships between forms of regulation, eating behaviors, sustained dietary behavior change, and psychological adjustment. *Motivation and Emotion.* 2004;28(3):245-277.

Pliner P, Saunders T. Vulnerability to freshman weight gain as a function of dietary restraint and residence. *Physiology & Behavior.* 2008;93(1-2):76-82.

Pollard TM, Steptoe A, Canaan L, Davies GJ, Wardle J. Effects of academic examination stress on eating behavior and blood lipid levels. *International Journal of Behavioral Medicine.* 1995;2(4):299-320.

Racette SB, Deusinger SS, Strube MJ, Highstein GR, Deusinger RH. Changes in weight and health behaviors from freshman through senior year of college. *Journal of Nutrition Education and Behavior.* 2008;40(1):39-42.

Racette SB, Deusinger SS, Strube MJ, Highstein GR, Deusinger RH. Weight changes, exercise, and dietary patterns during freshman and sophomore years of college. *Journal of American College Health* 2005;53(6):245-251.

Roberti JW, Harrington LN, Storch EA. Further psychometric support for the 10-item version of the perceived stress scale. *Journal of College Counseling.* 2006;9:135-147.

Ross SE, Niebling BC, Heckert TM. Sources of stress among college students. *College Student Journal*. 1999;33(2):312-318.

Serlachius A, Hamer M, Wardle J. Stress and weight change in university students in the United Kingdom. *Physiology & Behavior.* 2007;92(4):548-553.

Stice E, Ozer S, Kees M. Relation of dietary restraint to bulimic symptomatology: the effects of the criterion confounding of the restraint scale. *Behavior Research and Therapy*. 1997;35(2):145-152.

Tanofsky-Kraff M, Wilfley DE, Spurrell E. Impact of interpersonal and ego-related stress on restrained eaters. *International Journal of Eating Disorders.* 2000;27(4):411-418.

Tice DM, Bratslavsky E, Baumeister RF. Emotional distress regulation takes precedence over impulse control: if you feel bad, do it! *Journal of Personality and Social Psychology.* 2001;80(1):53-67.

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Weinstein SE, Shide DJ, Rolls BJ. Changes in food intake in response to stress in men and women: psychological factors. *Appetite.* 1997;28(1):7-18.

Table 3.1 Selected demographic and baseline anthropometric characteristics of cohorts 1 and 2[a]

	Cohort 1 (n = 240)[1]	Cohort 2 (n = 295)[2]	Both Cohorts
Gender			
Female	155 (65%)	190 (64%)	345 (65%)
Male	85 (35%)	105 (36%)	190 (35%)
Age (years)	18.12 (0.40)	18.10 (0.38)	18.1 (0.4)
Height (inches)	66.64 (3.49)	66.25 (3.60)	66.42 (3.55)
Weight (lbs)			
Female	133.5 (28.9)	129.5 (18.5)	30.9 (24.0)
Male	163.5 (28.4)	160.3 (22.4)	163.0 (25.7)
Body Mass Index (kg/m^2)			
Female	22.4 (4.4)	22.1 (2.7)	22.1 (3.6)
Male	23.5 (3.9)	23.1 (2.7)	23.4 (3.4)
Body Fat (%)			
Females	22.6 ±6.1	24.1± 4.4	23.4 ± 5.3
Males	11.0 ± 4.9	11.9 ± 4.1	11.5 ± 4.5
Race			
Caucasian	196 (81.7%)	262 (88.8%)	458 (85.6%)
African American	29 (12.1%)	11 (3.7%)	40 (7.5%)
Hispanic	7 (2.9 %)	11 (3.7%)	18 (3.4%)
Asian	4 (1.7%)	10 (3.4%)	14 (2.6%)
Other	4 (1.7%)	1 (<1%)	5 (< 1%)

[a]Data are presented as mean (SD) except for gender which is expressed as n (percent)

Table 3.2 Changes (mean ± SD) in body mass index (BMI), weight, and percent body fat between the beginning of the freshman year and the end of the sophomore year in college [a](Newell 2011)

	---------- Change ----------		
	BMI (kg/m^2)	Weight (lbs)	Body Fat (%)
All participants (n=342)	0.4 ± 2.4	3.9 ± 9.4	1.6 ± 3.3
Females (n=225)	0.2 ± 2.8	3.0 ± 8.7	1.3 ± 2.9
Males (n=117)	0.7 ± 1.5	5.4 ± 10.5	2.2 ± 3.9

[a]Statistically significant ($p < 0.05$)

