Eating Regulation and Residency Over the First Two Years of College: Associations with Body Mass Index, Weight, and Percent Body Fat in College Students

By

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Abstract

Objectives: To determine if eating regulation behaviors and residency were associated with body mass index (BMI), weight, and/or percent body fat in male and female students over the first two years of college.

Subjects: Of the 535 recruited participants from two cohorts that began the study, 342 participants (64%) returned at the end of the sophomore year for re-assessment; 328 participants (215 females and 113 males) were included in the statistical analyses.

Methods: Anthropometric assessments including height and weight (via standard techniques) and body composition (via bioelectrical impedance analysis) were conducted two to three times during both the freshman and sophomore year. Eating regulation behaviors also were assessed at each time point using the Regulation of Eating Behavior Scale.

Results: Both gender and residency effects were found. Significant negative associations between autonomous eating regulation and BMI, weight, and/or percent body fat were shown in females but not in males. In females, higher BMI, weight, and/or percent body fat at the end of the second year of college were found in those with low intrinsic motivation, low identified regulation, and high amotivation, while lower BMI, weight, and/or percent body fat were associated with high levels of intrinsic motivation, high levels of identified regulation, and low levels of amotivation. Significant positive associations between controlled eating regulation and BMI, weight, and/or percent body fat were found in those living off-campus, but not on-campus. In those living off-campus, higher BMI, weight, and/or percent body fat at the end of the second year of college were discovered in those with high levels of amotivation and high levels of external regulation while those with low levels of amotivation and low levels of external regulation had lower BMI, weight, and/or percent body fat. In males with high levels of introjected eating regulation, those living off-campus had higher percent body fat versus males living on-campus.

Conclusions: Specific eating behaviors during the first two years of college influence BMI, weight, and/or percent body fat in females. Residency, particularly off-campus residency, impacts BMI, weight, and/or percent body fat in those with specific eating behaviors. Such findings may be useful for the inclusion in university programs focused on college student health-preventing both obesity and disordered eating/ eating disorders in college students.

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Chapter 1

Introduction

Weight gain often occurs in college students, especially freshman students. Previous research indicates that freshmen college students experience changes in body weight and composition during the first year of college (Anderson and others 2003, Butler and others 2004, Economos and others 2008, Edmonds and others 2008, Graham and Jones 2002, Gropper and others 2009, Hajhosseini and others 2006, Hodge and others 1993, Hoffman and others 2006, Holm-Denoma 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, Mifsud and others 2009, Morrow and others 2006, Provencher and others 2009, Pullman and others 2009, Wengreen and Moncur 2009). These investigations reveal that freshmen typically gain more weight during the first semester of their freshman year than the second semester, and the weight gain observed averages 4-5 lbs and not the commonly publicized 15 lbs. Moreover, body fat tends to increase (on average greater than 1%) during the freshman year indicating unhealthy changes in body composition during this time period (Hull and others 2007).

To prevent weight gain during the first year of college, students may develop disordered eating habits and/or eating disorders (Delinsky and others 2008, Lowe and others 2006, Pliner and Saunders 2008). An estimated one million men and seven to ten million women struggle with eating disorders (ANAD 2011). Although eating disorders/disordered eating affects men and women of all ages, ethnicities, and socio-economic status, 95% of those with an eating disorder are females between the ages of 12-25, placing college students, especially females, at risk for developing an eating disorder (ANAD 2011). Ten percent of individuals diagnosed with an eating disorder are men and ten to fifteen percent of males struggle with bulimia and/or anorexia and twenty percent of males with eating disorders are homosexual (ANAD 2011).

Disordered eating habits and eating disorders commonly seen during college, especially during the first year of college include: dieting, anorexia nervosa, bulimia nervosa, and binge eating disorder (ANAD 2011, Bascow and others 2007). As many as 25% of college aged females reported using bulimia for weight control (ANAD 2011). Furthermore, a survey from the National Association of Anorexia and Associated Disorders (ANAD) revealed that 91% of female college students had dieted to control their weight, and 22% indicated that they were frequently or always dieting. Another survey conducted by ANAD included 185 female college students; 58% of females felt pressured to be a certain weight and 83% of those students dieted to lose weight (ANAD 2011).

This pressure and the use of various dieting behaviors among college students appear to be related, at least in part, to roommate assignment or residency in a sorority house (Bascow and others 2007, Yakusheva and others 2011). Freshmen females living on-campus with a roommate who was trying to lose weight gained less weight compared to those females living on-campus with a roommate who was not attempting to lose weight (Yakusheva and others 2011).

Moreover, those students with roommates who used weight loss supplements and/or dieting techniques to lose and/or maintain weight were more likely themselves to adopt these behaviors in order to lose and/or maintain weight (Yakusheva and others 2011). In another study, freshman and sophomore females living in Greek housing on-campus were more likely to engage in bulimic and dieting behaviors compared to those females who did not live in Greek housing (Bascow and others 2007). These studies suggest that both on-campus roommates and living in Greek housing (such as a sorority house) influence dieting behaviors. Whether or not those college students living off-campus demonstrate these same changes in dieting behaviors as those living on-campus is not known. It has, however, been shown that college students living on-campus have significantly different dietary selections and eating behaviors than college students living off-campus (Beerman and others 1990).

Differences in food intake in response to emotions (such as anxiety) also have been reported between those individuals with and without certain types of disordered eating (i.e. restrained eaters versus non-restrained eaters) (Herman and Polivy 1975). Yet, whether or not differences in this or other dieting behaviors are reflected in changes in weight and/or body composition have not been investigated in college students.

Only three studies have examined changes in weight and/or body composition in association with dieting behaviors and residency in college students. Hull and others (2007) discovered that females living off-campus experienced healthier changes in body composition than females living on-campus during their sophomore year of college. Similarly, Harrington (2009) found that female freshmen living on-campus during their first semester gained more weight but also fat-free mass than female freshmen living off-campus during their first semester. Finally, Pliner and Saunders (2008) revealed that college freshmen with restrained or restricted eating habits gained significantly more weight than those freshmen living at home with their parents.

What is absent from the literature is an evaluation of residency, regulation of eating behaviors, and their effects on body composition and weight. Therefore, the purpose of the investigation was to determine the effects of residency (on-campus living versus off-campus living) and regulation of eating habits on changes in body mass index, changes in weight and percentage body fat in male and female students during freshman year of college at Auburn University.

Chapter 2

Literature Review

This literature review is divided into ten main sections including: types of disordered eating behaviors, regulation of food intake, control of eating behavior theories, effects of disordered eating/ eating disorders, risk factors for developing eating disorders, prevalence of eating disorders, assessment of disordered eating and additional assessments frequently conducted with disordered eating and/or weight change in college students. Subsections addressing specific eating disorders and other areas are found within many of these areas.

Disordered eating is classified as unusual eating behaviors that negatively impact an individual's physical, mental, and social health. Disordered eating includes a variety of abnormal eating patterns in which the individual becomes fixated on food and weight due to fear of weight gain. The individuals may eat regardless of physical hunger and satiety. Hectic or unruly eating patterns, eating foods or nonfoods at irregular times, restrained eating habits, anorexia and bulimia nervosa, chronic dieting, and compulsive eating habits are all examples of disordered eating (NEDIC 2008).

Types of Disordered Eating Behaviors

There are three main clinical eating disorders classified by the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). The DSM-IV is published by the American Psychiatric Association and discusses all mental health disorders in adults and children (All Psych Online). The DSM-IV describes eating disorders as conditions in which individuals either eat or do not eat to extremes: anorexia nervosa, bulimia nervosa, and binge-eating disorder (Mayo Clinic 2010). Each of these disorders will be discussed in this section of the literature review. The following section provides information on other types of disordered eating, including dieting, restricted eating, and disinhibition.

Anorexia Nervosa

Anorexia nervosa is a severe psychotropic disorder in which individuals are unusually obsessed with controlling food intake as a means of controlling their lives. Individuals with this disorder have a false perception that thinness dictates self-worth. Individuals with this disorder become obsessed with severely restricting food intake and/or not eating to promote weight loss and/or weight maintenance. Common symptoms of anorexia include significant weight loss, weight below what is recommend for age, height, and sex, a fear of becoming fat, distorted body image, and a strong desire to always be thinner (Mayo Clinic 2010).

Bulimia Nervosa

Bulimia nervosa is another psychotropic disorder. Bulimia is characterized by binge eating and then compensating for the binging by vomiting, laxative use, diuretic use, diet pill use, excessive exercise, and/or skipping meals. Bulimics usually have a poor self-image and use the binge and purge method of disordered eating as a way of "handling" their self-perceived body image problems (Mayo Clinic 2010).

Binge Eating Disorder

Binge eating disorder is characterized by the quick consumption of excessive amounts of foods in one sitting on a regular basis, such as eating half-gallon of ice cream in a ten-minute period. Individuals with this disorder often eat extreme quantities of food as the result of hunger from either dieting or restricting food. The binge episode also may be a response to emotions whereby individuals eat in attempt to comfort or console themselves as well as to avoid situations or tasks that are perceived as stressful. Individuals with this disorder usually binge eat privately or secretively due to feelings of embarrassment or shame; many individuals with this disorder feel that they are not able to control their binges. Individuals who binge may be uncomfortably full after an episode. Binge eating is not yet considered a specific psychiatric condition (Mayo Clinic 2010).

Other Types of Disordered Eating

Dieting

Dieting is defined as restricting the consumption of food and/or certain types of foods in order to lose weight. Dieting behaviors may result in fixations on food and weight; such fixations can lead to other eating disorders, such as anorexia nervosa. Other effects of dieting may include: decreased self-esteem due to failed diets, increased desire to binge eat, lowered metabolism and consequential weight gain, and a greater likelihood of increased avoidance of social situations in which food is involved (NEDIC 2008).

According to Neumark-Sztainer and others (2006) and Stice (2002), dieting is an indicator of binge eating disorder and other eating disorders. Furthermore, dieting has been shown to provoke binge eating disorder that ultimately results in weight gain. Adolescents who reported dieting during a three-year investigation were significantly more likely to binge eat compared to adolescents who were not dieting (Field and others 2001). Additionally, chronic dieting in individuals who restrain their food intake promoted eventual weight gain, increased metabolic inefficiency, other disordered eating habits, and lack of appetite regulation (Garner and Wooley 1991, Polivy and Herman 1985, Tuschl and others 1990).

Dietary Restraint/Restrained Eating/Restrictive Eating

Dietary restraint is defined as intentionally limiting the amount and/or type of food eaten in order to maintain or lose weight (McLean and others 2001). Dietary restraint can be used interchangeably with restrained eating and restrictive eating and is a symptom of many disordered eating behaviors, such as dieting and anorexia nervosa (ANAD 2011). Herman and

Polivy (1975) found that normal weight restrained eaters reportedly consumed more food when anxious than when calm compared to non-restrictive normal weight individuals, who ate significantly less when anxious. Individuals who typically restrain the amount of food they consume do so as a response to experiencing high levels of emotional stress (Lowe and Maycock 1988). Cain and others (2008) revealed that some women use dietary restraint as a method to seek social acceptance. The use of dietary restraint to gain social acceptance is especially true when women have high levels of self-confidence (high-self-efficacy) concerning their physical appearance but have low-levels of self-confidence (low self-efficacy) in their ability to successfully establish and maintain relationships with others (Cain and others 2008).

Dietary Disinhibition

Dietary disinhibition is the tendency to over-consume foods in the presence of others, emotional stress, or certain environments or stimuli (Savage and others 2009). Disinhibited eating can lead to weight gain if food intake exceeds energy (caloric) needs (Lowe and others 2006). Moreover, dietary disinhibition may be associated with the severity of binge eating disordered in overweight women (Marcus and others 1985).

Regulation of Food Intake

It is important to note that there is a marked difference between appetite and hunger. Hunger is the physiological drive to eat in order to sustain energy reserves for optimal metabolism (homeostasis). Hunger is essential to life and involves numerous complex chemical reactions. Appetite is the desire to eat due to emotions and is not a physiological necessity. There are several reasons for an individual's desire to eat including anxiety, boredom, excitement, anger, despair, loneliness, etc. Moreover, appetite is often the result of conditioning to food. An example of an individual with a conditioned appetite is an individual who associates an "all you can eat pancake fest" with an appetite for pancakes. The section provides an overview on the regulation of appetite.

The Hypothalamus

The hypothalamus is the region of the brain that regulates hunger and satiety. The feeding center is the area of the hypothalamus that induces the conscious desire to eat in humans and animals. Stimulation of the hypothalamus's "satiety center" results in the termination of eating. If there are injuries present in the satiety center of the hypothalamus, hypothalamic obesity may result. The feeding and satiety centers work properly as long as there is no damage or injury to this part of the brain. The feeding center's activity is inhibited by the stimulation of the satiety center after consuming food. If the feeding center is destroyed, fatal anorexia occurs.

Hormones and Polypeptides Stimulating Food Intake

There are several proteins that stimulate appetite and thus increase food intake. Some of these orexigenic proteins include neuropeptide Y, orexin A and B, melanin-concentrating hormone (MCH), ghrelin, growth hormone releasing hormone (GHRH), and galanin. A brief description of each protein will be discussed hereafter.

Neuropeptide Y is produced in the central and peripheral nervous systems and possibly visceral adipose cells. The neuropeptide increases the consumption of food by Orexin-A and Orexin-B, two neuropeptides made in the lateral region of the hypothalamus which function to stimulate appetite by acting upon receptors in the brain that result in an increase in the consumption of food. MCH is found in the zona incerta and the lateral hypothalamus and affects appetite regulation by unclear mechanisms. Concentrations of ghrelin, a 28 amino acid polypeptide made in the stomach and pancreas, increased during the fasting state to evoke hunger and are decreased after a meal. Additionally, ghrelin stimulates the secretion of growth hormone. Growth Hormone Releasing Hormone (GHRH) is a hormone that is made within the arcuate nucleus of the hypothalamus and stimulates the release of growth hormone by binding to growth hormone releasing receptors found in the anterior pituitary gland. Galanin, a neuropeptide located in the brain, intestine, and spinal cord, exhibits many functions including increasing appetite, regulating sleep, blood pressure, and mood. Galanin increases appetite by promoting an action potential in neurons involving feeding.

Proteins and Polypeptides Inhibiting Food Intake

There are several hormones and polypeptides that inhibit appetite stimulation and thus decrease food intake (antiorexigenic neuropeptides). Antiorexigenic neuropeptides include leptin, glucagon, cholecystokinin (CCK), oxytocin, somatostatin, peptide YY, gastrin-releasing peptide (GRP), glucagon-like polypeptides 1 and 2 (GLP-1,2), CART, CRH, and bombesin. A brief description of each is discussed below.

Leptin inhibits the consumption of food through inhibitory interactions with neuropeptide y, which ultimately impacts brain satiety signals. Mutations in leptin genes may causes obesity. Glucagon, a hormone released from the pancreas and is the counter-regulatory hormone of insulin, functions to maintain normal blood glucose concentrations.

Cholecystokinin (CCK), a hormone made in the small intestine, inhibits appetite by being secreted into the duodenum to provoke the digestion of protein and lipids. Somatostatin, a hormone that is made by neurons in the hypothalamus, is secreted by the central nervous system into the intestines and pancreas. There are several functions of somatostatin; however, its main function is to inhibit other hormones in the pancreas, intestines, and central nervous system by inhibiting the release of gastric hormones such as CCK, secretin, motilin, and gastrin.

Peptide YY, a polypeptide produced in the medulla oblongata of the brain stem, is released in response to consuming food (fat). Peptide YY impedes gastric acid secretion to decrease gastric emptying rate and suppress hunger. Glucagon like polypeptide 1 (GLP-1), the derivative from the proglucagon gene, is found in intestinal L-cells. Physiological functions of GLP-1 include increasing insulin secretion, decreasing glucagon secretion, enhancing insulin sensitivity, and preventing gastric acid secretions to suppress gastric emptying. GLP-1 helps to suppress appetite by increasing satiety. Glucagon-like polypeptide 2 (GLP-2), another derivative of the proglucagon gene, also impedes gastric acid secretion in humans to maintain satiety levels and prevent food intake.