Figure 3.1: Stress X autonomous eating regulation predicts BMI

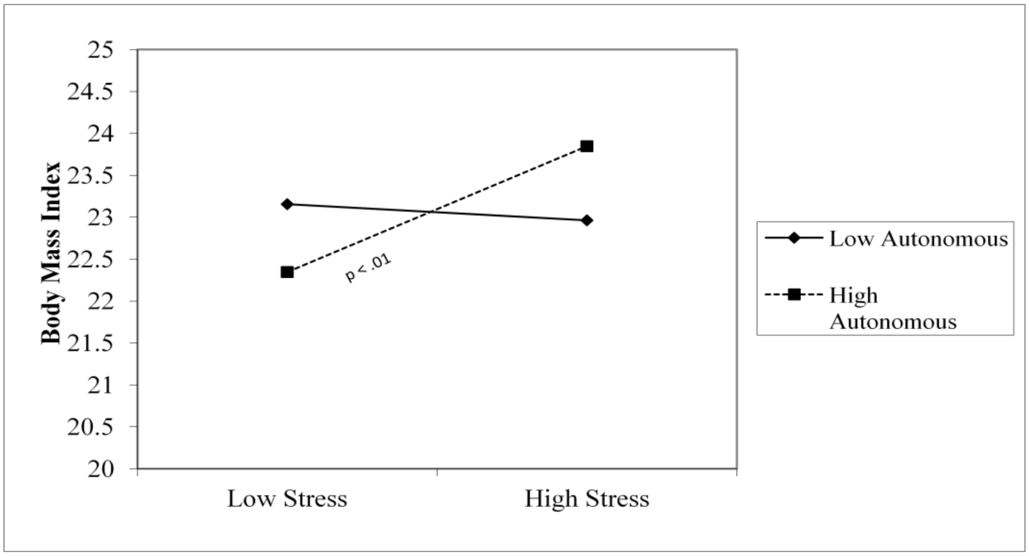


Figure 3.2: Stress X autonomous eating regulation predicts weight

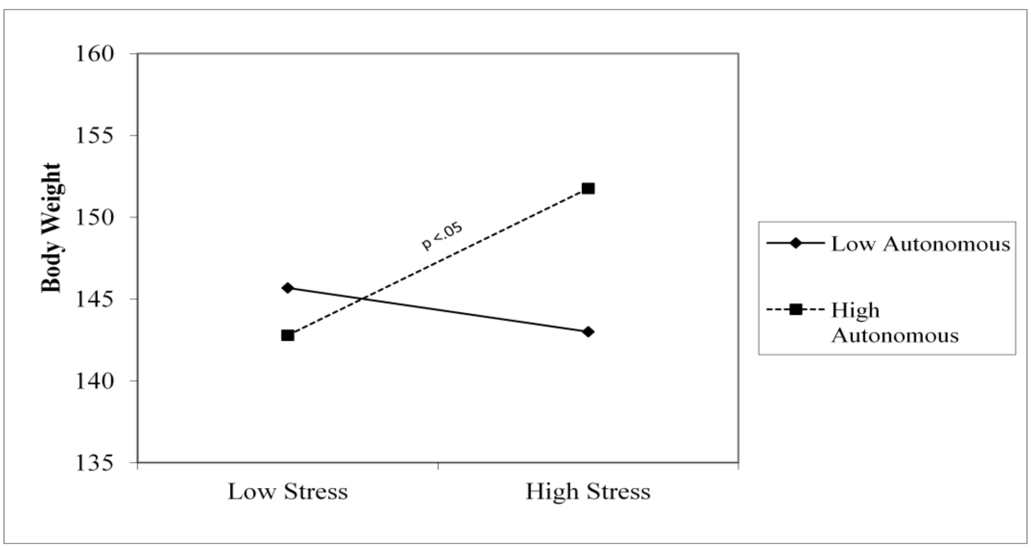


Figure 3.3: Stress X autonomous eating regulation predicts percent body fat

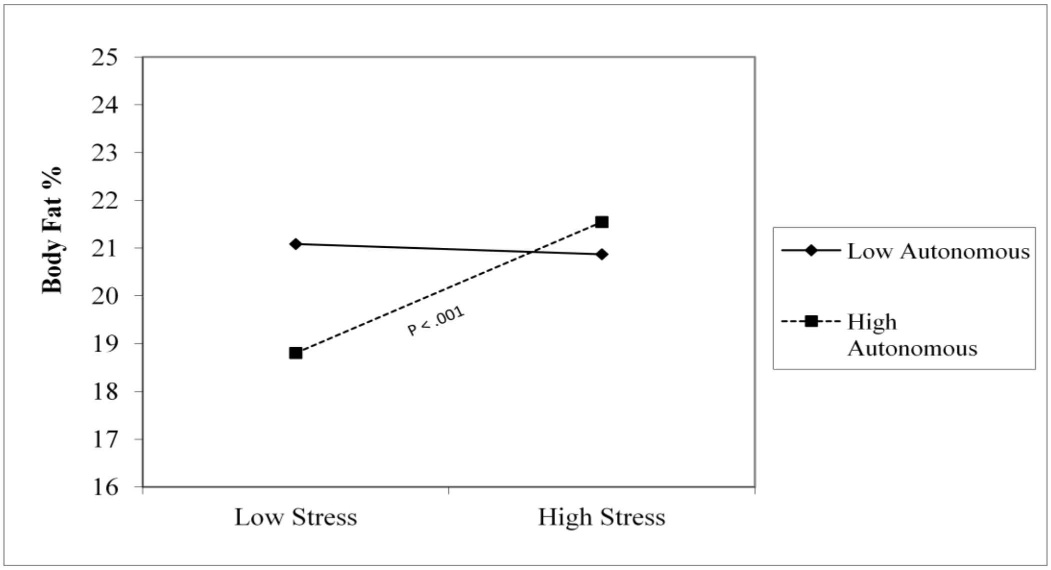


Figure 3.4: Stress X intrinsic motivation predicts BMI

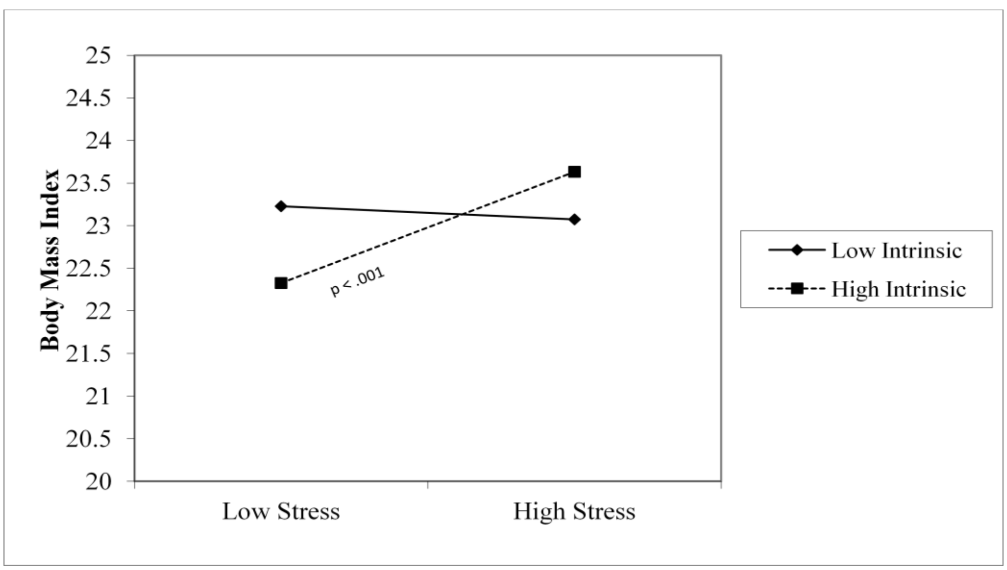


Figure 3.5: Stress X intrinsic motivation predicts percent body fat

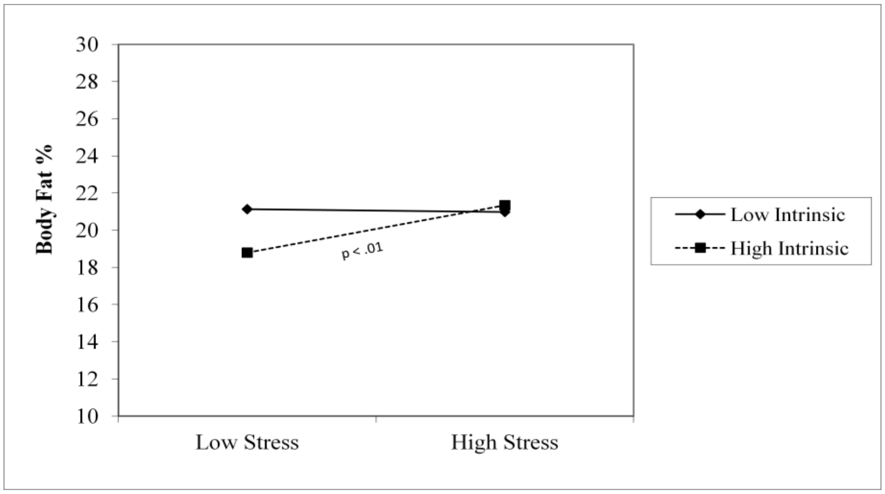


Figure 3.6: Stress X integrated eating regulation predicts BMI

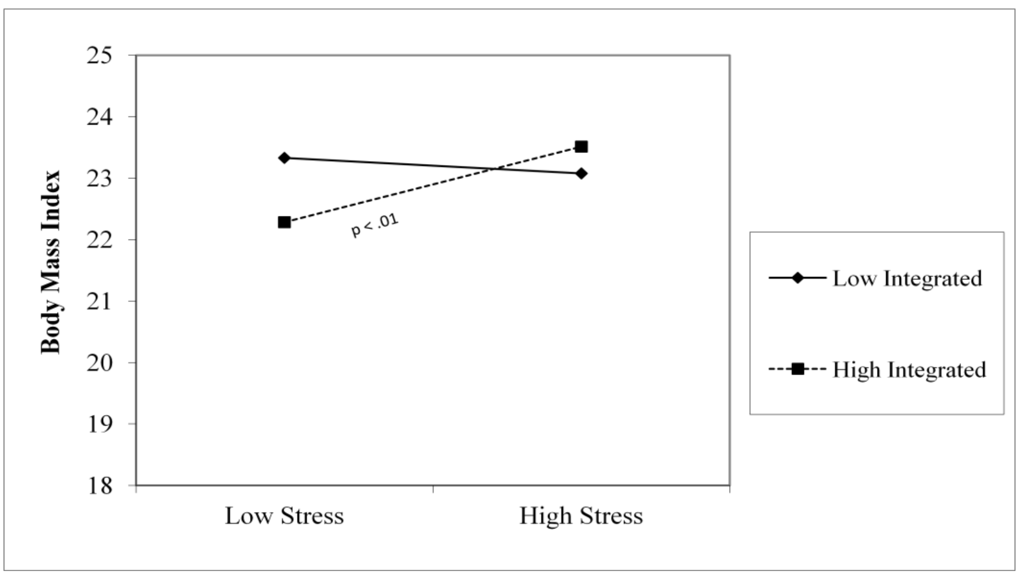


Figure 3.7: Stress X integrated eating regulation predicts percent body fat

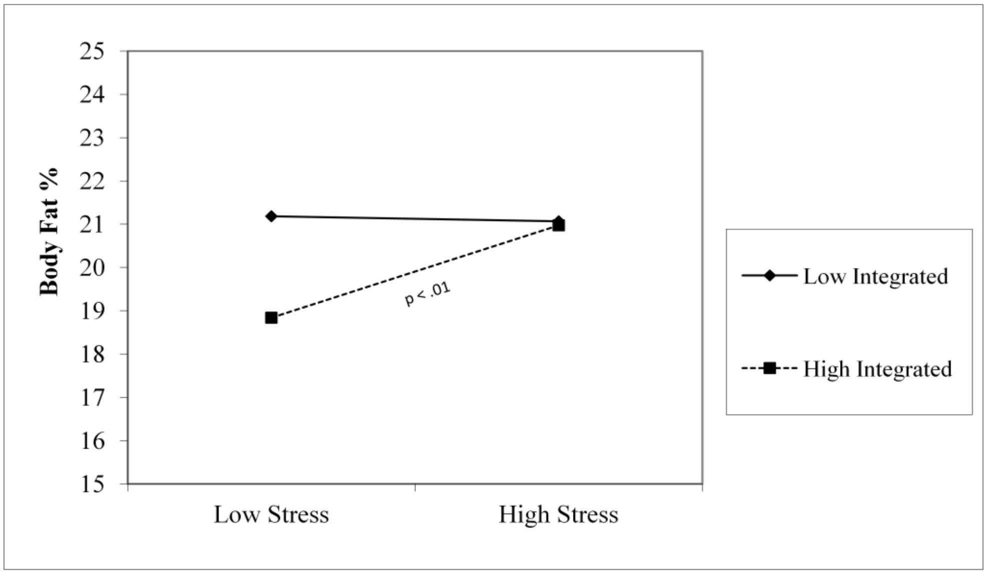


Figure 3.8: Stress X identified eating regulation predicts BMI