Cocaine and amphetamine-regulated transcript (CART), a neuropeptide found in the hypothalamus, impedes the consumption of food by decreasing the gene expression of neuropeptide y. Corticotropin-releasing hormone (CRH) is a neurotransmitter and polypeptide hormone secreted by the hypothalamus as a result of stress. CRH stimulates adrenocorticotropic hormone (ACTH) secretion as well as inhibiting food intake by unclear mechanisms. The peptide bombesin has two homologs found in humans and other mammals: gastrin-releasing peptide (GRP) and neuromedin B. Bombesin works with CCK to suppress feeding behaviors.

Other Factors Inhibiting Food Intake

The rate of gastric emptying can diminish food intake. Gastric emptying rates are influenced, in part, on the macronutrient (carbohydrate, protein, lipid) content of the diet. A high fat meal that also contains a lot of protein takes longer to digest versus a meal consisting of mostly carbohydrates, which is digested more quickly.

After the ingestion of a meal, the stomach becomes enlarged and gastric distention occurs. This distention in turn impedes hunger and/or appetite in individuals with normal eating behaviors. An empty stomach, in contrast, causes the stomach muscles to contract (i.e. growl) and typically stimulates hunger and/or appetite. In addition to gastric distention, gastric receptors, known as osmo receptors, monitor the osmotic pressure of the chyme entering the stomach. The osmo receptors, in turn, increase or decrease the rate of gastric motility and emptying; the slowing of gastric emptying helps to induce satiety. For example, meals with a high fat content have a higher osmolarity causing the osmo receptors to the decrease gastric motility and emptying, thus suppressing hunger and/or appetite.

Control of Eating Behavior

Several theories have been developed to help explain how people control eating behaviors. This section of the literature review addresses a few of these theories.

Theories of Self-Determination Theory and Motivation (SDT)

The Self-Determination Theory proposed by Deci and Ryan (1985, Ryan and Deci, 2000) is a critical theory that helps to understand what motivates or does not motivate an individual to regularly control his or her eating behaviors. The Self-Determination Theory states that controlling a behavior, such as eating regulation, can occur in many forms that relate to various behavioral regulatory styles. The behavioral regulatory styles can be classified based on levels of self-determination. Moreover, the behavioral styles of regulation are closely related to one of three types of motivation. The three types of motivation (discussed hereafter) include amotivation, extrinsic motivation, and intrinsic motivation (Pelletier and others 2004).

Amotivation is a state in which an individual cannot observe contingencies between his or her behavior and the consequences of the individual's actions. Because amotivated individuals are often unable to understand or realize the consequences of their actions, they believe that their behavior is often the result of external forces outside the realm of their control. Although amotivated individuals in the past may have had good intrinsic motivation for controlling their eating behaviors, they now feel a lack of control over their eating habits and may feel incompetent (Deci and Ryan 1985).

The Self-Determination Theory defines intrinsic motivation as an individual's own personal enthusiasm or self-determination to behave in a certain way that will bring pleasure and satisfaction to the individual. Individuals who are intrinsically motivated will perform or carry out certain behaviors due to their own interest, regardless if there are material rewards or external constraints. Behaviors that are intrinsically motivated are completely voluntarily and are usually absent of material rewards. For example, those individuals who naturally enjoy preparing healthy meals would be classified as having intrinsic motivation (Deci and Ryan 1985).

Unlike intrinsic motivation, extrinsic motivation includes behaviors that an individual is motivated to perform for others in order to find a means to an end. Extrinsically motivated actions are often done to avoid unpleasant consequences and/or to promote pleasant consequences, such as material rewards for behaving a way that is deemed as good or beneficial for the individual by another. An example of an extrinsically motivated individual is one who controls his or her diet because a medical professional or significant other encourages or tells the individual to do so.

Different Forms of External Motivation

Although Deci and Ryan (1985) originally believed that extrinsically motivated actions concerned only non-self-determined behaviors related to external possibilities, the researchers later suggested that different forms of extrinsic motivation exist based on the degree of control or regulation over the behavior as perceived by the individual. For example, the regulation of eating habits may be the result of an obligation by external sources (such as a health professional or family member) or could be freely chosen by the individual.

External regulation, introjected regulation, identified regulation, and integrated regulation are four types of extrinsic motivation that can be ordered along a self-determination scale (Deci and Ryan 1985). First, externally regulated actions are motivated by external rewards and/or punishments. An individual who is externally regulating his or her eating behaviors would be doing so in order to either seek rewards, such as recognition and/or praise from the family member, health professionals, or, to avoid negative consequences, such as a lectures and warnings from others (Deci and Ryan 1985).

Second, introjected regulation of behavior occurs when an individual voluntarily regulates his or her behavior (Ryan and Connell 1989). An individual who is encouraged to introjectedly regulate his or her eating behaviors would be doing so because they would be too embarrassed for not controlling his or her diet or would constantly worry or feel anxious or guilty about the negative consequences of not controlling his or her diet (Ryan and Connell 1989).

Third, identified regulation of behavior occurs when external sources of regulation have been adopted into the individual's self-identity. The behavior is so important that the individual perceives the behavior to be chosen by him or herself, rather than due to internalization of external controls. Although the individual is motivated to perform the behavior, the action may or may not necessary be intrinsically pleasurable for the individual. Instead, the person is encouraged to regulate the behavior because he or she perceives that the behavior is consistent with the behavior's own importance and worth. Identified regulation occurs when individuals decide to control their eating behavior because they believe it will improve their self-esteem and feelings about themselves (Deci and Ryan 1985).

Finally, integrated regulation of a behavior occurs when a behavior becomes constant and dependable with other goals and priorities of an individual. The behavior becomes essential to the individual's daily routine and is therefore integrated into the individual's self-identity. Integrated regulation occurs not only because the individual believes the behavior is essential, but also because the behavior corresponds with other past integrated behaviors and standards. Those who display integrated regulation of eating behaviors are individuals who realize that eating healthy efficiently and effectively prepare and succeed in other priorities, such as eating healthy to successfully complete athletic hobbies and/ or sports. Athletes are a good example of individuals who may control their eating habits through integrated regulation (Deci and Ryan 1985, 2000).

The Self-Determination Continuum

The Self-Determination Continuum proposed by Deci and Ryan (1985) states that the six forms of behavior regulation can be placed along a continuum that varies from non-self-determined forms of regulation to self-determined forms of regulation. Non-self-determined or controlled forms of regulation include amotivation, external regulation, and introjected regulation while the self-determined (autonomous) forms of regulation are identified regulation, integrated regulation, and intrinsic motivation. The continuum should be evaluated from the lowest level of the continuum (non-self-determined regulation) to the highest level of the continuum (self-determined regulation) (Deci and Ryan 1985).

Amotivation symbolizes the lowest part of the continuum. Amotivated individuals lack self-determination because they cannot accept responsibility for their actions. Instead, they believe that the results of their actions are due to external forces completely out of their control. A lack control of control leads to the individual feeling incompetent (Pelletier and others 2004).

To reach the highest part of the continuum, individuals must progress from amotivated to intrinsically motivated. Individuals who are intrinsically motivated have matured from initially governing their behaviors due to reinforcement from external sources to deciding to internalize the behavior because they believe that regulating the behavior is essential for maintaining optimal mental, physical, and social health. Individuals motivated by introjected and integrated regulation realize the importance of such behaviors although they may not find the behavior naturally interesting (Deci and others 1994). Intrinsically motivated individuals are ranked highest on the continuum because they are personally interested in performing the behavior, regardless of positive and negative consequences (Pelletier and others 2004). The validity of the self-determination continuum has been supported by several research studies (Guttman 1954, Ryan and Connell 1989, and Vallerand 1997).

Consequences of Self-Determination Theory

Due to the fact that the six behavior regulatory styles of the Self-Determination Theory coincide on a self-determination continuum in addition to the fact that higher levels of self-determination are correlated with beneficial results, the relationship between the regulatory styles and consequences should differ with the level of self-determination. Studies investigating work, interpersonal relationships, health, education, and sports discovered that the higher self-determined regulatory styles (identified and integrated regulation and intrinsic motivation) were associated with better performance, higher self-esteem, increased life satisfaction, improved health, better learning ability, as well as greater work effort and initiative compared to the less self-determined regulatory styles (amotivation, external regulation, introjection) (Vallerand 1997).

Although both autonomous and controlled forms of regulation are used to intentionally to motivate, the foundation of initiation and regulation is different and affects an individual's ability to function socially, mentally and physically in society. For example, those individuals using autonomous forms of regulation to manage behavior usually have more in lasting health behavior changes because the individual not only accepts full responsibility for controlling the behavior, but also exerts more effort toward achieving positive outcomes as well as continuing to exert effort despite difficulties (Ryan and others 1995, Ryan and others 1996).

According to Williams and others (1996), the foundation of autonomous regulation is adopting the standards of regulating behavior while also controlling associated behaviors and then integrating these values and standards into not only the individual's daily routine, but also incorporating the values into the individual's identity. Another study conducted by Sheldon and Elliot (1998) revealed that self-determined goals were more likely to be achieved than non-self-directed or controlled goals. The positive results of autonomous regulation were significant when regulating initial commitment, expected competence, and the interaction of expected competence with initial commitment to the behavior (Sheldon and Elliot 1998).

Sheldon and Elliot (1998) also determined that individuals who used a controlled regulation style may have problems converting their controlled goals into action. The findings of the investigation revealed that individuals who used controlled regulation style displayed strong motivation to perform the behavior at the decisional phase, but their motivation decreased during the planning phase (pre-actional phase) and action phase. Moreover, individuals who use autonomous regulation were more likely to devote more continued effort into their goals and therefore later experienced greater task perseverance (Ryan and Connell 1989, Sheldon and Elliot 1998).

The findings from the studies described above are important because they help explain a person's motivation for regulating behaviors and achieving goals. Moreover, the results have pertinent implications on the consequences of health-focus behaviors, such as the regulation of eating behaviors (Pelletier and others 2004).

Effects of Disordered Eating/ Eating Disorders

Several medical complications result from eating disorders. In general, disordered eating behaviors may cause both mental and physical harm, including fatigue, decreased cognition and concentration, depression, and death. Additionally, malnutrition may impair brain development as well as stunt muscle and bone growth, especially in young children (Mayo Clinic 2011). Medical complications depend upon the specific disorder, and are discussed hereafter.

Effects of Anorexia Nervosa

Anorexia nervosa affects many body systems including the cardiovascular, nervous, integumentary, reproductive, and skeletal systems. Effects of anorexia on the skin include dryness and scaliness secondary to dehydration. Hair loss is also common. Loss of body weight depletes body fat stores. Consequently, the loss of body fat lowers internal body temperature, leaving the individual feeling cold more often than those who are at a normal weight. Increased hair growth on areas of the body other than the head (langungo) often occur with body fat loss in order to provide added body warmth. Another effect of anorexia is the cessation of menstrual cycles (amenorrhea). Such changes negatively impact bone mass and increase the risk for early-onset osteoporosis and/or osteopenia.

Nutritional complications of anorexia usually include deficiencies of iron, folic acid, and vitamin B_{12}. Moreover, inadequate consumption of calcium and vitamin D rich foods combined with low estrogen concentrations further increase the risk of osteopenia and/or osteoporosis. Inadequate energy intake also slows thought and reaction processes in individuals with anorexia. Heart rhythm abnormalities can occur due to abnormal electrolyte levels. A heart attack may occur when the muscle tissue of the heart is partially catabolized as a fuel source. Heart and other organ failures as well as death may result if the malnourishment of anorexia is untreated. Anorexics who die of a heart attack are usually those individuals who have struggled with the disorder for several years. Anorexia nervosa has the highest mortality rate of any mental disorder (Remuda Ranch 2010).

Effects of Bulimia Nervosa

Like anorexia nervosa, bulimia nervosa causes a variety of health problems that vary in terms of severity. Weight gain, weakness, dizziness, amenorrhea, as well as swollen hands, feet, cheeks, and salivary glands are general effects of bulimia. Harmful gastrointestinal effects include tooth decay from excessive vomiting, abdominal pain, ruptured mucosa in the esophagus and stomach, acid reflux from vomiting, and chronic constipation and/or diarrhea from laxative abuse this.

Bulimia impairs nutrition status secondary to electrolyte imbalances that result from frequent vomiting and/or use of diuretics and/or laxatives. Hypokalemia is the most common electrolyte imbalance in bulimics and can result in fatigue, irregular heartbeat, kidney failure, difficulty thinking, and death. Drug and alcohol abuse also has been reported in individuals struggling with bulimia nervosa. Like anorexia, abnormal heart rhythms and heart attacks also may result from malnutrition and/or electrolyte imbalance. Approximately 3.9% of individuals with bulimia die each year (Remuda Ranch 2010).

Effects of Binge Eating Disorder

Binge eating disorder also causes several medical problems. Obesity and overweight are two problems commonly associated with this disorder. Obesity and overweight result from binge eating episodes on high-energy (kcal) foods. Other complications include muscle and joint pain, osteoarthritis, headaches, and insomnia. Additional medical problems often related to binge eating disorder and obesity are elevated blood pressure, high serum cholesterol concentrations, type 2 diabetes, heart disease, gallbladder disease, and other digestive disorders (Mayo Clinic 2010).

Risk Factors for Developing an Eating Disorder

According to the National Association of Anorexia Nervosa and Associated Disorders (ANAD), men and women of all ages, ethnicities, and socio-economic status are affected by eating disorders (ANAD 2011). While eating disorders affect both men and women, it is less common for men (versus women) to be diagnosed with an eating disorder for several reasons. First, health professionals are less likely to suspect eating disorders in males, thus delaying diagnosis and treatment. Also, less attention is drawn to males who consume a lot of food during a meal compared to women who binge-eat during a meal (ANAD 2011). Finally, many males are embarrassed and unwilling to seek medical help because they perceive that eating disorders and/or disordered eating are diseases that stereotypically affect women. Men who feel shameful of their eating disorders may struggle with their disorder for years before finally seeking treatment (ANAD 2011).

Characteristics of those at risk for developing bulimia, anorexia nervosa, or a binge eating disorder are similar in men and women. However, unlike women, men with eating disorders typically do not focus on losing weight, but instead may concentrate on attaining a more muscular body shape. Eating disorders in men may begin with dieting and/or exercising compulsively to achieve a more muscular shape and/or to improve fitness for a sport. Men may become very frustrated or anxious when they cannot exercise or adhere to their restricted diet patterns and replace spending time with friends and family with exercise (ANAD 2011).

Anorexia Nervosa

Individuals most at risk for the development of anorexia nervosa are females less than 40 years of age, especially teenage and adolescent women. Female teenagers are more vulnerable to anorexia due to increased social pressure and desire to fit in with their peers. Young females are also more likely to develop anorexic behaviors to prevent or reverse the hormonal and physical changes of puberty. Difficult transition periods, such as moving or starting a new middle school, high school, or college are additional risk factors for anorexia nervosa. Sports/athletic events such as gymnastics, ballet, running, wrestling, jockey, and other activities in which an individual must maintain a weight are often associated with the development of anorexia. Certain careers, especially those careers require an extremely thin shape, such as acting or modeling, can contribute to the development of anorexia nervosa (Mayo Clinic 2011).

Similarly, anorexia nervosa is also more likely to occur in those with selected genes and/or those with other family members who suffer from anorexia. Negative feedback from others about weight gain or encouragement about weight loss from others can result in the development of anorexia nervosa (Mayo Clinic 2011).

Bulimia Nervosa

Unlike the onset of anorexia nervosa, which occurs especially in younger adolescence, the onset of bulimia nervosa occurs mainly during college, or the late adolescence to early adulthood years of life. The disorder affects females more often than males. Weight loss from dieting as well as a family history of bulimia can promote bulimic behaviors. Interestingly, individuals with excessively critical parents or a family that nags them to maintain or lose weight are at a much higher risk of becoming bulimic (Mayo Clinic 2011). Other emotional disorders such as obsessive-compulsive disorder, depression, and anxiety can also influence bulimic eating patterns. Lastly, sports that focus on shape and/or weight, especially those sports with strict weight management (wrestling, ballet, jockey, running, gymnastics, etc.) also may contribute to the development of bulimia (Mayo Clinic 2011).