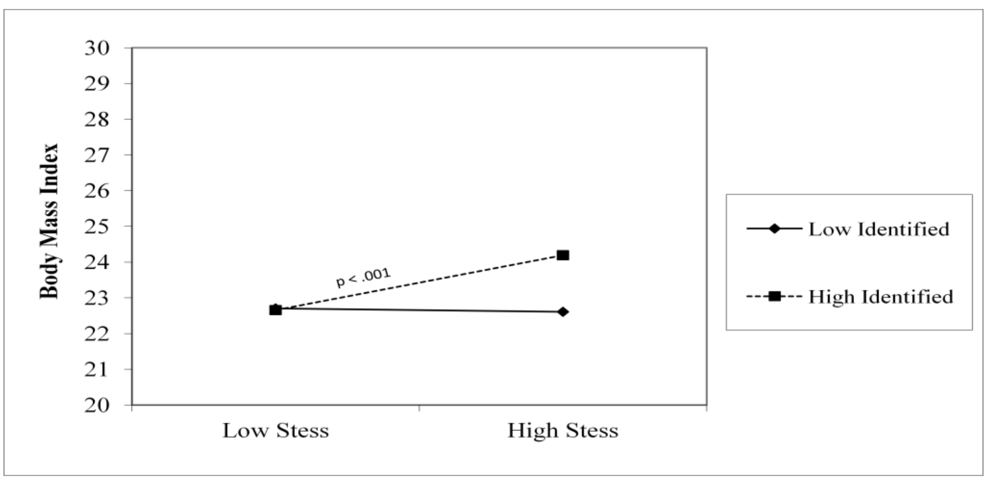


Figure 3.9: Stress X identified eating regulation predicts weight

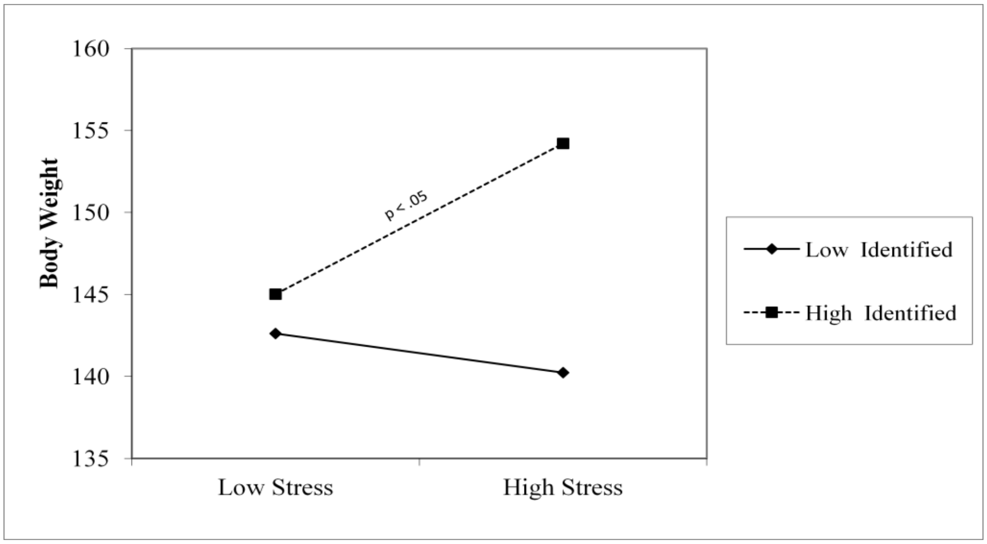


Figure 3.10: Stress X identified eating regulation predicts percent body fat

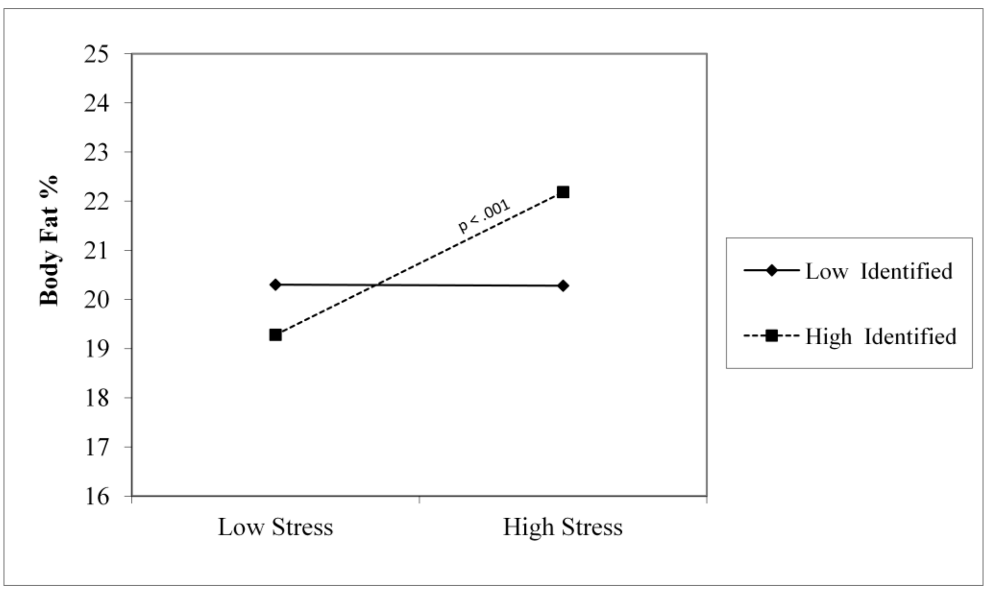


Figure 3.11: Stress X amotivation predicts BMI

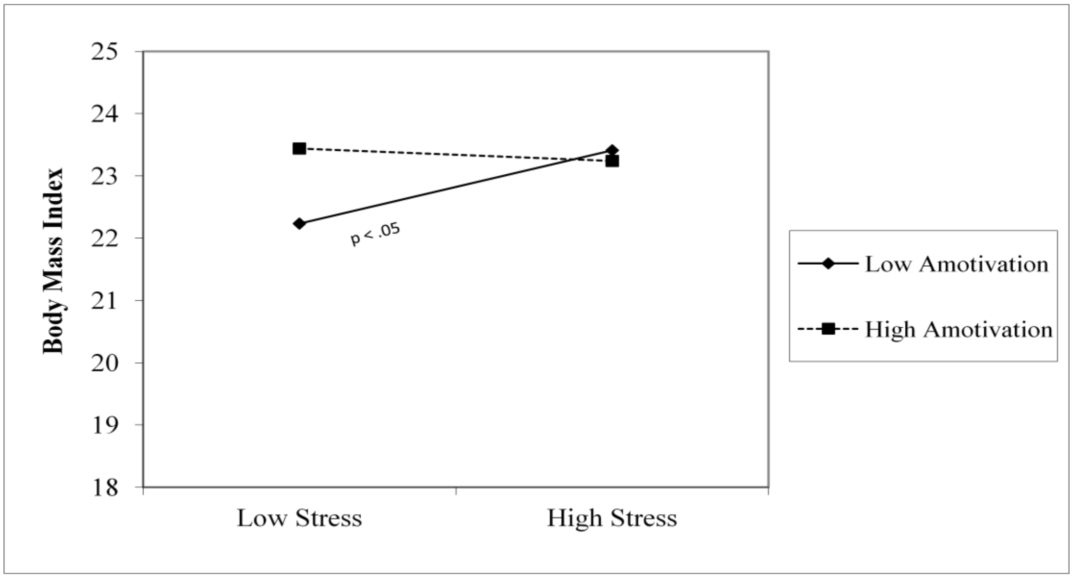
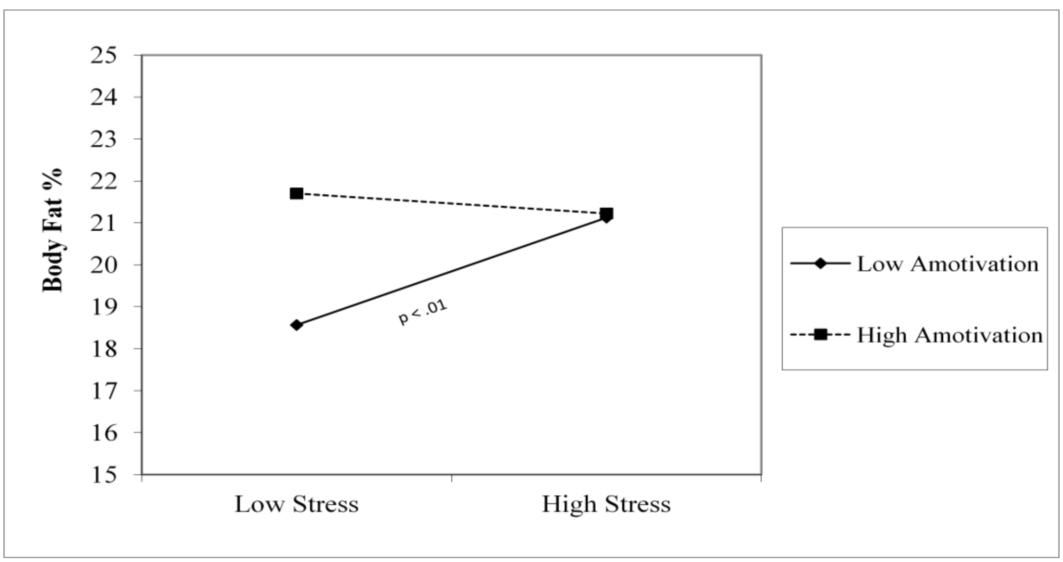


Figure 3.12: Stress X amotivation predicts percent body fat



Chapter 4

Summary of Findings

Following baseline measurements, perceived stress scores did not significantly differ across time. Eating regulation behaviors also did not significantly differ across time. No correlations were found between perceived stress scores and weight, BMI, or percent body fat changes over the two year period in males or in females.

Significant interactions were found for perceived stress, autonomous eating regulation and BMI, weight, and percent body fat. Significant positive associations were found for perceived stress and BMI, weight, and percent body fat in those with high autonomous eating regulation. Generally, those individuals with high perceived stress and high levels of autonomous eating regulation had higher BMI, weight, and percent body fat than those with low perceived stress and high autonomous eating regulation.

Significant interactions were found for perceived stress, intrinsic motivation, and BMI and percent body fat. Significant positive associations were found for perceived stress and BMI and percent body fat in those with high intrinsic motivation. Generally, those with high levels of perceived stress and high intrinsic motivation had a higher BMI and percent body fat than those with low perceived stress and high intrinsic motivation.

Significant interactions were found for perceived stress, integrated eating regulation and BMI, weight, and percent body fat. Significant positive associations were found for perceived stress and BMI and percent body fat in those with high integrated eating regulation. Those individuals with high perceived stress and high levels of integrated eating regulation had higher

BMI and percent body fat than those with low perceived stress and high integrated eating regulation.

Significant interactions between perceived stress and identified eating regulation were found for BMI, weight, and percent body fat. Significant positive associations were found for perceived stress and BMI, weight, and percent body fat in those with high identified eating regulation. Those individuals with high perceived stress and high identified eating regulation had higher BMI, weight, and percent body fat than those with low perceived stress and high identified eating regulation.

Significant interactions were found for perceived stress, amotivation, and BMI, weight, and percent body fat. Significant positive associations were found for perceived stress and BMI and percent body fat in those with low amotivation. Individuals with high perceived stress and low amotivation had higher BMI and percent body fat than those with low perceived stress and low amotivation.

Chapter 5

References

Abouserie R. Sources and levels of stress in relation to locus of control and self esteem in university students. *Educational Psychology.* 1994;14(3):323-330.

Aiken LS, West SG. *Multiple regression: testing and interpreting interactions*. Newbury Park: Sage; 1991.

[ACHA] American College Health Association: Reference group executive summary. 2011; http://www.achancha.org/docs/ACHA-NCHA-II_ReferenceGroup_ExecutiveSummary_Spring2011.pdf. Accessed April 22, 2012.

Anderson DA, Shapiro JR, Lundgren JD. The freshman year of college as a critical period for weight gain: An initial evaluation. *Eating Behaviors.* 2003;4(4):363-367.

[Auburn University OIRA] 2007-2008. Auburn University Office of Institutional Research and Assessment. Available at (https://oira.auburn.edu/). Accessed 4/15/10.

Butler SM, Black DR, Blue CL, Gretebeck RJ. Change in diet, physical activity, and body weight in female college freshman. *American Journal of Health Behavior.* 2004;28(1):24-32.

[CDC] Centers for Disease Control and Prevention. Press release. 2008; http://www.cdc.gov/media/pressrel/2008/r080717.htm. Accessed March 20, 2012.

[CDC] for Disease Control and Prevention: Prevalence trends data, Alabama overweight and obesity (BMI). 2010a; http://apps.nccd.cdc.gov/BRFSS/display.asp?yr=2010&state=AL&qkey=4409&grp=0&SUBMIT3=Go. Accessed March 23, 2012.

[CDC] Centers for Disease Control and Prevention: Behavioral risk factor surveillance system. 2010b; http://apps.nccd.cdc.gov/BRFSS/age.asp?cat=OB&yr=2006&qkey=4409&state=UB. Accessed April 11, 2012.

[CDC] Centers for Disease Control and Prevention: About BMI for adults. 2011a; http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html. Accessed April 18, 2012.

[CDC] Centers of Disease Control and Prevention: Nutrition topics web page. 2011b; http://www.cdc.gov. Accessed December 20, 2011

[CDC] Centers for Disease Control and Prevention: Adult obesity. 2012; http://www.cdc.gov/obesity/data/adult.html. Accessed March 20, 2011.

Chemers MM, Hu L, Garcia BF. Academic self-efficacy and first-year college students performance and adjustment. *Journal of Educational Psychology*. 2001;93(1):55-64.

Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *Journal of Health and Social Behavior.* 1983;24(4):385-396.

Cohen S. *Perceived stress in a probability sample of the United States.* Newbury park, CA: Sage; 1988.

Cohen J, Cohen P. *Applied multiple regression/correlation analysis for the behavioral sciences*. Hillsdale: L. Erlbaum; 1983.

Crandall C, Preisler J, Aussprung J. Measuring life event stress in the lives of college students: The undergraduate stress questionnaire (USQ). *Journal of Beahvioral Medicine.* 1992;15(6):627-662.

Crombie AP, Ilich JZ, Dutton GR, Panton LB, Abood DA. The freshman weight gain phenomenon revisited. *Nutrition Reviews.* 2009;67(2):83-94.

Deci EL, Ryan RM. *Intrinsic motivation and self-determination in human behavior.* New York: Plenum Press; 1985.

Deci EL, Ryan RM. The “What” and “Why” of Goal Pursuits: Human Needs and the Self-Determination of Behavior. *Psychological Inquiry*. 2000;11(4):227–268.

Delinsky SS, Wilson GT. Weight gain, dietary restraint, and disordered eating in the freshman year of college. *Eating Behavior.* 2008;9(1):82-90.

Dusselier L, Dunn B, Wang Y, Shelley MC, Whalen DF. Personal, health, academic, and environmental predictors of stress for residence hall students. *Journal of American College Health.* 2005;54(1):15-24.

Economos CD, Hildebrandt ML, Hyatt RR. College freshman stress and weight change: Differences by gender. *American Journal of Health Behavior.* 2008;32(1):16-25.

Epel E, Lapidus R, McEwen B, Brownell K. Stress may add bite to appetite in women: a laboratory study of stress-induced cortisol and eating behavior. *Psychoneuroendocrinology.* 2001;26(1):37-49.

Fontana D, Abouserie R. Stress levels, gender and personality factors in teachers. *British Journal of Educational Psychology* 1993;63(2):261-270.

Garner DM, Garfinkel PE. The eating attitudes test: An index of the symptoms of anorexia nervosa. *Psychological Medicine.* 1979;9:273-279.

Goldberg DP. *Manual for the general health questionnaire.* Windsor; NFER Publishing Company: 1978

Gormally J, Black S, Daston S, Rarddin D. The assessment of binge eating severity among obese persons. *Addictive Behaviors*. 1982;7(1):47-55.

Graham MA, Jones AL. Freshman 15: valid theory or harmful myth? *Journal of American College Health* 2002;50(4):171-173.

Greeno CG, Wing RR. Stress-induced eating. *Psychology Bulliten.* 1994;115(3):444-464.

Gropper SS, Simmons KP, Gaines A, Drawdy K, Saunders D, Ulrich P, Connell LJ. The freshman 15-a closer look. *Journal of American College Health* 2009;58(3):223-231.

Grau R, Salonava M, Peiro JM. Moderator effects of self-efficacy on occupational stress. *Psychology in Spain.* 2001;5(1):63-74.

Hajhosseini L, Holmes T, Mohamadi P, Goudarzi V, McProud L, Hollenbeck CB. Changes in body weight, body composition and resting metabolic rate (RMR) in first-year university freshmen students. *Jounal of the American College of Nutrition.* 2006;25(2):123-127.

Heaven PCL, Mulligan K, Merrilees R, Woods T, Fairooz Y. Neuroticism and conscientiousness as predictors of emotional, external, and restrained eating behaviors. *International Journal of Eating Disorders.* 2001;30(2):161-166.

Herman CP, Polivy J. Anxiety, restraint, and eating behavior. *Journal of Abnormal Psychology*. 1975;84(6):666-672.

Herman CP, Polivy J. A boundary model for the regulation of eating. In J.A. Stunkard & Stellar. *Eating and its Disorders* (pp. 141-156). New York: Raven Press; 1984.

Hodge CN, Jackson L, Sullivan L. The "freshman 15" facts and fantasies about weight gain in college women. *Psychology of Women Quarterly*. 1993;17:119-126.

Hoffman DJ, Policastro P, Quick V, Lee SK. Changes in body weight and fat mass of men and women in the first year of college: a study of the "freshman 15". *Journal of American College Health.* 2006;55(1):41-45.

Holm-Deoma J, Joiner T, Vohs K. The "freshmen fifteen" (the "freshmen five" actually): predictors and possible explanations. *Health Psychology* 2008;27:S3-S9.

Hovell M, Mewborn C, Randle Y, Fowler-Johnson S. Risk of excess weight gain in university women: a three-year community controlled analysis. *Addictive Behaviors.* 1985;10:15-28.

Insel PM, Roth WT. *Core concepts in health.* Palo Alto: Mayfield; 1985.