Binge Eating Disorder

Like the other eating disorders, women are slightly more likely to develop a binge eating disorder than men. However, unlike anorexia or bulimia nervosa, the onset of binge eating disorder can occur at any time during life. The onset of this disorder, however, is most likely in early adulthood and late adolescence. Dieting behaviors are one risk factor because restricting foods can encourage a binge episode. Like anorexia and bulimia, a family history of the eating disorder increases the likelihood of developing binge eating disorder. Emotional disorders such as depression or obsessive-compulsive disorder as well as problems controlling anger, behavior, or the use of illegal substances are also risk factors for binge eating disorder (Mayo Clinic 2011).

Prevalence

As many as one million men and between seven and ten million women in the United States suffer from eating disorders. About 0.5 to 3.7% of women suffer from anorexia and 1.1 to 4.2% of women struggle with bulimia (ANAD 2011).

A longitudinal study lead by Lucas and others (1999) reported that anorexia nervosa was most predominant in young women aged 15-24 years. Similarly, the Substance Abuse and Mental Health Services Administration (SAMHSA) and the Center for Mental Health Services (CMHS) reported that 95% of the individuals with an eating disorder are between the ages of 12 and 25 years (ANAD 2011). Thus, college age students, especially females, are among those most at risk. Emphasizing this point, the National Association of Anorexia and Associated Disorders (ANAD) reported that 91% of female college students had dieted to control their weight, and 22% indicated that they were frequently or always dieting (ANAD 2011). A survey of 185 female college students indicated that 83% use dieting techniques to lose weight and 58% felt pressured to be a certain weight (ANAD 2011). The Renfrew Center Foundation for Eating Disorders revealed that as many as 25% of college age females use binge and purge methods for weight control (ANAD 2011).

About one in ten (10%) of eating disorder cases involve men, and an estimated 10 to 15% of males suffer from bulimia and/or anorexia (ANAD 2011). Slightly higher numbers are reported by ANAD, whereby 25% of those diagnosed with anorexia nervosa are males (ANAD

2011). About 20% of homosexual men are diagnosed with an eating disorder and suffer from anorexia while 14% of homosexual men struggle with bulimia (ANAD 2011); although these numbers may be lower than the true prevalence as some men do not seek treatment for their condition (ANAD 2011).

Assessment of Disordered Eating

There are several instruments used to assess disordered eating. These include the Dutch Restrained Eating Scale, Eating Attitudes Test, Eating Disorder Examination-Questionnaire, Eating Disorder Inventory, Health and Eating Patterns Research Questionnaire, and Revised Restrained Eating Scale, which are briefly discussed next. Information on scoring of the instruments is given when available.

Dutch Restrained Eating Scale (DRES)

The degree of restrained eating and dieting behaviors are measured in DRES. The ten-item questionnaire asks about weight, restrained eating habits, and self-labeled dieting. A five point Likert format scale is used and ranges from never (0) to always (5). Two of the items are scored with a zero or a one. A zero indicates that the item is irrelevant to the individual because he or she "has never gained weight" or "never eaten too much." A one indicates that the items are relevant and that the individual "has gained weight" and/or "has eaten too much." The total score is indicated by adding all scores from each item together and then dividing by the number of items (ten). A high score signifies a greater degree of restrained eating behaviors while a lower score would indicate a lower degree of restrained eating habits (van Strien and others 1986).

Eating Attitudes Test (EAT-26)

The Eat-26 is a widely used and accepted questionnaire that measures concerns and indicators that are typical of eating disorders. The Eating Attitudes Test-26 does not diagnose an eating disorder, but is used to screen and identify individuals most at risk for developing or having eating disorders, such as high school and college students (Garner and others 1982).

The Eat-26 has 26 questions. Questions 1-25 are scored as 3=always, 2=usually, 1=often, 0=never. Question 26 is scored in the reverse manner (3=never, 2=often, 1=usually, 0=always). The scores are summed together and a score of 20 or higher indicates that the individual is at risk of having an eating disorder and should be referred to a mental health professional to determine if an eating disorder diagnosis and/or treatment is necessary. Scores less than 20 may still indicate a serious disordered eating problem. Consulting a mental health professional with Eat-26 scores less than 20 is important to identify abnormal or disordered eating patterns (Garner and others 1982).

The Eat-26 is interpreted on three "referral criteria" that includes a score of 20 or higher on the Eat-26 questionnaire, low BMI for sex using recommended BMI ranges for sex, and behavioral questions that indicate recent weight loss or symptoms of eating disorders. Individuals should be referred to an eating disorder specialist if they meet one or more of the criteria (Garner and others 1982).

Eating Disorder Examination-Questionnaire (EDE-Q)

The EDE-Q was derived from the Eating Disorder Examination Interview (EDE). In 1994, the EDE became the EDE-Q, a 41-item, self-report questionnaire. Trained mental health professionals administer the EDE-Q. The total score for the questionnaire is derived from a global rating and 4 subscales: weight concern, eating concern, shape concern, and restraint. Questions included relate to the rate of occurrence of behaviors characteristic of an eating disorder during the previous 28 days. The EDE-Q is rated on a 7-point scale with ratings from 0 to 6. A score of 0 indicates zero days during the last 28 days, a score of 1= 1-5 days, 2= 6-12 days, 3= 13-15 days, 4= 16-22 days, 5= 23-27 days, and 6= everyday within the last 28 days (Fairburn and Beglin 1994).

Eating Disorder Inventory (EDI)

The EDI is a tool that measures abnormal eating habits that are characteristic of eating disorders. Five items such as drive for thinness, bulimia, maturity fears, perfectionism, and interpersonal distrust from EDI subscales are scored on a 6-point scale. The 6-point scale ranges from 1(never) to 6 (always). Scores closer to 6 are indicative of individuals with more severe problematic eating disorders. The score from each item are summed together to provide a total EDI score (Garner and others 1983).

Health and Eating Patterns Research Questionnaire (HEPRQ)

HERPQ is a 101-item questionnaire that analyzes an individual's overall health and eating habits. Nine factors are addressed in HERPQ: body image, negative affect, substance usage, relationship with parents, interpersonal concerns, healthy and unhealthy eat habits, disordered eating, and exercise habits (Holm-Denoma and others 2008).

Regulation of Eating Behavior Scale (REBS)

The REBS is a 24-item questionnaire created by Pelletier and others (2004) to determine why some individuals are able to successfully control their eating behaviors while other individuals fail to regulate their eating behavior. The questionnaire investigates how controlled and/or autonomous eating regulation is associated with eating behavior. The questionnaire is divided into one of the six subscales; each subscale contains four questions. Each item in each subscale concerns one of the six regulatory styles of eating behavior: intrinsic motivation, integrated regulation, identified regulation, external regulation, amotivation, and introjected regulation (Pelletier and others 2004).

To answer each item, participants use a seven point scale to indicate the extent to which each item resembles their own personal motivation for controlling their eating behaviors. A score of one signifies that the item does not correspond at all, while a score of seven indicates that the item corresponds exactly to the individual's motivation to initiate an action. Total scores are determined by multiplying the sum score from each subscale by an assigned weight as a function of the position of the subscales included on the self-determination continuum. The lower the total score, the less likely the individual regulates his or her eating (Pelletier and others 2004).

Revised Restrained Scale (RRS)

The RRS is a 10-item scale that gauges restrained eating behaviors and patterns that can lead to bulimic nervosa and binge-eating disorder behaviors. Individuals scoring higher than 15 are classified as restrained eaters. Individuals who score 15 or less are regarded as unrestricted eaters (Herman and Polivy 1980).

Additional Assessments Frequently Conducted with Disordered Eating Assessment

Because those with eating disorders often have poor self-esteem, poor body satisfaction, depression, and stress, studies often examine such characteristics along with measures of disorder eating. Some of these additional assessments include the Rosenberg Self-Esteem Scale, State Self Esteem Scale, Body Area Satisfaction Scale, the Body Shape Questionnaire, Epidemiologic Studies Depression Scale, Perceived Stress Scale, Social Provisions Scale, and Transition Perception Scale. Each will be briefly discussed with information on the scoring of the instrument when it is available.

Rosenburg Self-Esteem Scale (RSE)

The RSE assesses global self-esteem through a 10-item Likert-type survey. Each question is answered on a four-point scale: strongly agree, agree, disagree, or strongly disagree. Half of the ten items ask questions written in a positive manner and the other half have questions written in a negative manner. This survey has been utilized in research for many years and is noted for its validity and reliability (Blascovish and Joseph 1993).

State-Self Esteem Scale (SSES)

SSESS gauges an individual's self-esteem by measuring three related factors: social, appearance, and performance. The 20-item scale asked questions about how subjects felt about their appearance, performance, and social skills within the past week (Heatherton and Polivy 1991).

Body Shape Questionnaire (BSQ)

The Body Shape Questionnaire is a 34-item instrument that measures an individual's anxiety about his or her appearance and body shape. The 6-point scale for each items ranges from 1 (never) to 6 (always). The score for each item is added together to provide the total BSQ score (Cooper and others 1987).

Epidemiologic Studies-Depression Scales (CES-D)

The CES-D is a 20-item questionnaire that is used as a screening tool for measuring the frequency of depressed feelings and behaviors during a previous week. The questionnaire uses a three-point scale for all questions. Zero points signifies depressed emotions and/or behaviors rarely or none of the time (less than 1 day), one point signifies depressed emotions and/or behaviors some of the time (1-2 days), two points signifies depressed emotions and/or behaviors occasionally or moderate amount of time (3-4 days), and three points signifies depressed emotions and/or behaviors most or all the time (5-7 days). Scores are then added together to find the total score. However, the scoring for questions 4,8,12, and 16 is the opposite; zero would indicate most or all the time, one point indicates occasionally or moderate amount of time. Individuals scoring less than 15 may display mild symptoms of depression while those individuals who scored between 15 and 21 points most likely display symptoms of mild to moderate depression. A score of at least 21 indicates that the individual is at high risk of severe depression. In summary, the higher the scores, the more severe the symptoms. Although the CES-D is used as a brief screening tool to encourage individuals to seek treatment, the developer of the questionnaire, Lenore Radloff, discovered that 85% of individuals diagnosed with depression scored high on the CES-D. However, 20% of those individuals who scored high on the questionnaire did not meet the diagnostic criteria (Radloff 1977).

Perceived Stress Scale (PSS)

The PSS is one of the most prevalent scales used to assess an individual's perception of the degree of stressful situations. The questionnaire is intended to use at the community level for individuals with at least high school literacy. There are 10 questions on the questionnaire that help to determine the degree to which an individual deems a situation as stressful (i.e. outside the individual's capabilities or coping skills). The individual answers the PSS based on how he or she felt within the last month. Responses are given numbers and the individual selects the number that he or she feels best represents the answer to the question. A response of 0 indicates never, a response of 1 indicates almost never, a response of 2 indicates sometimes, a response of 3 indicates fairly often, and a response of 4 indicates very often. Scores are acquired for items 4, 5, 7 and 8 by reversing the number for the response; for example, a response of 0 equals a score of 4, a response of 1 equals a score of 3, a response of 2 equals 2, and a response of 1 equals 3, and 0 equals 4. The total score is obtained by adding all of the individual item scores together (Cohen and others 1983).

Social Provisions Scale (SPS)

The SPS is a questionnaire that measures Weiss's provision of social relationships principal. The principal describes six anticipations that reveal what an individual receives from relationships with others. The six provisions include reassurance of worth (acknowledgement of one's competency), dependable alliance (assurance that others can be counted on during times of stress), guidance, opportunity for nurturance (providing assistance to others), social integration (feeling of acceptance to a group of friends), and emotional closeness or attachment (Cutrona and Russell 1987).

Individuals taking the SPS answer 24 questions concerning how they feel about their relationships with family, friends, community members, and colleagues. A scale of one to four is used to indicate the individual score for each question as well as the participant's feelings. A scale of one signifies that the individual strongly disagrees, a scale of two indicates that the individual disagrees, a scale of three signifies that the individual agrees, and a scale of four indicates that the individual strongly agrees. The scoring for questions 2, 3, 6, 9, 12, 14, 15, 19, 21, 22, and 24 should be reversed (1 equals strongly agrees, etc.). Scores from all 24 items are summed together and then reported; scores closer to 24 indicate that the individual recognizes a higher level of social support. Lower scores indicate that the individual does not perceive social support from individuals he or she knows and believes that the relationships lack in one or more of the six provisions (Cutrona and Russell 1987).

Transition Perception Scale (TPS)

The Transition Perception Scale is a questionnaire that measures an individual's perception associated with the transition from high school to college or university. Questions address an individual's anxiety and concern level about the adjustment from high school to college. A five-point scale ranging from 0 to 4 was used for the Provencher and others (2009) study. Higher scores signify a higher level of apprehension about starting college. A rating of 0 indicates that the individuals never feels anxious and/or concerned about the adjustment from high school to college and a score of 4 indicates that the individual feel anxious and/or concerned very often. Additionally, other studies have used an 8-point scale where scores ranged from -4 to +4; a score of -4 signified that the individual very strongly disagreed and a rating of +4 signified that the person very strongly agreed (Provencher and others 2009).

Eating Habits of College Students

Numerous studies have examined the eating habits of college students. Selected findings from four studies are presented hereafter. In addition, the results of one study that assessed the effects of residency on food selection choices are also provided. Adams and Rini (2007) investigated the effects of eating behaviors as a predictor of changes in body mass index (BMI) among college males and females 18 to 31 years of age. A total of 116 subjects were included in the statistical analyses. Females with increases in BMI were more likely to consume caffeinated beverages, alcohol, and high cholesterol foods and were less likely to eat fiber rich foods and cruciferous vegetables. Additionally, increases in BMI were associated with higher levels of perceived stress. Due to the small sample size of male students, statistical analyses did not reveal significant factors associated with changes in BMI in male college freshmen students (Adams and Rini 2007).

Kasparek and others (2008) studied the consumption habits (primarily fruits, vegetables, and alcohol) in 23 male and 170 female (193 total) freshman college students. Students completed a web-based questionnaire in the fall of 2002 and in the spring of 2003. Alcohol intake significantly increased while vegetable intake significantly decreased over the freshman year (Kasparek and others 2008).

Serlachius and others (2007) analyzed the changes in eating habits in 268 (168 females and 100 male) first year university students between the ages of 18-25 years. Students included in the study were attending a university in London, England. Subjects completed a survey at the beginning of their first semester at the university and then again at the end of the freshman year. Students were more likely to consume alcohol while at the university than during high school. Significantly fewer meals were consumed during the students' first year at the university compared to their last year of high school. Interestingly, the students' snacking habits remained constant throughout freshman year (Serlachius and others 2007).

Racette and others (2005) investigated changes in the diets of 764 male and female freshman and sophomore college students at least 18 years of age and in 290 students who returned for the follow up during sophomore year. All participants were enrolled at Washington University in St. Louis, Missouri. Food frequency questionnaires were used to determine intake of fried foods, fruit and vegetable consumption, and high-fat fast food intake. At the beginning of freshman year, 50% of students (n=382) reported consuming high-fat and fried foods at least three times per week and 70% of students (n=535) reported eating fewer than five servings of fruits and vegetables each day. Females reported greater consumption of high-fat foods than males. An inverse association was found between fruit and vegetable consumption and the intake of fried food and high-fat fast food, while a direct correlation was observed between fast food consumption and intake of high-fat fast foods at the beginning of freshman year. There were 290 students who returned for the follow up assessments at the end of their sophomore year. Although consumption of high-fat fast foods did not decrease and the intake of fruits and vegetables did not decrease, the consumption of fried foods decreased at the end of sophomore year (Racette and others 2005).

Residency and Eating Habits

Beerman and others (1990) investigated the effects of residency on food selection choices in 67 male and 85 female students living in sororities and fraternity (Greek) houses, on-campus, and off-campus. The majority of students were freshmen and sophomores (n=99) and were under the age of 21 years (n=112). There were 65 students living on-campus (49 females and 16 males), 25 students who lived in a fraternity or sorority house (10 females and 15 males), and 62 students who lived off-campus (26 females and 36 males). Residency influenced the location of food consumption. Participants living off-campus consumed the majority of meals at home or off-campus while those living on-campus in dormitories ate most of their meals in on-campus food establishments. Students who were living in a sorority or fraternity house consumed the majority of their meals (which were prepared by a cook) in the house. Residency also influenced food choice selection as those subjects who lived in Greek housing or off-campus consumed significantly more alcohol (beer) in comparison to those students who lived on-campus and/or who were not living in Greek housing. No significant correlation was discovered between residency and the consumption of meat. Subjects living off-campus (27% or n=13) or in Greek housing (27% or n=7) were significantly less likely to eat cookies than those living on-campus (35% or n=23). Interestingly, subjects living off-campus ate less fruits and vegetables on a daily basis (31% or n=19) compared to students living in dorms (56% or n=36) or in Greek housing

(55% or n=14). Students living in a fraternity or sorority home were significantly less likely to less to skip meals compared to students not living in Greek housing. Gender influenced food choice and consumption patterns in that females reported consuming more sugar-free sweetened soft drinks (45% or n=38 vs. 23% or n=15) than males, and males drank more sugar-sweetened soft drinks compared to females (18% or n=12 vs. 10% or n=9). Additionally, males consumed significantly more beer compared to females. Both residency and gender had an effect on food consumption selection in that males and females residing on-campus consumed alcohol and sweets significantly more often than students who did not reside on-campus (Beerman and others 1990).