Jaccard J, Turrisi R, Wan CK. *Interaction effects in multiple regression*. Newbury Park: Sage; 1990.

Jung ME, Bray SR, Martin Ginis KA. Behavior change and the freshman 15: tracking physical activity and dietary patterns in 1st-year university women. *Journal of American College Health.* 2008;56(5):523-530.

Kandiah J, Yake M, Jones J, Meyer M. Stress influences appetite and comfort food preferences in college women. *Nutrition Research.* 2006;26:118-123.

Kasparek DG, Corwin SJ, Valois RF, Sargent RG, Morris RL. Selected health behaviors that influence college freshman weight change. *Journal of American College Health* 2008;56(4):437-444.

Kleinbaum DG, Kupper LL, Muller EE. *Applied regression analysis and other multivariable methods.* Boston: PWS-Kent;1988.

Levitsky DA, Halbmaier CA, Mrdjenovic G. The freshman weight gain: a model for the study of the epidemic of obesity. *International Journal of Obesity and Related Metabolic Disorders* 2004;28(11):1435-1442.

Lewis CE, Siegel JM, Lewis MA. Feeling bad: exploring sources of distress among pre-adolescent children. *American Journal of Public Health.* 1984;74(2):117-122.

Lloyd-Richardson EE, Lucero ML, Dibello JR, Jacobson AE, Wing RR. The relationship between alcohol use, eating habits and weight change in college freshmen. *Eating Behaviors.* 2008;9(4):504-508.

Lord DC. Eating regulation and residency over the first two years of college: Associations with BMI, weight, and percent body fat. Auburn: Nutrition, Dietetics, and Hospitality Management, Auburn Unvieristy; 2012.

Lowe MR, Annunziato RA, Markowitz JT, Didie E, Bellace DL, Riddel L, Caralynn M, Shortie M, Stice E. Multiple types of dieting prospectively predict weight gain during the freshman year of college. *Appetite.* 2006;47(1):83-90.

Lukaski HC, Johnson PE, Bolonchuk WW, Lykken GI. Assessment of fat-free mass using bioelectrical impedance measurements of the human body. *American Journal of Clinical Nutrition.* 1985;41(4):810-817.

Martini FH. *Fundamentals of Anatomy & Physiology*. Seventh ed. San Francisco: Pearson Education; 2006.

Mihalopoulos NL, Auinger P, Klein JD. The freshman 15: is it real? *Journal of American College Health.* 2008;56(5):531-533.

Mokdad AH, Serdula MK, Dietz WH, Bowman BA, Marks JS, Koplan JP. The spread of the obesity epidemic in the United States, 1991-1998. *The Journal of the American Medical Association.* 1999;282(16):1519-1522.

Morrow ML, Heesch KC, Dinger MK, Hull HR, Kneehans AW, Fields DA. Freshman 15: fact or fiction? *Obesity.* 2006;14(8):1438-1443.

[NIH] National Institute of Health: Bioelectrical impedance analysis in body composition measurements. National institute of health technology assessment conference. *American Journal of Clinical Nutrition.* 1996;64:524S-532S.

[NIH] National Institute of Health. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. The evidence report. *Obesits Research.* 1998;6:51S-209S.

Newell FH. *Physical activity and body composition changes during the first two years of college*. Auburn: Nutrition, Dietetics, and Hospitality Management, Auburn University; 2011.

Norbeck JS. Modification of the recent life event questionnaires for use with female respondents. *Research in Nursing and Health*. 1984;7:61-71.

Norris R, Carroll D, Cochrane R. The effects of physical activity and exercise training on psychological stress and well being in an adolescent population. *Journal of Psychosomatic Research.* 1991;36(1):55-65.

Oliver G, Wardle J. Perceived effects of stress on food choice. *Physiology & Behavior.* 1999;66(3):511-515.

Oliver G, Wardle J, Gibson EL. Stress and food choice: a laboratory study. *Psychosomatic Medicine.* 2000;62(6):853-865.

Pelletier LG, Dion SC, Slovinec-D'Angelo M, Reid R. Why do you regulate what you eat? Relationships between forms of regulation, eating behaviors, sustained dietary behavior change, and psychological adjustment. *Motivation and Emotion.* 2004;28(3):245-277.

Pliner P, Saunders T. Vulnerability to freshman weight gain as a function of dietary restraint and residence. *Physiology & Behavior.* 2008;93(1-2):76-82.

Pollard TM, Steptoe A, Canaan L, Davies GJ, Wardle J. Effects of academic examination stress on eating behavior and blood lipid levels. *International Journal of Behavioral Medicine.* 1995;2(4):299-320.

Racette SB, Deusinger SS, Strube MJ, Highstein GR, Deusinger RH. Changes in weight and health behaviors from freshman through senior year of college. *Journal of Nutrition Education and Behavior.* 2008;40(1):39-42.

Racette SB, Deusinger SS, Strube MJ, Highstein GR, Deusinger RH. Weight changes, exercise, and dietary patterns during freshman and sophomore years of college. *Journal of American College Health* 2005;53(6):245-251.

Roberti JW, Harrington LN, Storch EA. Further psychometric support for the 10-item version of the perceived stress scale. *Journal of College Counseling.* 2006;9:135-147.

Romero-Corral A, Somers V, Sierra-Johnson J, et al. Normal weight obesity: a risk factor for cardiometabolic dysregulation and cardiovascular mortality. *European Heart Journal.* 2010;31:737-746.

Rosenberg M. *Society and the adolescent self-image.* Princeton: Princeton University Press; 1965.

Ross SE, Niebling BC, Heckert TM. Sources of stress among college students. *College Student Journal.* 1999;33(2):312-318.

Sarason IG, Johnson JH, Siegel JM. Assessing the impact ofl ife changes: Development of the life experiences survey. *Journal of Consulting and Clinical Psychology.* 1978;46:932-946.

Scheier MF, Carver CS. Optimism, coping, and health: assessment and implications of generalized outcome expectancies. *Health Psychology.* 1985;4(3):219-247.

Selye H. *The Stress of Life*: McGraw-Hill; 1956.

Serlachius A, Hamer M, Wardle J. Stress and weight change in university students in the United Kingdom. *Physiology & Behavior.* 2007;92(4):548-553.

Siegert RJ, Patten, MD, Walkey FH. Development of a brief social support questionnaire. *New Zealand Journal of Psychology.* 1987;16:79-83.

Spaceapan S, Oskamp S. *The social psychology of health: claremont symposium on applied social psychology.* Vol 13. Newbury Park, CA: Sage; 1988.

Spielberge CD, Gorsuch RL, Lushene R, Vagg PR, Jacobs GA. *Manual for the state-trait anxiety inventor*. Palo Alto: Consulting Psychologist Press; 1983.

Steptoe A, Pollard TM, Wardle J. Development of a meausre of the motives underlying the selection of food: the food choice questionnarie. *Appetite*. 1995;25:267-284.

Stice E, Ozer S, Kees M. Relation of dietary restraint to bulimic symptomatology: the effects of the criterion confounding of the restraint scale. *Behavior Research and Therapy*. 1997;35(2):145-152.

Stunkard AJ, Messic S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. *Journal of Psychosomatic Research*. 1985;29(1):71-83.

Tanofsky-Kraff M, Wilfley DE, Spurrell E. Impact of interpersonal and ego-related stress on restrained eaters. *International Journal of Eating Disorders.* 2000;27(4):411-418.

Tice DM, Bratslavsky E, Baumeister RF. Emotional distress regulation takes precedence over impulse control: if you feel bad, do it! *Journal of Personality and Social Psychology*. 2001;80(1):53-67.

Van Strien T, Frijters J, Bergers G, Defares P. The dutch eating behavior questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. *International Journal of Eating Disorders*. 1986;5(2):295-315.

Vohs KD, Heatherton TF. Self-regulatory failure: a resource-depletion approach. *Psychological Science.* 2000;11(3):249-254.

Wardle J, Steptoe A, Oliver G, Lipsey Z. Stress, dietary restraint and food intake. *Journal of Psychosomatic Research.* 2000;48(2):195-202.

Weinstein SE, Shide DJ, Rolls BJ. Changes in food intake in response to stress in men and women: psychological factors. *Appetite.* 1997;28(1):7-18.

Zeratsky K. Mayo clinic; normal weight obesity: a hidden heath risk? 2012; http://www.mayoclinic.com/health/normal-weight-obesity/AN02007. Accessed March 23, 2012.

Zuckerman M. The development of an affect adjective check list for the measurment of anxiety. *Journal of Consulting and Clinical Psychology*.1960;24:457-462.

Appendices

Appendix A

Perceived Stress Scale – 10 Item

Instructions: The questions in this scale ask you about your feelings and thought during the last month. In each case, please indicate with a check how often you felt or through a certain way.