Non-Dietary Factors Associated with Disordered Eating and/or Weight Gain Among College Students

Dozens of studies have examined factors that are unrelated to diet but are associated with disordered eating and/or weight change in college students. Some of the main factors that have been identified and are presented in this section include: (a) apprehension/ anxiety with weight gain, (b) body dissatisfaction, dieting, and negative eating attitudes, (c) dietary disinhibition and restraint, (d) relationships with parents, (e) weight suppression and, (f) affiliation with the Greek system and/or residency.

Apprehension/Anxiety with Weight Gain

Eating habits and beliefs were investigated by Graham and Jones (2002) in 39 females and 10 male freshmen with an average age of 18.5 years attending Mount Mercy College, a small Midwestern college. All subjects lived on-campus and completed questionnaires about awareness and concern of the “Freshman 15;” eating behaviors and beliefs, exercise habits, and body image during the first two weeks of fall semester and then again at the end of the second semester during freshman year. Ninety percent of participants were aware of the “Freshman 15”; 29% extremely concerned, 36.4% somewhat concerned, while only 35.1% barely concerned. Anxiety about the “Freshman 15” was associated with perceived weight gain rather than actual weight gain; distressed subjects at the beginning of the year believed that they had gained the most weight at the end of the year. Greater risk of disordered eating, poor body image at the end of the year, self-categorization of overweight, and greater likelihood of thinking about gains in weight at the end of the year were all related to extreme apprehension about the “Freshman 15” at the beginning of the year. No significant changes in body image or EAT-26 scores from the beginning to the end of freshman year were noted (Graham and Jones 2002).

Body Dissatisfaction, Dieting, and Negative Eating Attitudes

Provencher and others (2009) investigated changes in weight, depression, self-esteem, social support, perceived stress, and transition perception during the first year of college. Approximately 2,921 first year female (n= 671 for cohort 1 and 935 for cohort 2) and male (n=404 for cohort 1 and 890 for cohort 2) college students attending one of six Canadian universities (University of Toronto at St. George, York University, University of Toronto at Mississauga, University of Guelph, Memorial University of Newfoundland, and Wilfrid Laurier University) were included in the study. Students completed self-questionnaires three times during the seven-month study: at baseline (the summer before classes started), at three months (during the first semester), and at seven months (during the second semester). The transition from high school to college resulted in a small, but significant weight gain of 1.4 kg (3.08 lbs) for females and 1.6 kg (3.52 lbs) for males. Selected psychological factors were found to foreshadow which students would be at greater risk for weight gain during freshman year. Freshman female students who started college with body dissatisfaction, dieting, and negative eating attitudes were significantly more likely to gain weight than those without these traits. For those females who gained weight and were concerned with their eating behaviors and weight, the negative psychological factors increased during the study. However, none of the psychological eating factors were reported in freshman male students. Furthermore, those male students who gained weight were more likely to have a normal BMI and higher levels of well-being. Weight gain in normal weight males seemed to provide self-esteem and body satisfaction compared to female students who gained weight. Lastly, those males who lost weight reported more negative feelings about the transition to college (Provencher and others 2009).

Dietary Disinhibition and Restraint

McGuire and others (1999) investigated risk factors of weight regain in 1,047 men and women at least 18 years of age who participated are part the National Weight Control Registry (NWCR). Individuals belonging to this registry had lost at least 30 pounds and successfully maintained the weight loss for at least one year. Fifty-nine percent of the participants successfully maintained their weight loss at the one-year follow up. However, 35% of participants regained weight. Predictors of weight regain included larger weight losses, higher levels of dietary disinhibition, as well as recent weight losses. Furthermore, individuals who regained some of their weight at the one-year follow-up indicated that their while physical activity levels decreased, their consumption of higher fat foods increased. Increased binge eating and dietary disinhibition as well as declined restrictive eating were reported in individuals who gained weight at the one-year follow-up (McGuire and others 1999).

Delinsky and others (2008) evaluated weight change and disordered eating in 149 females (mean age 17.92 years) who attended Rutgers University, New Jersey, for their freshman year. Subjects completed a series of questionnaires addressing restrained eating, disordered eating, self-esteem, and body image. Females gained an average of 3.36 lbs over the freshman year; 63% percent of subjects gained weight, 13% maintained their weight, and 24% lost weight. For those subjects who gained weight, the weight gain averaged 7.32 lbs. Dietary restraint in September did not foreshadow weight change in April. However, females who lost weight during freshman year reported significantly greater dietary restraint in September compared to subjects who gained weight. The frequency of eating disorder symptoms reportedly increased from September to April. Self-esteem, concern about the "Freshman 15," and dietary restraint in September predicted the shape concern subscale and EDE-Q scores later in the year (Delinsky and others 2008).

Relationships with Parents

Holm-Denoma and others (2008) examined selected predictors of weight change in 341 females and 266 males, 16-26 years of age, who attended Dartmouth College, New Hampshire during their freshman year of college. Students completed several questionnaires to measure disordered eating and restricted eating, self-esteem, and dieting behaviors during their senior year of high school and during fall (November) and spring of their freshman year of college. Weight (3.5 lbs for men and 4.0 lbs for women) significantly increased between spring of the senior year of high school and fall (November) of the freshman year of college, but did not significantly change during the remainder of freshman year. In males, weight gain was predicted by frequent, intense exercise as well as negative relationships with parents who did not allow independence. Weight gain in females was foreshadowed by positive relationships with parents who allowed independence. Weight loss in women was predicted by a negative relationship with parents (Holm-Denoma and others 2008).

Weight Suppression

Lowe and others (2006) evaluated factors promoting weight gain in 69 freshman females aged 18-19 years at Drexel University, Pennsylvania. The students' weight was measured at three different times during the 10-month study. Information on overeating, emotional eating, disinhibition, restrained eating, dieting behaviors, and weight history were collected through self-reports three weeks after the semester began. Weight gain averaged 2.1 kg (4.62 lbs) over the 10-month study. Overeating or restraint did not predict weight change. BMI at baseline also did not foreshadow an increase in weight. Subjects with high weight suppression gained more weight (2.97 kg or 6.53 lbs) compared to subjects with low weight suppression (average 1.2 kg or 2.64 lbs). Weight suppression is defined as a successful weight loss that has been maintained for at least a year (French and Jeffery 1994); weight suppression has been associated with decreased overall food consumption, increased physical activity, and the consumption of lower fat foods (French and Jeffery 1994). Time and diet history displayed a significant interaction in foreshadowing weight gain. Although history of weight suppression and dieting predicted greater amounts of weight gain, these factors were largely independent of one another. Interestingly, the average weight gain was significantly greater in females currently dieting (5.0 kg or 11 lbs) compared to subjects who had a history of dieting (2.5 kg or 5.5 lbs) and those females who had never been on a diet (Lowe and others 2006).

Affiliation with the Greek System and/or Residency

This section includes the findings from five studies. One study examined the effects of an affiliation with the Greek system specifically belonging to and living in a sorority, on disordered eating, while the other four studies examined the effects on residency and health-related behavior on weight change among college students.

Bascow and others (2007) compared the effect of female sophomore college students belonging to versus not belonging to a sorority on the level of perceived social pressure, body objectification, and disordered eating behaviors in female sophomore college students. Ninety-eight sophomore members of a sorority and 80 sophomore females not belonging to a sorority were included in the study. Females who were members of a sorority reported significantly greater levels of social pressure from their peers compared to females who did not belong to a sorority. Moreover, higher levels of perceived stress were related with significantly higher levels of body shame, body surveillance, body dissatisfaction, and the Eating Disorder Inventory-2 (EDI-2) Drive for Thinness subscale (a subscale used to measure the extent of concern with dieting and fear of weight gain) in sorority members compared to non-sorority members. A significantly increased risk of developing bulimic and dieting behaviors was found among females residing in a sorority home compared to students who did not live in a sorority home (Bascow and others 2007).

Hull and others (2007) investigated a group of females during their sophomore year at the University of Oklahoma. These researchers found that females living off-campus (n=26) experienced no change in weight but had significant decreases in percent body fat (-2%) and fat mass (-2.6 lbs) and gains in fat free mass (2.4 lbs), while females living on-campus (n=22) experienced slight but significant gains in weight (0.9 lbs), percent body fat (0.1%), and fat free mass (0.9 lbs) during their sophomore year (Hull and others 2007). The findings suggest healthier changes in body composition in sophomore females living off-campus versus on-campus.

Two studies have examined randomized on-campus housing assignments on weight change and health related behaviors. Kapinos and others (2011) studied the effects of on campus randomized housing assignment on weight change (as well as exercise and eating habits) in 537 freshman college students (193 males and 344 females) who were 18 years of age attending a small, private Midwestern university. The university was located in an urban setting that did not provide campus transportation for students; the campus was considered to be a walking campus. Data were collected during the fall 2008 and spring 2009 semesters. Dormitories one, two, and six did not have a gym or dining facility within the dormitory. Dorm seven had both a gym and dining hall located inside of the dorm and dormitories three, four, and five had dining halls. Overall, females gained more weight than males (1.23 kg or 2.71 lbs vs. 0.66 kg or 1.45 lbs). Males reported exercising more often than females; however, physical activity levels decreased in both males and females during freshman year. Additionally, specific amenities located within or near dormitories, such as dining halls or gym, greatly influenced changes in exercise and eating patterns. Male and female students who lived in dorms two and seven exercised more than students who lived in the other dorms, perhaps because dorm seven had an on-site gym and dorm two was located close to dorm seven. The presence of a gym or dining hall in dorm was associated with weight changes in females. Those female students who lived in a dorm with a dining hall weighed 0.85 kg or 1.87 lbs more at the end of spring semester than females who did not live a dorm with a dining hall. Furthermore, males who lived in dormitories with an on-site dining hall consumed more meals and snacks each day (0.38 and 0.22 more) than males who lived in a dorm without a dining hall during spring semester. Interestingly, females exercised less per week (1.43 times) when they lived in a dorm with a dining hall during spring semester. Lastly, those females who lived closer to central campus but lived further away from campus gyms reported less frequent exercise compared to students living further away from central campus (Kapinos and others 2011).

Yakusheva and others (2011) studied the peer effects of randomized on campus roommate assignment on weight change and behavior in 372 freshman females at least 18 years of age who were attending a small (less than 2,000 students), private Midwestern college during fall of 2008 and spring of 2009. Average body weight increased 1.65 lbs during freshman year and was related to fewer females attempting to lose weight during freshman year (69% to 52%). The percentage of freshmen exhibiting dietary restraint decreased from 54% fall semester to 47% spring semester. Additionally, the use of weight loss supplements increased from 5% fall semester to 7% spring semester and visits to the gym increased from 2.23 times per week to 2.55 times per week during the course of freshman year. Overall, randomized roommate selection had an effect on weight gain during freshman year in that students with roommates who participated in weight loss behavior prior to the beginning of college were more likely to engage in such behaviors themselves, especially those roommates who considered themselves to be overweight. Specifically, randomized roommate selection had an effect on eating and exercise habits; those students whose peers restricted food intake before their first semester of college were less likely to have an all-you-can-eat meal plan. Additionally, students whose peers used weight loss supplements before college were also more likely to use weight loss supplements themselves during freshman year. Students whose friends exercised frequently before college were also more likely to exercise on a regular basis during freshman year.

Only one study to date has directly studied the effects of residency, restrained eating, and weight change in college students. Pliner and Saunders (2008) investigated these outcome variables in eight males and 39 females living on-campus and in seven males and 18 females living at home with their families; all subjects were freshmen and enrolled in an introductory psychology course taken at an unspecified university in Toronto, Canada. Participants completed questionnaires at two different sessions: once in early October of freshman year and then again 22 weeks later in mid-March. Restrained eating was assessed using the Revised Restraint Scale. Male and female students with restrained eating behaviors living on-campus living gained an average of 4.1 kg (9.02 lbs) compared to restrained eaters living at home, who gained an average of 1.2 kg (2.64 lbs) during the 22-week study.

Campus meal plans may also contribute to weight gain as most universities and colleges require freshmen students (particularly those living on-campus) to purchase a meal plan. Typically, a variety of meal plans are offered at various costs. At the time this study was conducted, Auburn University required all incoming freshman students to purchase a meal plan, regardless of their residency. Students were required to purchase meal plans of at least $300.00 dollars. Meal plans are accessed by students on their student I.D. card as the I.D. card contains meal plan dollars. Meal plan dollars must be spent within a designated time frame otherwise they expire and no refunds are given. This expiration date may lead students to use dollars and purchase food, even when not hungry, to avoid losing money. There are several restaurants and/or dining halls located on Auburn University's campus. However, at the time of the study, the variety of food served in restaurants and/or dining halls at Auburn University was limited to mainly fast food type establishments with few dining halls. Until 2008, Sewell dining hall provided an all-you-can-eat cafeteria style dining to dorm residents who mostly consisted of athletes. Terrell dining hall is located in the Hill area of Auburn's campus and had both fast food and cafeteria type dining establishments. However, the campus dining establishment closed in 2007. Terrell food court now has several fast food type restaurants including: Nathan's Famous, Panda Express, Outtakes, Tiger Treats, Twisty Mac, and Rye of the Tiger. The food court at Foy Student Union Center operated until 2009, when the new Student Center opened. Although the new Student center has more dining options such as Au Bon Pain, Chef's Table, Out-takers, Mamma Leones, Chick-Fil-A, Coyote Jacks Grill, Starbucks, and Chef Yan Can Cook, the food is still fast food type food. The Village also has a new food area with a more traditional all-you-can-eat dining hall, Tiger Zone, along with several fast food options including Cub Stop Store C, End Zone Diner, Home Plate, O & B Grill, Plainsmen Pizza and Pasta, and Rye of the Tiger. Throughout campus other fast food type restaurants are found including Lupton Deli, Einstein's, Dudley Hall Drawing Board Café, Library Stacks Caribou Coffee, and Haley Center Coffee and Smoothie shops. It has been suggested that the daily opportunities for freshmen living on-campus to chose from a multitude of on-campus restaurants and all-you-can-eat dining halls linked to the meal plan may provide a "toxic environment" (Hull and others 2007, Levitsky and others 2004). Past research shows that food intake increases with increased variety and choice in food selection (Norton and others 2006; Pliner and others 1980). Similar to other universities, students at Auburn University may use meal plan dollars at over 20 different campus dining establishments (mostly fast food restaurants but also a few dining halls). While students living both on- and off-campus frequent fast food restaurants, because students living off-campus usually have access to better food storage and cooking facilities, it can be speculated that students living off-campus may eat out less frequently than students living on-campus.

Justification

Weight gain occurs in about 70% of college students, especially during the freshman year (Gropper and others 2009). Disordered eating also frequently develops among females in college, often as a means to prevent weight gain or maintain weight (Delinsky and others 2008, Lowe and others 2006, Pliner and Saunders 2008). About 0.5 to 3.7% of women suffer from anorexia and 1.1 to 4.2% of women struggle with bulimia (National Institute of Health 2002), and approximately 95% of the individuals with an eating disorder are between the ages of 12-25 years (ANAD 2011).

Interrelationships among eating disorders/disordered eating, weight gain, and residency during the college years have been suggested in the results of some studies. These studies link on-campus residency roommate assignments with disordered eating in roommates. For example, in a group of freshmen living on-campus, college roommates with disordered eating habits, such as dietary restraint (intentionally limiting the amount and/or type of food eaten in order to maintain or lose weight), and those who used weight loss supplements, significantly influenced the eating and health habits of their female freshman roommates (Yakusheva and others 2011). Yet, weight gain was not directly compared between the different groups and students living with roommates in off-campus housing were not included in the study (Yakusheva and others 2011). It is further known that food intake differs among those who are restrained eaters versus those who are not restrained eaters. Restrained eaters (of normal weight) have been reported to consume significantly more food when anxious than normal weight non-restrained eaters (Herman and Polivy 1975). It has not been reported whether or not weight gain differs among those who are restrained eaters versus those who do not restrain their eating habits. On-campus residency in freshman and sophomore females has also been associated with the development of disordered eating behaviors (such as binge eating, dieting, and bulimia nervosa) (Bascow and others 2007).

Eating behaviors and dietary choices of college students residing on-campus have been shown to significantly differ from those of students living off-campus (Beerman and others 1990). Residency in turn may influence weight gain, but this has only been studied in a small group of females during the sophomore year of college and in a small group of freshmen.

Females living on-campus experienced significant gains in weight and percent body fat versus females living off-campus who experienced no weight change but had significant losses of percent body fat and fat mass (Hull and others 2007). Additionally, among a small group of freshmen with dietary restraint behaviors, males and females living on-campus were found to have gained significantly more weight than those living at home with their parents (Pliner and Saunders 2008).

Missing from the literature is an examination of the relationship between regulatory eating behavior and residency, specifically living in an on-campus residence hall versus living in an off-campus house or apartment (but not at home), and their effects on body weight and percent body fat. Thus, the purpose of this study was to investigate whether residency and regulation of eating behavior are associated with body mass index, weight, and/or percent body fat in a group of male and female students over the first two years of college.

Chapter 3

Eating regulation and residency over the first two years of college: Associations with body mass index, weight, and percent body fat in college students

Abstract

Objective: To determine if eating regulation behaviors and residency were associated with body mass index (BMI), weight, and/or percent body fat in male and female students over the first two years of college.

Subjects: Of the 535 recruited participants from two cohorts that began the study, 342 participants (64%) returned at the end of the sophomore year for re-assessment; 328 participants

(215 females and 113 males) were included in the statistical analyses.

Methods: Anthropometric assessments including height and weight (via standard techniques) and body composition (via bioelectrical impedance analysis) were conducted two to three times during both the freshman and sophomore year. Eating regulation behaviors also were assessed at each time point using the Regulation of Eating Behavior Scale.

Results: Both gender and residency effects were found. Significant negative associations between autonomous eating regulation and BMI, weight, and/or percent body fat were shown in females but not in males. In females, higher BMI, weight, and/or percent body fat at the end of the second year of college were found in those with low levels of intrinsic motivation, low levels of identified regulation, and high levels of amotivation, while lower BMI, weight, and/or percent body fat were associated with high levels of intrinsic motivation, high levels of identified regulation, and low levels of amotivation. Significant positive associations between controlled eating regulation and BMI, weight, and/or percent body fat were found in those living off-campus, but not on-campus. In those living off-campus, higher BMI, weight, and/or percent body fat at the end of the second year of college were found in those with high amotivation and high external regulation while those with low levels of amotivation and low levels of external regulation had lower BMI, weight, and/or percent body fat. In males with high levels of introjected eating regulation, those living off-campus had higher percent body fat versus males living on-campus.

Conclusions: Specific eating behaviors during the first two years of college influence BMI, weight, and/or percent body fat in females. Residency, particularly off-campus residency impacts BMI, weight, and/or percent body fat in those with specific eating behaviors. Such findings may be useful for the inclusion in university programs focused on college student health, preventing

both obesity and disordered eating/eating disorders in college students.

Introduction

Weight gain often occurs in college students, especially among freshmen during their first semester of college. Moreover, it is primarily body fat that tends to increase (on average greater than 1%) during the freshman year (Anderson and others 2003, Butler and others 2004, Economos and others 2008, Edmonds and others 2008, Graham and Jones 2002, Gropper and other 2009, Hajhosseini and others 2006, Hodge and others 1993, Hoffman and others 2006, Holm-Denoma and others 2008, Hovell and others 1895, Jung and others 2008, Kasparek and others 2008, Levitsky and others 2004, Lloyd-Richardson and others 2008, Lowe and others 2006, Mifsud and others 2009, Morrow and others 2006, Provencher and others 2009, Pullman and others 2009, Wengreen and Moncur 2009).

To prevent this weight gain, college students sometimes develop disordered eating habits and/or eating disorders (ANAD 2011, Bascow and others 2007). An estimated one million men and seven to ten million women struggle with eating disorders (ANAD 2011). Although eating disorders/ disordered eating affects men and women of all ages, ethnicities, and socio-economic status, 95% of those with an eating disorder are females between the ages of 12-25 years, placing college students, especially females, at risk (ANAD 2011). There are several types of disordered eating habits/ eating disorders. Eating disorders most commonly seen during college, especially during the first year of college include: dieting, anorexia nervosa, bulimia nervosa, and binge eating disorder (ANAD 2011, Bascow and others 2007). As many as 25% of college-aged females reported using bulimia for weight control (ANAD 2011). Furthermore, a survey from the National Association of Anorexia and Associated Disorders (ANAD) revealed that 91% of female college students had dieted to control their weight, and 22% indicated that they were frequently or always dieting. Another survey conducted by ANAD that included 185 female college students found that 58% of females felt pressured to be a certain weight and 83% of those students dieted to lose weight (ANAD 2011).

This pressure and the use of various dieting behaviors among females in college appear to be related, at least in part, to roommate assignment or residency in a sorority house whereby females adopt the behaviors of their roommates or those living in the same residence, such as in Greek housing or in a on-campus dormitory/ residence hall (Bascow and others 2007, Yakusheva and others 2011). Research has not yet investigated if these practices occur in females and males attending college who reside off-campus. Moreover, whether or not differences in eating behaviors are reflected in changes in weight and/or body composition also has not been investigated in male and female college students. Therefore, the purpose of the investigation was to assess whether on-campus living versus off-campus living and regulation of eating behaviors influence body mass index (BMI), weight, and percent body fat in male and female students over the first two years of college.

Methods

Participants and Study Design

This prospective longitudinal study followed a convenience sample of freshmen attending Auburn University in Auburn, Alabama from the freshman to sophomore year. Participants were recruited for the study by email as well as by oral announcements in introductory courses at the beginning of fall semester in 2007 (cohort 1) and 2008 (cohort 2). Recruited participants were between 17-19 years of age, were not married, were without children, and had no diagnosed eating disorder. Informed consent for those who were 19 years of age and older was obtained prior to study participation. If the participant was under 19 years of age, signed consent was obtained from the parent or legal guardian and assent from the participant. Participants received monetary compensation for their participation. This study was approved by the university's Institutional Review Board for the Use of Human Subjects in Research (approval letter found in the appendices).

Cohorts 1 and 2 were assessed at three points during the freshman year; at the beginning of the fall semester-Time 1 (T_1) (2007 and 2008, respectively), at the end of fall semester- T_2 (2007 and 2008, respectively), and at the end of the spring semester- T_3 (2008 and 2009, respectively). During the sophomore year, cohort 1 was again assessed at three points time points; at the beginning of the fall semester- T_4 (2008), the end of fall semester- T_5 (2008), and at the end of spring semester-T_6 (2009); cohort 2 was assessed only at the beginning of the fall semester- T_4 (2009) and at the end of spring semester-T_6 (2010).

Anthropometric Assessments

Anthropometric assessments were conducted between eight and eleven a.m. at all time points. Height was measured to the nearest one-quarter inch using standard techniques with a height rod attached to a digital scale (Healthometer, Pelstar, LLC, Model 500KL, Bridgeview, IL). A digital scale was used to obtain weight to the nearest 0.2 lbs. Scale accuracy was checked with external weights. Participants were required to remove items from their pockets as well to remove outer garments such as coats, shoes, belts, and hat before they were weighed and measured. Body mass index (BMI) was determined by dividing an individual's body weight (in kilograms) by his or her height (in meters squared).

Body composition was measured using bioelectrical impedance analysis (Bodystat; BioVant Systems, Detroit, MI). Measurements varied by less than 0.5% with repeated measurements of the same subject. Prior to conducting measurements, participants were asked to lie down on their back for at least five minutes. Participants' arms and legs were separated laterally from the medial axis before the attachment of electrodes to the right hand and foot. Since hydration status affects accuracy, participants were also instructed not to eat 2-4 hours prior to assessment as well as not to drink alcohol or caffeine or participate in moderate to vigorous physical activity 12 hours prior to assessment (NIH 1996).

Demographic Information

Demographic information including date of birth, age, gender, ethnicity, state of permanent residence, as well as residency while attending the university (e.g. at home with parents, off-campus apartment, duplex, trailer, or on-campus residence hall) was determined by a self-report demographic questionnaire. The residency information was obtained at all time points.

Eating Regulation Assessment

The Regulation of Eating Behavior Scale (Pelletier and others, 2004) was used to assess eating regulation. The self-report questionnaire contains 24-items (questions) based on a 7-point Likert scale that range from 1 (does not correspond at all) to 7 (corresponds exactly). Participants use the Likert scale to express the extent the item corresponded to his or her personal motive for regulating eating habits. Items on the questionnaire can be classified into two general types of eating regulation: autonomous and controlled eating regulation (Deci and Ryan 1985, 2000). Autonomous eating regulation (ER) is further divided into three subscales on the questionnaire: intrinsic motivation, integrated regulation, and identified regulation. Controlled eating regulation is also divided into subtypes: introjected regulation, external regulation, and amotivation. The investigation was part of a larger trial that examined body shape and size as well as additional psychological traits.

Statistical analyses

Differences in ethnicity/race between the university freshman population and the study population were examined using the chi-square test. Repeated measures analyses of variance was used to examine differences in BMI, weight, percent body fat, and eating regulation scores across the six time points. Moderated regression analysis was used to test the effects of interactions. The type (subscale) of eating regulation was the predictor. Gender and residency were the moderators. Body mass index (BMI), weight, and percent body fat were the outcomes or dependent variables.

Hierarchical multiple regression analyses with four steps were conducted to determine the main effects and interaction effects of the predictor eating regulation types (subscales) and the two moderator variables (gender and residency) on each of the outcome measures (BMI, weight, and percent body fat). Multiplicative terms were created for the centered independent variables to test interaction effects.

Variables were added into the equation in four successive models (steps). In the first model, T_1 BMI, weight, and percent body fat were added as a control. Gender and residency were added. Next (2), main effects (i.e. type of eating regulation, residency, gender, and cohort) were added. This was followed by (3), two-way interactions: eating regulation x gender, eating regulation x residency, and residency x gender. Finally (4), a three-way interaction of eating regulation, residency, and gender was added in the last (4^{th}) step.

Eight hierarchical multiple regression analyses were conducted (four analyses for each dependent variable, separately for each moderator). Unstandardized regression coefficients were used to interpret the standardized variables a priori.

Results

Participants

Participants included 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 participants (190 males and 345 females). The majority of the 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%). The remaining ethnic composition of the 2007 incoming freshman class included African American (11.3%), Hispanic (2.9%), Asian (1.9%), and other/unreported (0.8%). 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%). 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%). Small numbers of students were also from 18 other states. 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 re-assessment. Of the 342 participants, 215 (66%) were females and 117 (34%) were males, and 164 (48%) were from cohort 1 and 178 (62%) were from cohort 2. Table 3.2 shows changes in BMI, weight, and percent body fat over the first two years of college (i.e. T_1 to T_6). Both males and females exhibited significant gains in BMI, weight, and percent body fat over the two-year period (Newell and others 2011).

Eating Regulation Findings

Total scores on the regulation of eating behavior scale did not significantly differ from the beginning of the freshman year (T_1) to the end of the sophomore year (T_6); therefore, scores at T_6 were used for all statistical analyses. A total of 328 participants were included in the statistical analyses. Fourteen subjects were not used in the statistical analyses due to missing eating regulation questionnaire data or because they were classified as outliers with responses + 4 standard deviations from the mean.

Two-way interactions

Two-way interactions examined autonomous eating regulation and its subscales (intrinsic motivation, integrated regulation, and identified regulation) and controlled eating regulation and its subscales (introjected, external motivation, and amotivation) and both gender and residency. The first group of interactions focused on the association between gender and eating regulation on BMI, weight, and percent body fat. The second group of interactions addressed residency and eating regulation on BMI, weight, and percent body fat.

Gender

Gender X Autonomous Eating Regulation-BMI, Weight, and Percent Body Fat

BMI-A significant interaction between gender and autonomous eating regulation was determined for BMI (β= -0.356; p<0.05). Figure 3.1 indicates a significant (p<0.01) inverse association between autonomous eating regulation and BMI in females, but not males. Females with low levels of autonomous eating regulation had a higher BMI than females with high autonomous eating regulation. The two interactions taken together represented 0.4% of the variance in BMI and the total model explained 83% of the variance in the total model.

Weight-A significant interaction was determined between gender and autonomous eating regulation for weight (B= -2.053, $p<0.05$). Figure 3.2 illustrates a significant ($p<0.01$) inverse relationship between autonomous eating regulation and weight in females; the level of autonomous eating regulation did not predict weight in males. Females with low levels of autonomous eating regulation weighed more than females with high levels of autonomous eating regulation. The interactions taken together illustrated 0.2% of variance while the total model explained 90% of variance in weight.

Percent Body Fat-A significant interaction between autonomous eating regulation and gender was shown for percent body fat (β= -0.847, $p<0.01$). Figure 3.3 indicates that there is a significant ($p<0.01$) negative association between autonomous eating regulation and percent body fat in females. No correlation between autonomous eating regulation and body fat was shown in males. Females with low levels of autonomous eating regulation had a higher percent body fat than females with high levels of autonomous eating regulation. The two interactions taken together explained 0.6% of variance while the total model explained 84% of the variance in percent body fat.

Gender X Intrinsic Motivation-BMI, Weight, and Percent Body Fat

BMI- A significant interaction was revealed between gender and intrinsic motivation for BMI (β= -0.255, $p<0.05$). Females displayed a significant ($p<0.01$) negative relationship between intrinsic motivation and BMI (Figure 3.4). No association was found in males. Females with low intrinsic motivation had a higher BMI than females with high intrinsic motivation. The interactions taken together indicated 0.3% of the variance and 83% of the variance was represented by the total model.

Weight- A trend toward a significant interaction between gender and intrinsic motivation was found for weight (B= -1.427, $p<0.10$). A significant ($p<0.01$) negative association between intrinsic motivation and weight was discovered in females. Females (but not males) with low levels of intrinsic motivation weighed more than females with high levels of intrinsic motivation. The two interactions taken together revealed 0.1% of variance and 90% of variance was illustrated in the total model.

Percent Body Fat-A significant interaction between intrinsic motivation and gender was discovered for percent body fat (β= -0.808, $p<0.005$). There was a significant ($p<0.01$) inverse association between intrinsic motivation and percent body fat in females, and no relation in males. At low levels of intrinsic motivation, females had higher percent body; at high levels of intrinsic motivation, females had lower percent body fat (Figure 3.5). The interactions taken together explained 0.6% of the variance in percent body fat while in the total model, it accounted for illustrated 84% of the variance.

Gender X Integrated Eating Regulation-BMI, Weight, and Percent Body Fat

No significant interaction was found between gender and integrated eating regulation for BMI, weight, or percent body fat.

Gender X Identified Eating Regulation- BMI, Weight, and Percent Body Fat

BMI- There was a significant interaction between gender and identified eating regulation for BMI (B= -0.424, $p<0.05$). Figure 3.6 indicates a significant ($p<0.01$) negative relationship between BMI and identified eating regulation in females; no relationship was shown in males. Females with low identified eating regulation had higher BMIs than did females with high levels of identified eating regulation. The interactions taken together explained 0.5% of the variance and 83% of the variance was represented in the total model.

Weight- A significant interaction between gender and identified eating regulation for weight was determined (B= -2.552, $p<0.01$). Figure 3.7 revealed a significant ($p<0.01$) inverse association between identified ER and weight in females. The level of identified eating regulation did not predict weight in males. Females with low levels of identified eating regulation weighed more than females with high identified eating regulation. The interactions taken together represented 0.3% of the variance. The total model displayed 90% of the variance in weight in females.