1. In the last month, how often have you been upset because of something that happened unexpectedly?

2. In the last month, how often have you felt that you were unable to control the important things in your life?

3. In the last month, how often have you felt nervous and “stressed”?

4. In the last month, how often have you felt confident about your ability to handle your personal problems?

5. In the last month, how often have you felt that things were going your way?

6. In the last month, how often have you found that you could not cope with all the things that you had to do?

7. In the last month, how often have you been able to control irritations in your life?

8. In the last month, how often have you felt that you were on top of things?

9. In the last month, how often have you been angered because of things that were outside of your control?

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Respondents answered questions on the following scale: 0=never, 1=almost never, 2=sometimes, 3=fairly often, 4=very often.

Appendix B

Regulation of Eating Behavior Scale
Pelletier, Dion, Slovinec-D'Angelo, & Reid (2004)
(Internal Consistency for the subscales range from .79-.91)

To what extend does each item correspond to your personal motive for regulating your eating behaviors? (Response scale ranges from (1- Does not correspond at all to 7- Corresponds exactly). Items are presented in random order. Items fall into the six self-regulation categories proposed by Deci and Ryan. The first three subscales can be grouped together to form a global autonomous regulation subscale. The latter three subscales can be used to form a global score of controlled regulation.

To What extend does each item correspond to your personal motive for regulating your eating behaviors? Please circle your answer.

1-Does not correspond at all…………………………………………………...………7- Corresponds exactly

Intrinsic Motivation

er 1 It is fun to create meals that are good for my health.

er 2 I like to find new ways to create meals that are good for my health.

er 3 I take pleasure in fixing healthy meals.

er 4 For the satisfaction of eating healthy.

Integrated Regulation

er 5 Eating healthy is an integral part of my life.

er 6 Eating healthy is part of the way I've chosen to live my life.

er 7 Regulating my eating behaviors has become a fundamental part of who I am.

er 8 Eating healthy is congruent with other important aspects of my life.

Identified Regulation

er 9 I believe it will eventually allow me to feel better.

er 10 I believe it is a good thing I can do to feel better about myself in general.

er 11 It is a good idea to try to regulate my eating behaviors.

er 12 It is a way to ensure long term health benefits.

Introjected Regulation

er 13 I don't want to be ashamed of how I look.

er 14 I feel I must absolutely be thin.

er 15 I would feel ashamed of myself if I was not eating healthy.

er 16 I would be humiliated if I was not in control of my eating behaviors.

External Regulation

er 17 Other people close to me insist that I do.

er 18 Other people close to me will be upset if I don't.

er 19 People around me nag me to do it.

er 20 It is expected of me.

Amotivation

er 21 I don't really know. I truly have the impression I am wasting my time trying to regulate my eating behaviors.

er 22 I don't know why I bother.

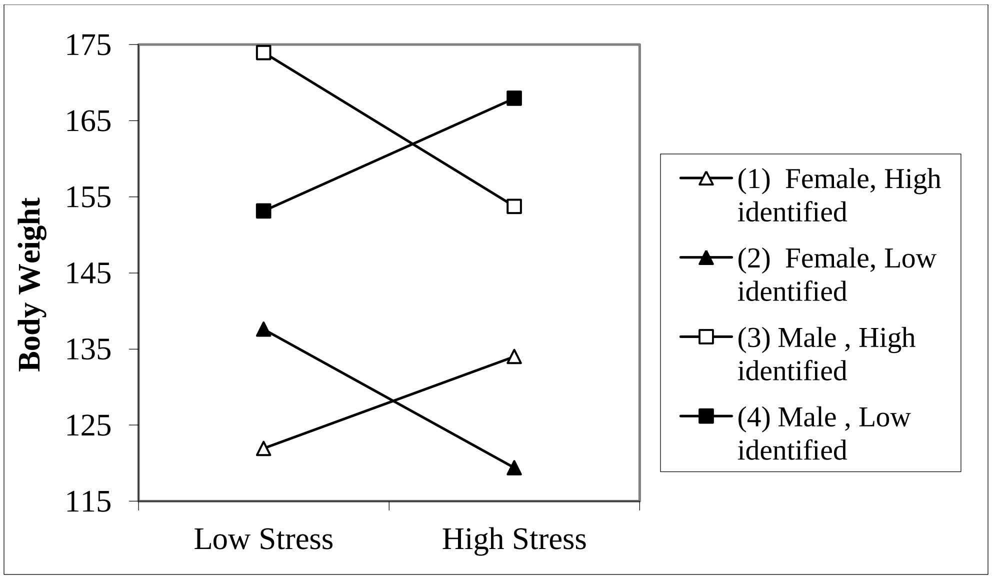
er 23 I can't really see what I'm getting out of it.

er 24 I don't know. I can't see how my efforts to eat healthy are helping my health situation.

Appendix C

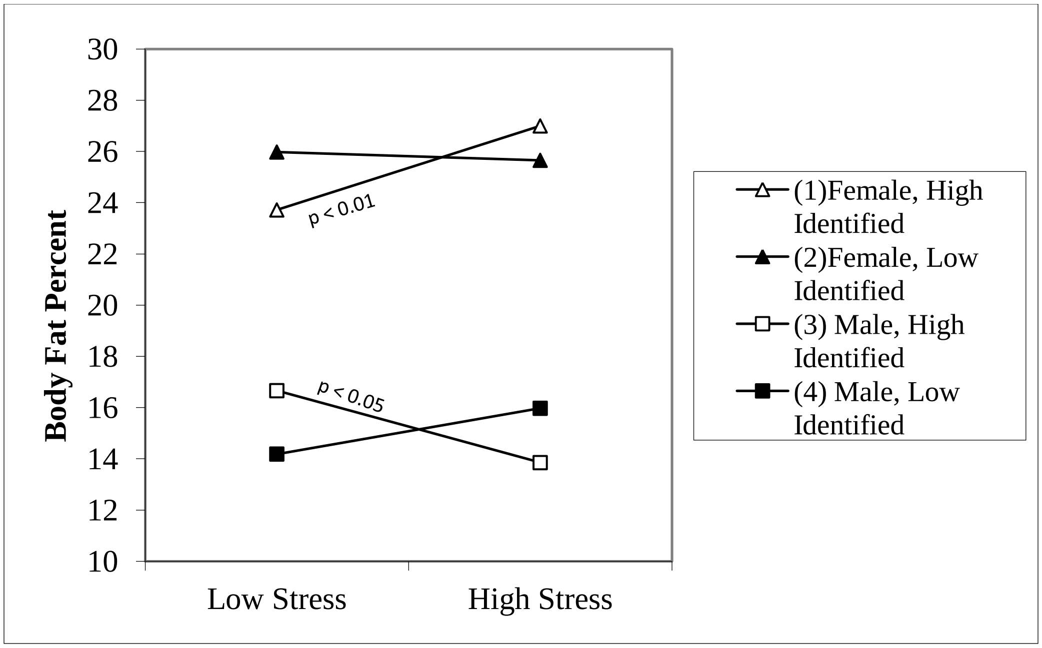
Results for T_1 analysis

Stress X identified regulation X female predicts weight



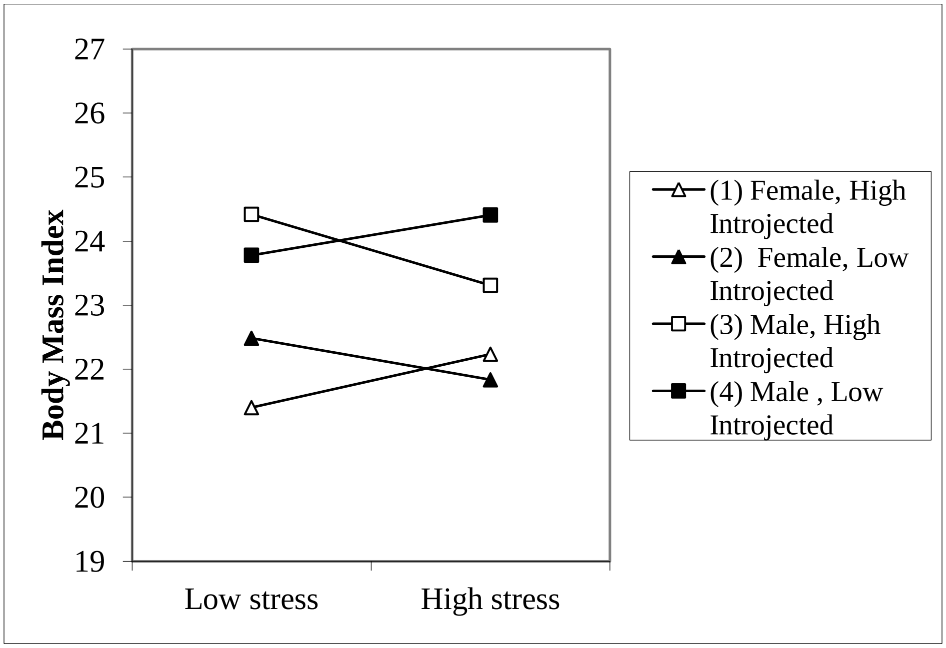
There was a significant ($\beta = 1.758$, $p < 0.05$) interaction for perceived stress, identified eating regulation, and gender for weight. There were not significant association for perceived stress, identified eating regulation, and gender for weight.