Percent Body Fat- A significant interaction between gender and identified eating regulation for percent body fat was determined (β= -0.698, $p<0.05$). Figure 3.8 displays a significant ($p<0.01$) negative relationship between identified regulation and percent body fat in females. An association was not found in males. Females with low levels of identified eating regulation had higher levels of body fat than females with high levels of identified eating regulation. The two interactions taken together explained 0.4% of the variance in percent body fat. The total model revealed 84% of the variance.

Gender X Controlled Eating Regulation-BMI, Weight, Percent Body Fat

No significant interactions were identified between gender and controlled eating regulation in predicting BMI, weight, or percent body fat.

Gender X Introjected Eating Regulation- BMI, Weight, Percent Body Fat

No significant interactions were discovered between gender and introjected eating regulation in the prediction of BMI, weight, or percent body fat.

Gender X External Regulation-BMI, Weight, Percent Body Fat

No significant interactions were found between gender and external regulation in the prediction of BMI, weight, or percent body fat.

Gender X Amotivation- BMI, Weight, and Percent Body Fat

No significant interactions were shown between gender and amotivation for BMI or for weight.

Percent Body Fat- A significant interaction between gender and amotivation was identified (β= 0.622, $p<0.05$). A significant ($p<0.001$) positive relationship between amotivation and percent body fat was shown in females (Figure 3.9); no relationship was discovered between amotivation and percent body fat in males. Females with high levels of amotivation had a higher percent body fat than did females with low levels of amotivation. The interactions taken together illustrated 0.5% of the variance and the total model indicated 84.5% of the variance in percent body fat.

Residency

The results of two-way interactions that examined interactions between residency and eating regulation on BMI, weight, and percent body fat are provided hereafter.

Residency X Autonomous Eating Regulation and its Subscales- BMI, Weight, and Percent Body Fat

No significant interactions were found between residency and autonomous eating regulation and its three subtypes (intrinsic motivation, integrated eating regulation, and identified eating regulation) in predicting BMI, weight, or percent body fat.

Residency X Controlled Eating Regulation and Subscales- BMI, Weight, and Body Fat

The results of two-way interactions examining associations among residency and controlled eating regulation and its subscales: introjected regulation, external regulation, and amotivation are provided next.

Residency X Controlled Eating Regulation-BMI, Weight, and Percent Body Fat

BMI- A significant interaction was discovered between residency and controlled eating regulation (B=-0.405, $p<0.05$). Figure 3.10 illustrates a significant ($p<0.011$) positive association between controlled eating regulation and BMI in participants residing off-campus. Participants living on-campus did not display an association between controlled ER and BMI. Off-campus participants with low levels of controlled eating regulation had lower BMIs than did off-campus participants with high levels of controlled eating regulation. The interactions taken together represented 0.2% of the variance while the total model displayed 83% of the variance.

Weight-A significant interaction between residency and controlled eating regulation was discovered (β= -3.025, $p<0.05$). A significantly ($p<0.01$) positive relationship between residency and controlled eating regulation in predicting weight was identified in participants living off-campus, Figure 3.11. Participants living on-campus did not exhibit a relationship between controlled eating regulation and weight. Off-campus participants with low controlled eating regulation weighed less than off-campus participants with high levels of controlled eating regulation. The interactions taken together explained 0.2% of variance and the total model indicated 90% of variance.

Percent Body Fat- A significant interaction was identified between residency and controlled eating regulation in predicting percent body fat (β= -1.088, $P<0.05$). Figure 3.12 indicates that there is a significant ($p<0.01$) positive association between controlled eating regulation and percent body fat in participants living off-campus; however a relation between controlled eating regulation and percent body fat in participants living on-campus was not determined. Participants residing off-campus with low levels of controlled eating regulation had lower percent body fat than participants with high levels of controlled eating regulation living off-campus. The interactions taken together explained 0.4% of the variance in percent body fat and the total model revealed 84.5% of the variance.

Residency X External Eating Regulation- BMI, Weight, and Percent Body Fat

No significant interactions were found between residency and external eating regulation for BMI and weight.

Percent Body Fat- A significant interaction between residency and external eating regulation was determined (β= -0.560, p<0.05). A significant (p<0.01) positive association between external eating regulation and percent body fat was shown in participants living off-campus (Figure 3.14); no association was discovered between external regulation and body fat in those living on-campus. Participants living off-campus with low external regulation had lower percent body fat compared to those with higher external regulation. The two interactions taken together represented 0.3% of variance and 84% of variance was indicated in the total model.

Residency X Amotivation- BMI, Weight, and Percent Body Fat

BMI- A significant interaction was identified between residency and amotivation (B= -0.300, P<0.05). A significant association (p=0.034) was found between amotivation and BMI in participants living off-campus. Participants living off-campus with low levels of amotivation had lower BMIs than those living off-campus with higher levels of amotivation. The interactions taken together explained 0.3% of the variance; 83% of the variance was illustrated in the total model.

Weight- A significant interaction was identified between residency and amotivation (β=-2.126, p<0.05). No significant (p<0.221) association between amotivation and residents was discovered: for both resident and non-residents, the association and body weight was not significantly different from zero (Figure 3.15). The interactions taken together represented 0.2% of the variance and the total model indicated 90% of the variance in weight.

Percent Body Fat- A significant interaction between residency and amotivation was established (β= -0.851, p<0.01). Figure 3.16 displays a significant (p<0.01) positive association between amotivation and percent body fat among participants living off-campus. No correlation was discovered between amotivation and percent body fat in participants living on-campus. Participants living off-campus with low levels of amotivation had lower body fat compared to participants living off-campus with higher levels of amotivation. The two interactions taken together represented 0.5% of the variance while the total model displayed 84.5% of the variance in percent body fat.

Three-way interactions

Three way interactions focused on gender, residency, and eating regulation as predictors of BMI, weight, and percent body fat. The significant three-way interaction that was identified was only found in males. Specifically, males living off-campus with high levels of introjected regulation behavior had higher percent body fat than males living on-campus with high levels of introjected regulation (Figure 3.17).

Discussion

This study examined the association between gender and residency and regulation of eating behaviors on BMI, weight, and percent body fat in students over the first two years of college. Gender effects were clearly demonstrated in that relationships between regulation of eating behavior and BMI, weight, and percent body fat were only shown in females; no associations were found in males. Similarly, residency effects were also shown whereby relationships between eating regulation and BMI, weight, and percent body fat were only found in participants living off-campus, and not in those living on-campus.

This study's findings are of significance in that they extend the work of other studies which have demonstrated both unhealthy dietary intake patterns in college students (Kasparek and others 2008, Racette and others 2005, Serlachius and others 2007) and association between poor dietary habits and gains in weight and/or BMI in college students, especially during the freshman year (Adams and Rini 2007, Economos and others 2008, Haberman and Luffy 1998, Levitsky and others 2004). In this study, higher BMI, weight, and percent body fat in females were associated with low intrinsic motivation and low identified eating regulation; higher percent body fat also was associated with high amotivation. Such findings are consistent with theories of control of eating behaviors. For example, according to Pelletier and others (2004), highly amotivated individuals believe that their behavior is the result of external forces outside the realm of their control. Therefore, individuals, specifically females, with low levels of amotivation would believe that they control their eating habits (and perhaps exercise habits). Individuals with low levels of amotivation believe that how they control their eating habits is not related to external forces. This explanation is consistent with the demonstrated associations between low amotivation and lower percent body fat/ high amotivation and higher percent body fat in females in this study. Identified regulation of eating behavior occurs when individuals control their eating behavior because they believe that the regulatory behavior will improve their feelings about themselves and will help to ensure long term health benefits (Deci and Ryan 1985). Those who possess high levels of intrinsic motivation believe that it is fun/ pleasurable to prepare healthy meals and enjoy creating meals that are good for their health. Individuals with high levels of intrinsic motivation desire to regulate their eating habits in order to optimize their health. Thus, the findings from the current investigation that low levels of identified eating regulation and low levels of intrinsic motivation predict higher BMI, weight, and percent body fat in females are consistent with theories of control of eating behaviors.

The eating regulation behaviors associated with BMI, weight, and percent body fat found in females were mostly confined to autonomous eating regulation. Individuals with high levels of autonomous eating regulation are highly internally motivated to make healthy dietary choices and select foods that will provide for better health. Moreover, those with high autonomous eating regulation exhibit feelings of competency about their food choices.

The gender differences observed in this study have also been shown in a study by Provencher and others (2009) who reported relationships between weight gain and several psychological factors in females, but not in males, during the freshman year of college. Most studies that have examined regulation of eating behaviors have used other instruments to assess eating behaviors and have included only females (Delinsky and others 2008, Yakusheva and others 2011), thus direct comparisons with these studies are not possible.

Reasons for the observed gender differences are not clear; however, this study's findings are not surprising given the higher prevalence of eating disorders / disordered eating in females versus males (ANAD 2011, Cain and others 2008, Jarry and others 2006, Lowe and others 2006). Disordered eating habits such as restrained eating typically occur in women more than men because women often use dietary restraint as a means to obtain social acceptance (Jarry and others 2006). This is especially true when women have high levels of self-confidence (high self-efficacy) in their looks, but have low levels of self-confidence (low self-efficacy) in their ability to successfully maintain relationships with others (Cain and others 2008). Moreover, Cain and others (2008) revealed that undergraduate females with a combination of low levels of confidence in interpersonal relationships combined with high levels of stress in relationships with others, high interpersonal perfectionism, and higher levels of self-confidence about appearance frequently diet.

In the present study, residency effects were also found, whereby controlled eating behaviors – specifically amotivation and external regulation were associated with BMI, weight, and percent body fat in participants living off-campus. The associations found in this study are consistent with theories of eating behavior. Low levels of amotivation were associated with lower BMI, weight, and percent body fat. Individuals with low levels of amotivation would see the benefits of eating healthy and thus would not feel like they wasted their time regulating eating habits. Low levels of external regulation also were associated with lower percent body, and there was a trend toward an association with lower BMI and weight. According to theories of eating regulation behaviors, individuals with low levels of external regulation would feel like other people did not matter when it comes to controlling their eating behaviors. The eating regulation behaviors most associated with BMI, weight, and percent body fat in the college students living off-campus in this study were confined to controlled (versus autonomous) eating regulation. Individuals with low levels of controlled eating do not consider others when making dietary food choices; they are not as influenced by external sources as someone with high levels of controlled eating. In contrast those with high levels of controlled eating are greatly influenced by others and often feel helpless and incompetent about making food choices that will benefit them.

The findings of associations between external regulation and amotivation eating regulations and BMI, weight, as well as percent body fat only in those study participants who lived off-campus but not on-campus are not clear. The difference may be related to a greater amount of control (or sense of control) that students living off-campus have over their food selection and preparation options than students living on-campus. The usual appliances found in a dorm room are a microwave oven and perhaps a small refrigerator versus a full kitchen that would be available to those living off-campus. Most studies, however, have examined on-campus residency. It has been reported that over 70% of college students kept salty snacks, cereal or granola bars, main dishes, desserts, or candy and sweetened beverages in their dorm rooms (Nelson and Story 2009). It also has been suggested that the daily opportunities for freshmen living on-campus to choose from a multitude of on-campus restaurants linked to the meal plan may provide a "toxic environment" (Hull and others 2007).

A review of the literature shows few studies that have examined the role of residency during college as it relates to either dietary habits or weight gain. An examination of the population used in this study by Harrington (2009) found that over the freshman year, females living on-campus reportedly ate at restaurants significantly more frequently (7.0 per week) than did females living off-campus (4.4 times per week); greater frequency of restaurant/ fast food dining has been link with higher energy consumption and BMI and/or weight gains (Bowman and Vinyard 2004, Duffey and others 2007, French and others 2000, Jeffery and French 1998). Beerman and others (1990) found that college students living off-campus were less likely to eat cookies than those students living on-campus, and those living off-campus were less likely to eat fruits and vegetables compared to those students living on-campus. Although only studying students living on-campus, Kapinos and Yakusheva (2011) found that males who lived in an on-campus dorm with an on-site or nearby dining hall exhibited increased snack consumption and females had greater weight gain versus those living on-campus without nearby dining facilities. These findings suggest perhaps "less healthy" dietary intake habits in those living on-campus, especially with on-site dining, than those living off-campus. Whether such dietary intake differences between students living on versus off-campus result in differences in weight gain have not been studied. However, three studies examining BMI, weight, and body composition between students living on- versus off-campus reported greater weight gains and unhealthier body composition changes in those living on-versus off-campus (Harrington 2009, Hull and others 2007, Pliner and Saunders 2008).

The residency effects demonstrated in the present study were confined primarily to students living off-campus with higher BMI, weight, and percent body fat associated with higher external regulation and higher amotivation; however, males living off-campus with high levels of introjected eating regulation had higher percent body fat than males living on campus with high levels of introjected eating regulation. This finding suggests that males who live on-campus who are self-conscious about their appearance and eating healthy may act on these behaviors to control eating (and perhaps physical activity) to a greater extent than males living off-campus; such actions could account for the lower percent body fat among the males living on-campus versus off-campus. Typically, it would be expected that those with high levels of introjected regulation would be more influenced by others versus those with low levels of introjected regulation. Studies conducted among female college students living on-campus found that roommates clearly exert an influence. Yakusheva and others (2011) found that females living on-campus in residence halls often adopted the habits of restrictive food consumption and use of weight loss supplement from their female roommates. Furthermore, Bascow and others (2007) showed that females living in Greek housing were more likely to practice bulimic behaviors than those who did not live in Greek housing, regardless if the individual was a member of a sorority. Individuals with disordered eating behaviors such as bulimia are often influenced by peers or adopt the disordered eating habit due to bodily shame or due to overwhelming emotions (i.e. being out of control); moreover, they usually have higher BMI, weight, and/or percent body fat (Mayo Clinic 2011). It may be speculated that living on-campus negatively impacts the eating habits of females with high levels of introjected eating regulation; however, further studies are needed to evaluate such relationships in both males and females living on- and off-campus.

This study has both strengths and limitations. Some of the strengths are its fairly large sample size that was representative of the university population and the ability to include students living both on- and off campus since many universities across the United States require freshmen to live on-campus and thus do not have off-campus residency opportunities for first year students. Another strength was the longitudinal design of the study; most studies of college students have been restricted to freshman year. A limitation of the study was that the results may not be applicable to those students attending private universities since study participants attended a public university. Also, the study did not include a comparison or control group of young adults who moved away from home after high school but did not enter college. Another limitation was self-selection bias since only students who may have felt secure enough with their weight or were comfortable enough to be measured again may have returned. Weight goals of the participants were not controlled for and may have influenced the results. Lastly, the findings relied on the subject's honesty to self-report their responses to the eating regulation questionnaire.

The investigation makes a unique contribution to the literature in that it is the first study to examine the impact of eating regulation behaviors and residency on BMI, weight, and percent body fat in males and females during the first two years of college. In females, higher BMI, weight, and/or percent body fat at the end of the sophomore year of college were primarily found in those with low levels of intrinsic motivation, low levels of identified regulation, and high levels of amotivation, while lower BMI, weight, and/or percent body fat was associated with high levels of intrinsic motivation, high levels of identified regulation, and low levels of amotivation. In those living off-campus, higher BMI, weight, and/or percent body fat at the end of the second year of college were found in those with high levels of amotivation and high levels of external regulation while those with low levels of amotivation and low levels of external regulation had lower BMI, weight, and/or percent body fat. In males with high levels of introjected eating regulation, those living off-campus had higher percent body fat versus males living on-campus.

The findings of this study provide important information to universities designing programs focused on college student health- preventing high BMI, weight, and percent body fat associated with obesity and disordered eating as well as preventing low BMI, weight and percent body fat associated with eating disorders such as anorexia nervosa in college students. Programs that target college students, especially females, are needed and should both promote the importance of a healthy diet and physical activity for optimal health as well as to strive to increase awareness of eating disorders/ disordered eating. Program content also should address eating regulation, focusing on diminishing controlled eating regulation and increasing autonomous eating regulation among students.

Chapter 4

Summary

Autonomous Regulation and Subscales X Gender

Significant negative interactions between autonomous eating regulation and gender were found for BMI, weight, and percent body fat. Generally, those females with low levels of autonomous eating regulation had higher BMI, body weight, and percent body fat than females with high levels of autonomous regulation.

Significant negative interactions between intrinsic motivation and gender were discovered for BMI and percent body fat. Females with low levels of intrinsic motivation displayed higher BMI and percent body fat than females with high levels of intrinsic motivation.