Stress X identified regulation X female predicts percent body fat



There was a significant (β = 0.344, $p < 0.01$) interaction between perceived stress, identified eating regulation and gender for percent body fat. There was a significant ($p < 0.05$) negative association between perceived stress, high identified eating regulation, and males. There was a significant ($p < 0.01$) positive association between perceived stress, high identified eating regulation, and females. There was a trend towards significance ($p = 0.07$) for perceived stress, low identified regulation, and males. There was no significant association for perceived stress, low identified eating regulation, and females.

Stress X introjected regulation X female predicts BMI



There was a significant ($\beta = 0.134$, $p < 0.05$) interaction between perceived stress, introjected eating regulation, and gender for BMI. There were not significant associations for perceived stress, introjected eating regulation, and gender for BMI.

Appendix D

Table 3.3 Body mass index T_1 for all eating regulation styles

Body Mass Index T_1		
Predictor	**Autonomous Eating Regulation**	**Controlled Eating Regulation**

	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.078***		.080***
Female	-2.014(.397)***		-2.062(.399)***	
Stress	.004(.037)		-.003(.038)	
Eating Regulation	.011(.168)		.192(.242)	
Step 2		.016		.005
Stress X Gender	-.008(.080)		.048(.082)	
Stress X Eating Regulation	.002(.034)		-.017(.042)	
Gender X Eating Regulation	-.801(.344)*		-.618(.510)	
Step 3		.004		.008~
Stress X Eating Regulation X Gender	.083(.070)		.166(.100)~	
Total R^2		.099		.093
Number of Subjects *(n)*		319		319

~p < .10; * p < .05; ** p < .01; *** p < .001

Body Mass Index T_1						
Predictor	***Intrinsic Motivation***		***Integrated Regulation***		***Identified Regulation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.078***		.080***		.083***
Female	-2.006(.397)***		-2.008(.394)***		-2.112(.401)***	
Stress	.003(.037)		.000(.037)		.006(.037)	
Eating Regulation	-.013(.131)		-.110(.134)		.211(.161)	
Step 2		.009		.024*		.004
Stress X Gender	.006(.079)		-.015(.080)		.007(.080)	
Stress X Eating Regulation	.006(.026)		-.001(.026)		-.006(.035)	
Gender X Eating Regulation	-.476(.272)~		-.782(.278)**		-.350(.330)	
Step 3		.000		.001		.000
Stress X Eating Regulation X Gender	-.007(.054)		.032(.056)		.019(.056)	
Total R^2		.088		.105		.087
Number of subjects (*n*)		319		319		319

~p < .10; * p < .05; ** p < .01; *** p < .001

Body Mass Index T_1 Controlled Eating Regulation						
Predictor	***Introjected Regulation***		***External Regulation***		***Amotivation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.079***		.078***		.087***
Female	-1.982(.403)***		-2.020(.397)***		-2.006(.392)***	
Stress	.006(.038)		.003(.037)		-.009(.037)	
Eating Regulation	-.058(.164)		.029(.144)		.299(.168)~	
Step 2		.001		.007		.004
Stress X Gender	.022(.081)		.041(.080)		.049(.082)	
Stress X Eating Regulation	.004(.029)		-.035(.028)		-.002(.034)	
Gender X Eating Regulation	-.174(.337)		-.221(.317)		-.388(.357)	
Step 3		.012*		.004		.001
Stress X Eating Regulation X Gender	.134(.066)*		.077(.067)		.034(.074)	
Total R^2		.092		.089		.092
Number of subjects (*n*)		319		319		319
~p < .10; * p < .05; ** p < .01; *** p < .001						

BMI T_6 for all eating regulatory styles

Body Mass Index T_6				
Predictor	**Autonomous Eating Regulation**		**Controlled Eating Regulation**	
	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.082***		.082***
Female	-2.046(.393)***		-2.038(.392)***	
Stress	.039(.034)		.033(.036)	
Eating Regulation	.058(.164)		.061(.221)	
Step 2		.026*		.005
Stress X Gender	.057(.072)		.082(.075)	
Stress X Eating Regulation	.066(.024)**		.018(.038)	
Gender X Eating Regulation	-.234(.344)		-.113(.486)	
Step 3		.000		.001
Stress X Eating Regulation X Gender	.007(.050)		.052(.085)	
Total R^2		.108		.088
Number of Subjects *(n)*		319		319
~p < .10; * p < .05; ** p < .01; *** p < .001				

Body Mass Index T_6						
Predictor	***Intrinsic Motivation***		***Integrated Regulation***		***Identified Regulation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.082***		.083***		.101***
Female	-2.019(.393)***		-.2021(.391)***		-2.174(.391)***	
Stress	.034(.034)		.031(.034)		.048(.034)	
Eating Regulation	-.046(.136)		-.097(.125)		.425(.163)**	
Step 2		.020~		.016		.027*
Stress X Gender	.056(.072)		.075(.072)		.051(.070)	
Stress X Eating Regulation	.047(.021)*		.044(.022)*		.064(.022)**	
Gender X Eating Regulation	-.287(.285)		-.165(.264)		-.090(.329)	
Step 3		.001		.001		.000
Stress X Eating Regulation X Gender	.023(.043)		-.022(.046)		.018(.047)	
Total R^2		.103		.100		.129
Number of subjects (*n*)		319		319		319
~p < .10; * p < .05; ** p < .01; *** p < .001						

Body Mass Index T_6 **Controlled Eating Regulation**						
Predictor	***Introjected Regulation***		***External Regulation***		***Amotivation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.084***		.083***		.083***
Female	-1.986(.394)***		-2.053(.392)***		-2.002(.393)***	
Stress	.042(.034)		.032(.034)		.027(.036)	
Eating Regulation	-.136(.151)		.099(.130)		.124(.178)	
Step 2		.010		.011		.018
Stress X Gender	.074(.075		.064(.071)		.100(.075)	
Stress X Eating Regulation	.031(.027)		.026(.022)		-.055(.027)*	
Gender X Eating Regulation	-.329(.334)		.248(.303)		-.224(.365)	
Step 3		.004		.000		.000
Stress X Eating Regulation X Gender	.076(.062)		.001(.054)		-.016(.057)	
Total R^2		.099		.094		.101
Number of subjects (*n*)		319		319		319

~p < .10; * p < .05; ** p < .01; *** p < .001

Weight T_1 for all eating regulation styles

Weight T_1				
Predictor	**Autonomous Eating Regulation**		**Controlled Eating Regulation**	
	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.342***		.342***
Female	-.36.08(2.877)***		-36.011(2.896)***	
Stress	-.149(.269)		-.184(.276)	
Eating Regulation	.688(1.214)		.469(1.753)	
Step 2		.010		.003
Stress X Gender	-.089(.578)		.280(.594)	
Stress X Eating Regulation	.017(.243)		-.316(.307)	
Gender X Eating Regulation	-5.326(2.498)*		-2.09(3.702)	
Step 3		.004		.004
Stress X Eating Regulation X Gender	.663(.507)		.974(.724)	
Total R^2		.355		.349
Number of Subjects *(n)*		319		319
~p < .10; * p < .05; ** p < .01; *** p < .001				

Weight T_1						
Predictor	***Intrinsic Motivation***		***Integrated Regulation***		***Identified Regulation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.343***		.342***		.344***
Female	-36.198(2.88)***		-35.87(2.856)***		-35.564(2.905)***	
Stress	-.143(.268)		-.186(.270)		-.151(.267)	
Eating Regulation	.850(.950)		-.552(.972)		1.416(1.167)	
Step 2		.006		.016~		.002
Stress X Gender	.021(.575)		-.150(.577)		.035(.582)	
Stress X Eating Regulation	.002(.188)		.026(.187)		-.033(.255)	
Gender X Eating Regulation	-3.257(1.967)~		-5.608(2.018)**		-1.887(2.393)	
Step 3		.000		.001		.022**
Stress X Eating Regulation X Gender	.030(.393)		.296(.403)		1.758(.538)**	
Total R^2		.349		.359		.368
Number of subjects (*n*)		319		319		319
~p < .10; * p < .05; ** p < .01; *** p < .001						

Weight T_1 Controlled Eating Regulation						
Predictor	***Introjected Regulation***		***External Regulation***		***Amotivation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.341***		.341***		.343***
Female	-35.79(2.917)***		-35.84(2.88)***		-35.87(2.85)***	
Stress	-.157(.273)		-.162(.269)		-.211(.273)	
Eating Regulation	-.194(1.187)		-.121(1.043)		1.031(1.225)	
Step 2		.001		.006		.001
Stress X Gender	.208(.589)		.276(.582)		.195(.596)	
Stress X Eating Regulation	-.094(.212)		-.337(.206)		-.049(.248)	
Gender X Eating Regulation	-1.502(2.440)		.201(2.298)		-1.198(2.601)	
Step 3		.007~		.003		.000
Stress X Eating Regulation X Gender	.852(.478)~		.533(.486)		-.077(.540)	
Total R^2		.350		.350		.344
Number of subjects (*n*)		319		319		319
~p < .10; * p < .05; ** p < .01; *** p < .001						