Significant interactions were found in identified regulation and gender in the prediction of BMI, weight, and percent body fat. Females with low levels of identified regulation showed higher BMI, weight, and percent body fat compared to females with high levels of identified regulation.

Controlled Regulation and Subscales X Gender

A significant interaction was determined between amotivation and gender in the prediction of percent body fat. Females with low levels of amotivation displayed lower percent body fat than females with high levels of amotivation.

Controlled Regulation and Subscales X Residency

Significant positive interactions were identified between controlled regulation and residency in the prediction of BMI, weight, and percent body fat. Generally, participants living off-campus with low levels of controlled regulation had lower BMIs, body weight, and percent body fat versus those living off-campus with high levels of controlled regulation.

A significant positive interaction was found between external regulation and residency in the prediction of percent body fat. Participants living off-campus with low levels of external regulation had a lower percent body fat than those living off-campus with high levels of external regulation.

Significant positive interactions were revealed between amotivation and residency in the prediction of BMI, weight, and percent body fat. Participants living-off campus with low levels of amotivation had lower BMI, weight, and percent body fat than those living off campus with high levels of amotivation.

Eating Regulation X Residency X Gender

A significant three-way interaction was found between eating regulation, residents, and gender. Males living off-campus with high introjected eating regulation behavior had higher percent body fat than males living on-campus with high levels of introjected regulation or females regardless of residency or the level of introjected eating regulation.

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Table 3.1: Selected baseline demographic and anthropometric characteristics of the participants

	Cohort 1 (n = 240)[1]		Cohort 2 (n = 295)[2]	Both Cohorts
Gender[a]				
Female	155 (65%)		190 (64%)	345 (65%)
Male	85 (35%)		105 (36%)	190 (35%)
Age (years)	18.12(0.40)		18.10(0.38)	18.11(0.4)
Height (inches)				
Female	64.7(2.3)		64.3(2.3)	64.5(2.3)
Male	70.0(2.6)		69.8(2.7)	69.9(2.6)
Weight (lbs)				
Female	133.5(28.9)		129.5(18.5)	130.9(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 (3.92)		23.1 (2.7)	23.4 (3.4)
Body Fat %				
Females	22.6 $\pm$ 6.1		24.1 $\pm$ 4.4	23.4 $\pm$ 5.3
Males	11.0 $\pm$ 4.9		11.9 $\pm$ 4.1	11.5 $\pm$ 4.5
Caucasian	196 (81.7%)		262 (88.8%)	
African American	29 (12.1%)		11 (3.7%)	
Hispanic	7 (2.9 %)		11 (3.7%)	
Asian	4 (1.7%)		10 (3.4%)	
Other	4 (1.7%)		1 (<1%)	
Permanent Residence[a]				
Alabama	149 (62.1%)		180 (61.0%)	
Georgia	37 (15.4%)		38 (12.8%)	
Tennessee	11 (4.6%)		17 (5.7%)	
Texas	9 (3.8%)		7 (2.4%)	
North Carolina	7 (2.9%)		3 (1.0%)	
Florida	4 (1.7%)		12 (4.1%)	
Louisiana	2 (0.4%)		4 (1.4%)	
Maryland	2 (0.4%)		5 (1.7%)	
Illinois	2 (0.4%)		3 (1.0%)	
Mississippi	2 (0.4%)		2 (<1.0%)	
Ohio	2 (0.4%)		2 (<1.0%)	
Virginia	2 (0.4%)		2 (<1.0%)	
Arizona	2 (0.4%)	Kentucky	3 (1.0%)	
Other (1 each)	9 (3.8%)	Other (1 each)	6 (2.0%)	

22 different states		different states
School Residence[a]		
Campus dorm	147 (61.3%)	168 (56.0%)
Apartment, house, duplex, or trailer	90 (37.5%)	124 (42.0%)
With parents	2 (1.2%)	3 (1.0%)

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

[1] Baseline assessment beginning Fall 2007.
[2] Baseline assessment beginning Fall 2008.

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

	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

Figures of Significant Two-way Interactions: Autonomous Eating Regulation and Subscales