Weight T_6 for all eating regulation styles

Weight T_6				
Predictor	**Autonomous Eating Regulation**		**Controlled Eating Regulation**	
	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.344***		.341***
Female	-36.54(2.847)***		-36.22(2.845)***	
Stress	.145(.249)		.046(.258)	
Eating Regulation	1.556(1.189)		.536(1.605)	
Step 2		.015~		.002
Stress X Gender	.325(.521)		.360(.548)	
Stress X Eating Regulation	.453(.176)*		.099(.280)	
Gender X Eating Regulation	-.693(2.50)		1.218(3.531)	
Step 3		.000		.001
Stress X Eating Regulation X Gender	-.065(.366)		.315(.620)	
Total R^2		.360		.344
Number of Subjects *(n)*		319		319

~p < .10; * p < .05; ** p < .01; *** p < .001

Weight T_6						
Predictor	***Intrinsic Motivation***		***Integrated Regulation***		***Identified Regulation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.342***		.341***		.366***
Female	-36.339(2.85)***		-36.145(2.843)***		-37.541(2.814)***	
Stress	.106(.249)		.065(.249)		.193(.242)	
Eating Regulation	.614(.986)		-.167(.909)		4.12(1.17)**	
Step 2		.010		.010		.017*
Stress X Gender	.328(.521)		.452(.523)		.254(.507)	
Stress X Eating Regulation	.294(.152)~		.319(.160)*		.454(.161)**	
Gender X Eating Regulation	-1.60(2.072)		-.099(1.922)		.413(2.374)	
Step 3		.000		.000		.000
Stress X Eating Regulation X Gender	-.008(.314)		-.131(.331)		-.030(.339)	
Total R^2		.352		.351		.383
Number of subjects (*n*)		319		319		319
~p < .10; * p < .05; ** p < .01; *** p < .001						

Weight T_6 **Controlled Eating Regulation**						
Predictor	***Introjected Regulation***		***External Regulation***		***Amotivation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.342***		.343***		.341***
Female	-54.92(2.864)***		-36.34(2.844)***		-36.07(2.86)***	
Stress	.107(.249)		.040(.247)		.046(.262)	
Eating Regulation	-.704(1.095)		.866(.947)		.391(1.295)	
Step 2		.003		.011		.012
Stress X Gender	.406(.543)		.266(.515)		.580(.544)	
Stress X Eating Regulation	.135(.200)		.242(.158)		-.411(.193)*	
Gender X Eating Regulation	-1.070(2.433)		2.979(2.191)		-1.626(2.652)	
Step 3		.005		.000		.002
Stress X Eating Regulation X Gender	.686(.450)		.054(.387)		-.387(.412)	
Total R^2		.349		.354		.355
Number of subjects (*n*)		319		319		319
~p < .10; * p < .05; ** p < .01; *** p < .001						

Percent body fat T_1 for all eating regulation styles

Percent Body Fat T_1				
Predictor	**Autonomous Eating Regulation**		**Controlled Eating Regulation**	
	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.505***		.505***
Female	10.69(.613)***		10.51(.616)***	
Stress	.071(.057)		.065(.059)	
Eating Regulation	-.275(.258)		.346(.373)	
Step 2		.013*		.009
Stress X Gender	.198(.122)		.274(126)*	
Stress X Eating Regulation	-.017(.051)		-.068(.065)	
Gender X Eating Regulation	-1.064(.529)*		-.811(.783)	
Step 3		.005~		.001
Stress X Eating Regulation X Gender	.192(.107)~		.142(.153)	
Total R^2		.523		.515
Number of Subjects *(n)*		319		319
~p < .10; * p < .05; ** p < .01; *** p < .001				

Percent Body Fat T_1						
Predictor	***Intrinsic Motivation***		***Integrated Regulation***		***Identified Regulation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.505***		.509***		.504***
Female	10.69(.612)***		10.61(.605)***		10.52(.620)***	
Stress	.072(.057)		.063(.057)		.080(.057)	
Eating Regulation	-.226(.202)		-.410(.206)*		.172(.249)	
Step 2		.009		.017*		.006
Stress X Gender	.207(.122)~		.192(.122)		.211(.124)~	
Stress X Eating Regulation	-.001(.040)		-.023(.039)		-.014(.054)	
Gender X Eating Regulation	-.609(.417)		-1.025(.426)*		-.439(.508)	
Step 3		.001		.002		.014**
Stress X Eating Regulation X Gender	.078(.083)		.100(.085)		.344(.115)**	
Total R^2		.515		.528		.524
Number of subjects (*n*)		319		319		319

~p < .10; * p < .05; ** p < .01; *** p < .001

Percent Body Fat T_1 Controlled Eating Regulation						
Predictor	***Introjected Regulation***		***External Regulation***		***Amotivation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.503***		.503***		.507***
Female	10.57(.622)***		10.59(.613)***		10.61(.607)***	
Stress	.075(.058)		.077(.057)		.061(.058)	
Eating Regulation	.061(.253)		.036(.222)		.385(.261)	
Step 2		.005		.011~		.009
Stress X Gender	.225(.125)~		.267(.123)*		.260(.126)*	
Stress X Eating Regulation	.001(.045)		-.081(.044)~		-.036(.052)	
Gender X Eating Regulation	-.203(.518)		-.208(.486)		-.558(.549)	
Step 3		.004		.000		.000
Stress X Eating Regulation X Gender	.165(.102)		.057(.103)		-.019(.114)	
Total R^2		.513		.515		.515
Number of subjects (*n*)		319		319		319
~p < .10; * p < .05; ** p < .01; *** p < .001						

Percent body fat T_6 for all eating regulation styles

Percent Body Fat T_6				
Predictor	**Autonomous Eating Regulation**		**Controlled Eating Regulation**	
	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.507***		.508***
Female	10.71(.606)***		10.60(.604)***	
Stress	.078(.053)		.067(.055)	
Eating Regulation	-.275(.253)		.445(.341)	
Step 2		.020**		.006
Stress X Gender	.143(.110)		.196(.116)~	
Stress X Eating Regulation	.115(.037)*		-.059(.059)	
Gender X Eating Regulation	-.401(.528)		.241(.746)	
Step 3		.001		.001
Stress X Eating Regulation X Gender	.063(.077)		-.053(.060)	
Total R^2		.528		.515
Number of Subjects *(n)*		319		319
~p < .10; * p < .05; ** p < .01; *** p < .001				

Percent Body Fat T_6						
Predictor	***Intrinsic Motivation***		***Integrated Regulation***		***Identified Regulation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.509***		.511***		.508***
Female	10.74(.605)***		10.69(.601)***		10.53(.608)***	
Stress	.074(.053)		.069(.053)		.101(.052)~	
Eating Regulation	-.332(.209)		-.389(.192)*		.351(.253)	
Step 2		.016*		.012~		.022**
Stress X Gender	.130(.109)		.173(.110)		.135(.109)	
Stress X Eating Regulation	.087(.032)*		.067(.034)*		.115(.035)**	
Gender X Eating Regulation	-4.89(.435)		-.373(.404)		-.122(.509)	
Step 3		.002		.000		.002
Stress X Eating Regulation X Gender	.074(.066)		.012(.070)		.077(.073)	
Total R^2		.527		.523		.531
Number of subjects (*n*)		319		319		319

~p < .10; * p < .05; ** p < .01; *** p < .001

Percent Body Fat T_6 Controlled Eating Regulation

Predictor	***Introjected Regulation***		***External Regulation***		***Amotivation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		.505***		.507***		.510***
Female	10.66(.609)***		10.60(.604)***		10.76(.605)***	
Stress	.092(.053)~		.082(.052)		.056(.055)	
Eating Regulation	-.034(.233)		.227(.201)		.475(.274)~	
Step 2		.007		.006		.019**
Stress X Gender	.151(.115)		.185(.110)~		.196(.144)~	
Stress X Eating Regulation	.048(.042)		-.029(.034)		-.121(.040)**	
Gender X Eating Regulation	.007(.515)		.341(.467)		-.082(.556)	
Step 3		.000		.003		.001
Stress X Eating Regulation X Gender	.048(.096)		-.119(.082)		-.083(.086)	
Total R^2		.512		.517		.530
Number of subjects (*n*)		319		319		319
~p < .10; * p < .05; ** p < .01; *** p < .001						

Appendix E: IRB approval form

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

AUBURN
UNIVERSITY

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

July 10, 2009

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
ORIGINAL APPROVAL DATE: RENEWAL DATE: EXPIRATION DATE:	July 9, 2007 July 2, 2009 July 8, 2010

The renewal for the above referenced protocol was approved as Expedited by IRB procedure under 45 CFR 46.110 (Category #6 & #7):

> "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, 2010, you must submit a request for an extension of approval to the IRB no later than June 22, 2010. 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, 2010, 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. Please note that the approval, stamped version of your informed consent should be provided to participants during the consent process. You are reminded that you must keep signed 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,

Kathy Jo Ellison

Kathy Jo Ellison, RN, DSN, CIP
Chair of the Institutional Review Board
for the Use of Human Subjects in Research

cc: Dr. Doug White