**ER= Eating Regulation*

Figure 3.1: Autonomous Eating Regulation X Gender Predict BMI

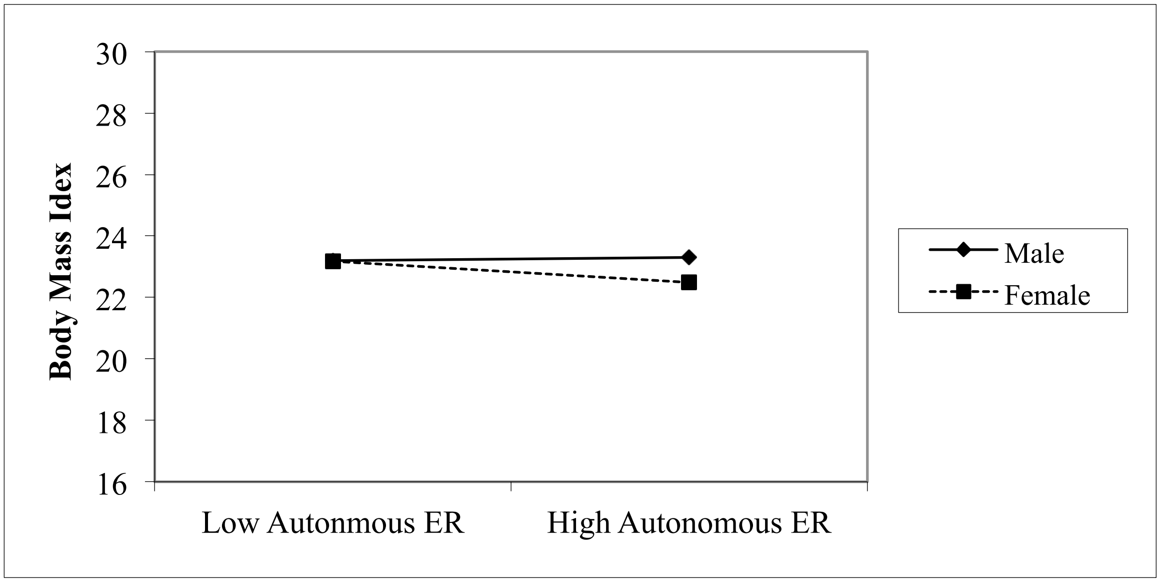


Figure 3.2: Autonomous Eating Regulation X Gender Predict Weight

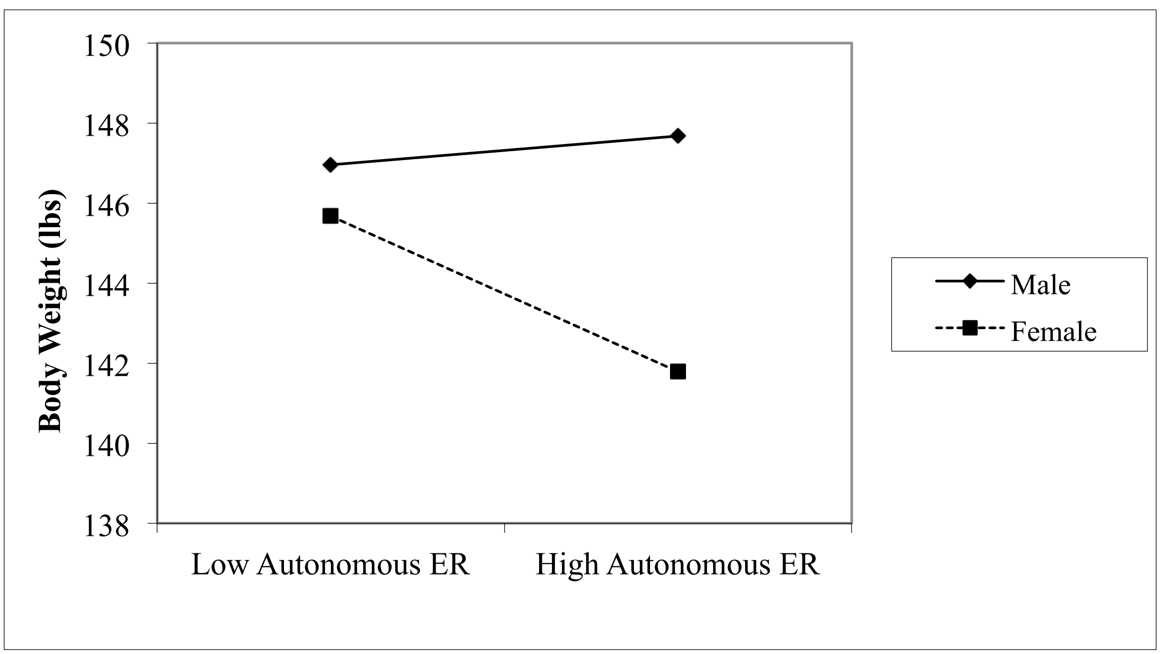


Figure 3.3 Autonomous Eating Regulation X Gender Predict Percent Body Fat

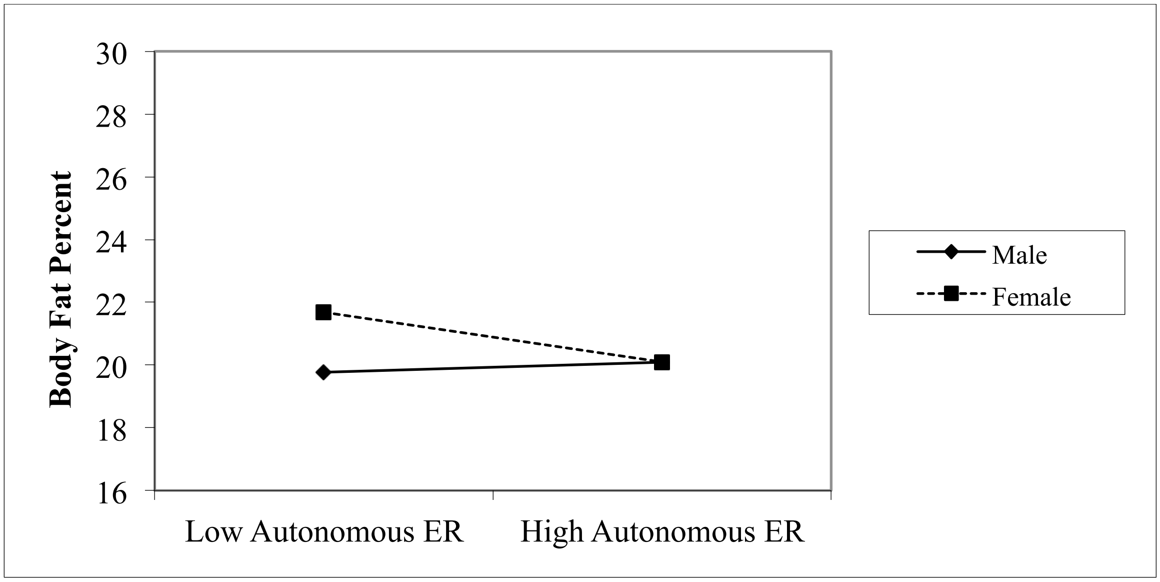


Figure 3.4: Intrinsic Motivation X Gender Predict BMI

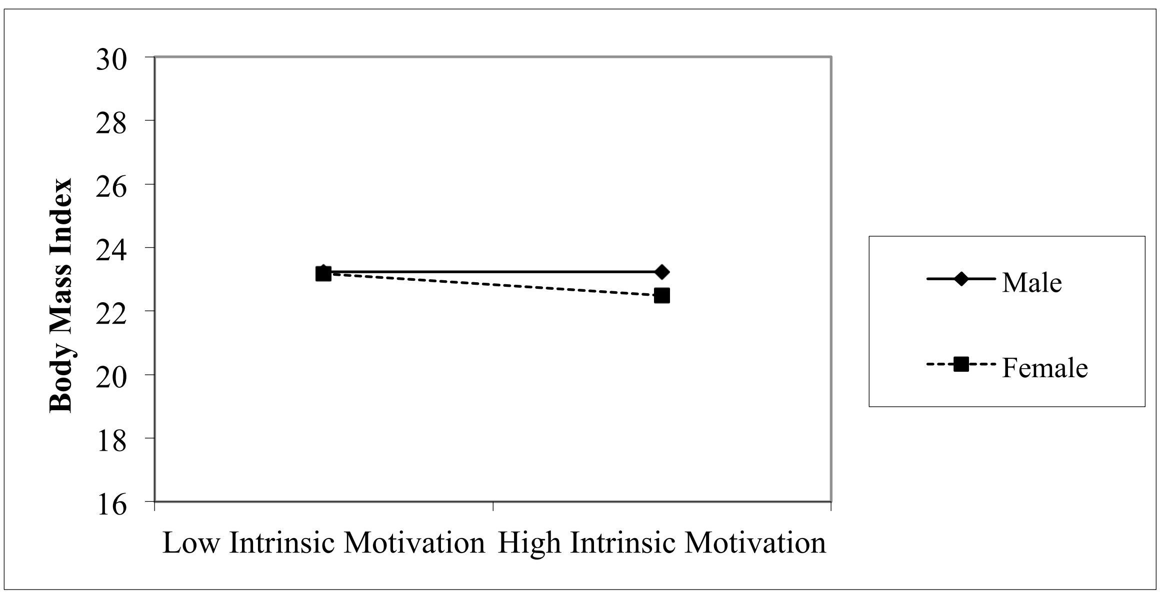


Figure 3.5: Intrinsic Motivation X Gender Predict Percent Body Fat

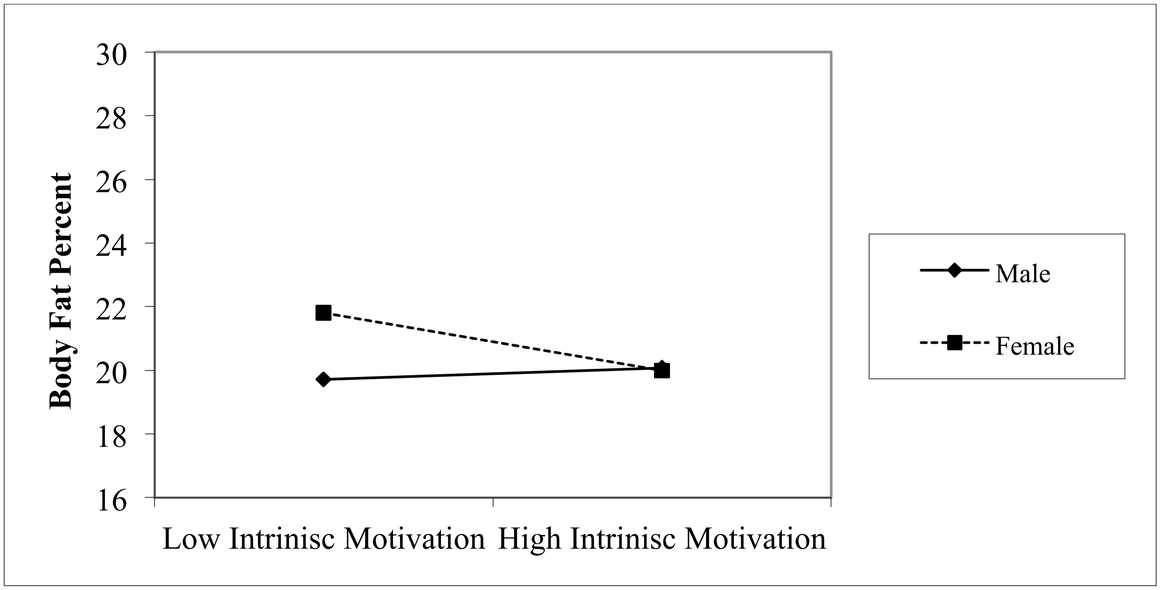


Figure 3.6: Identified Eating Regulation X Gender Predict BMI

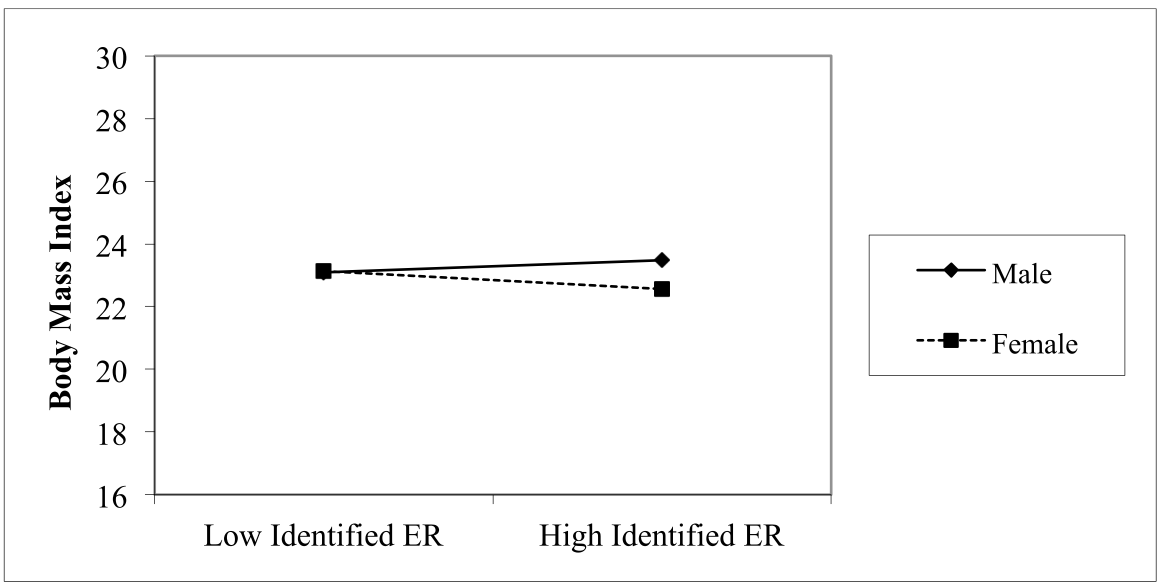


Figure 3.7: Identified Eating Regulation X Gender Predict Weight

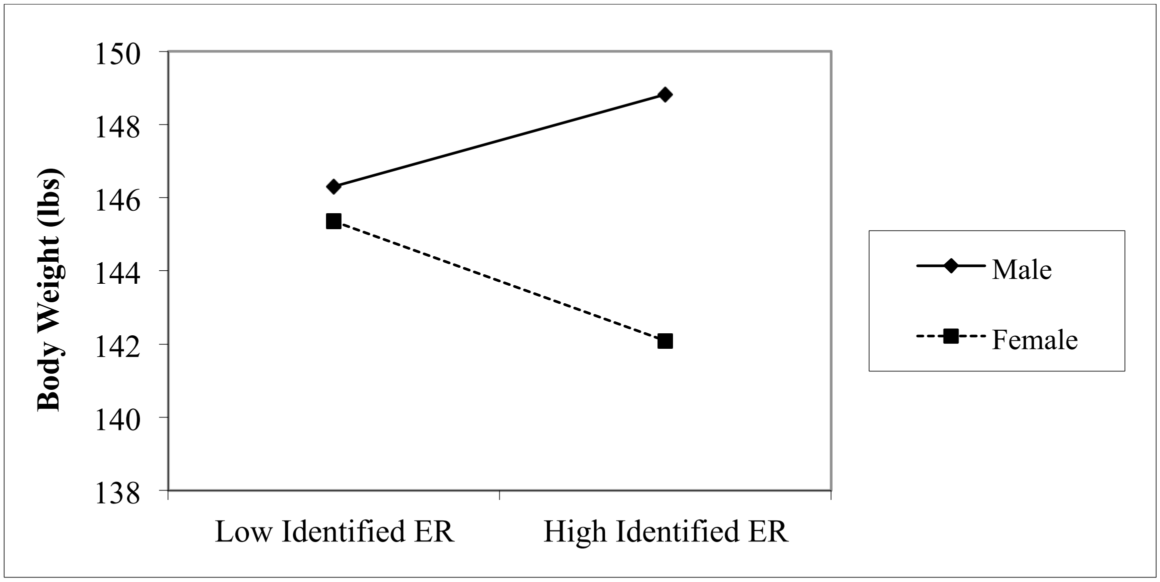
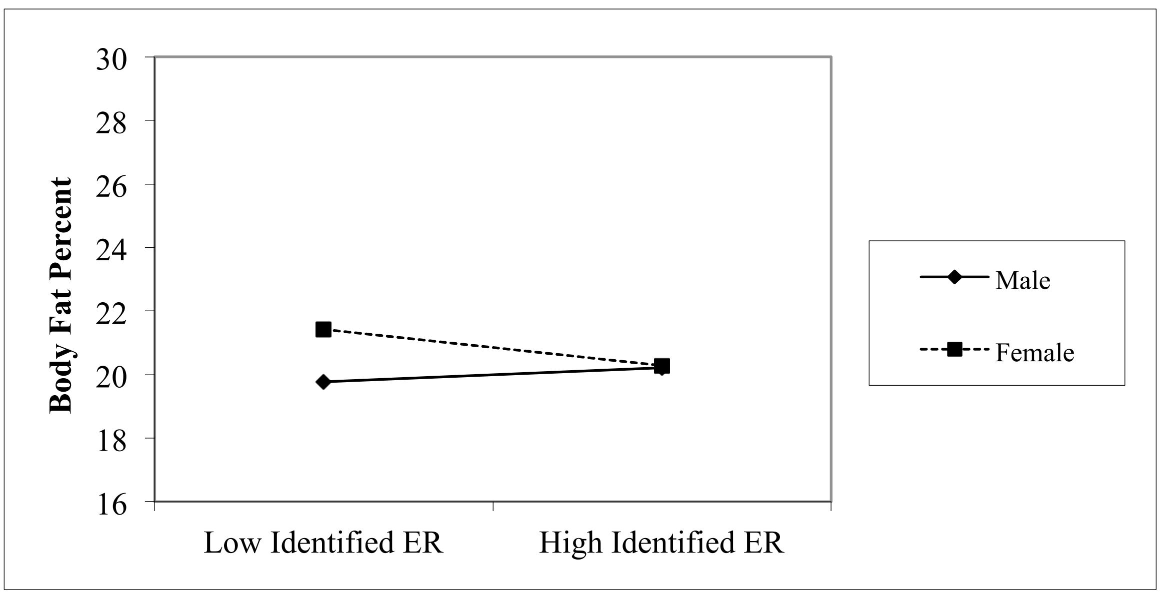


Figure 3.8: Identified Eating Regulation X Gender Predict Percent Body Fat



Figures of Significant Two-Way Interactions of Controlled ER and Subscales

Figure 3.9: Amotivation X Gender Predict Percent Body Fat

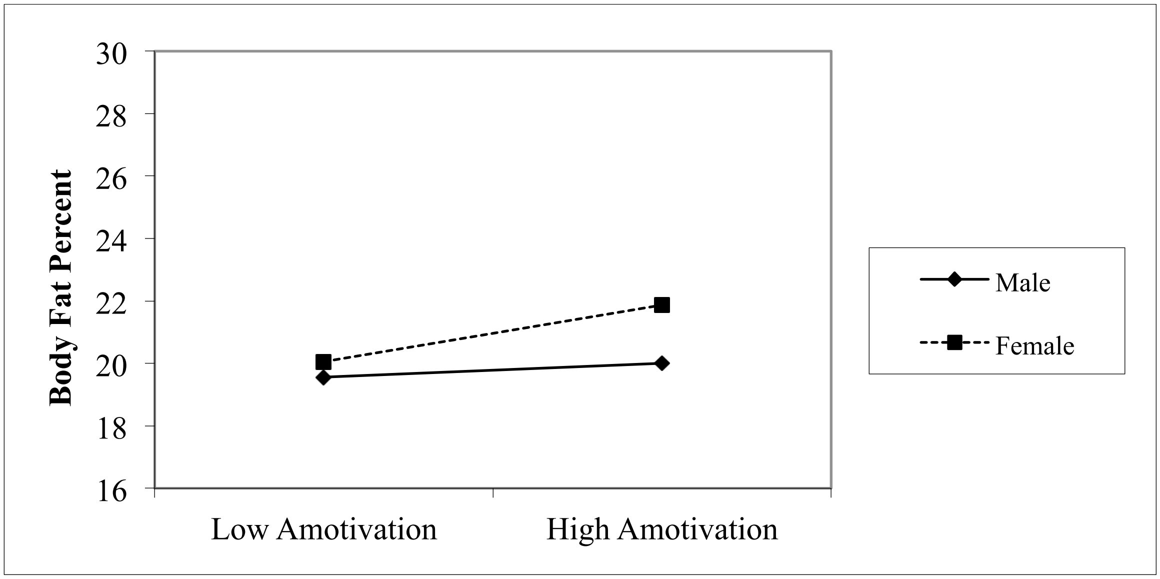


Figure 3.10: Controlled Eating Regulation X Residency predict BMI

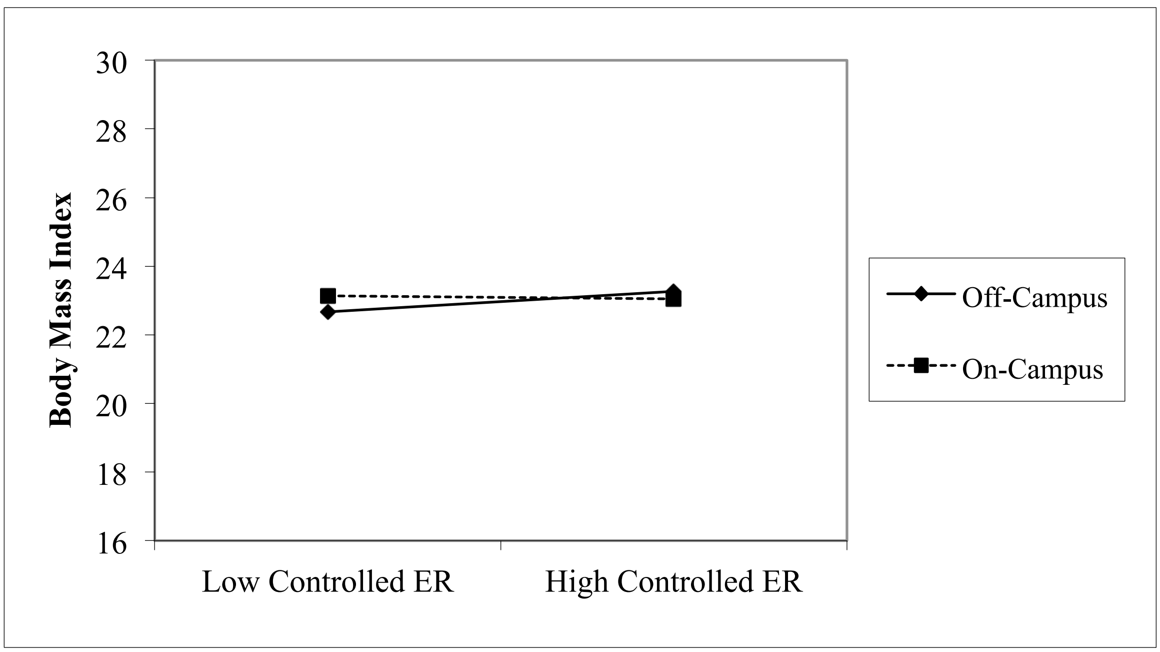


Figure 3.11: Controlled Eating Regulation X Residency Predict Weight

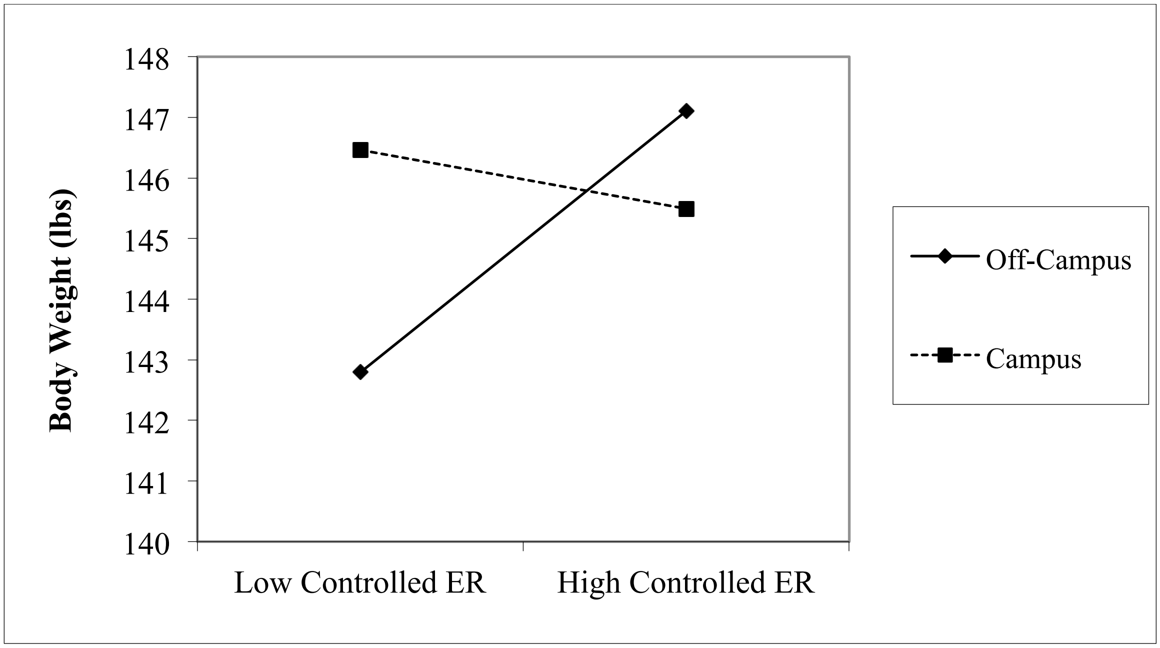


Figure 3.12: Controlled Eating Regulation X Residency Predicts Percent Body Fat

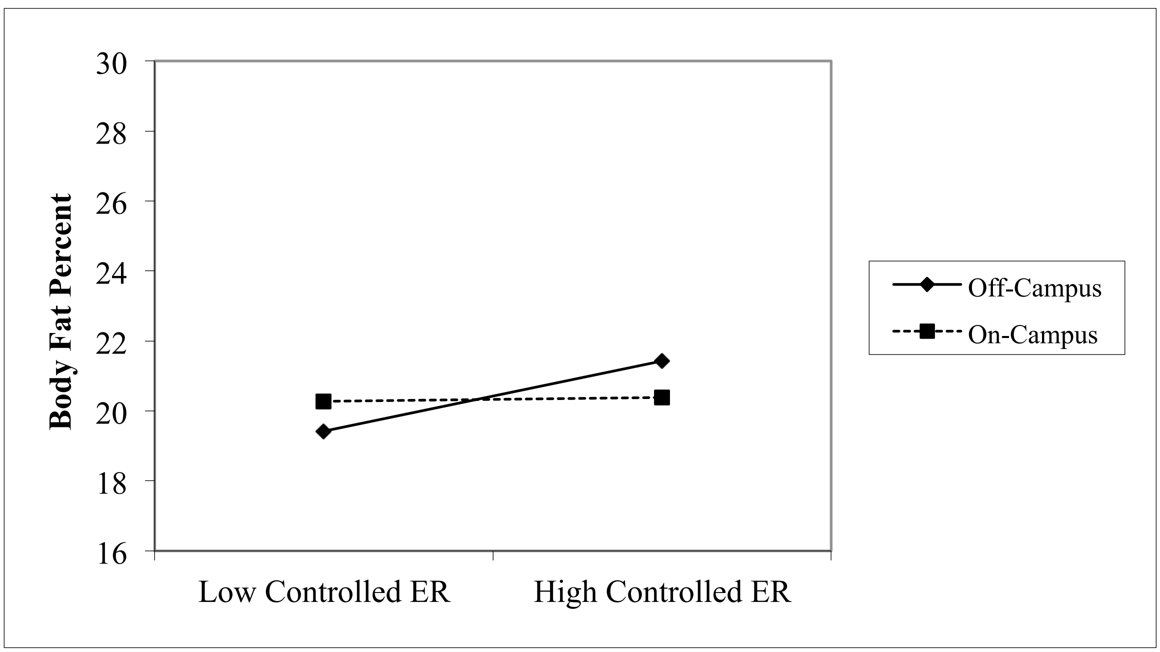


Figure 3.13: External Eating Regulation X Residency Predict Percent Body Fat

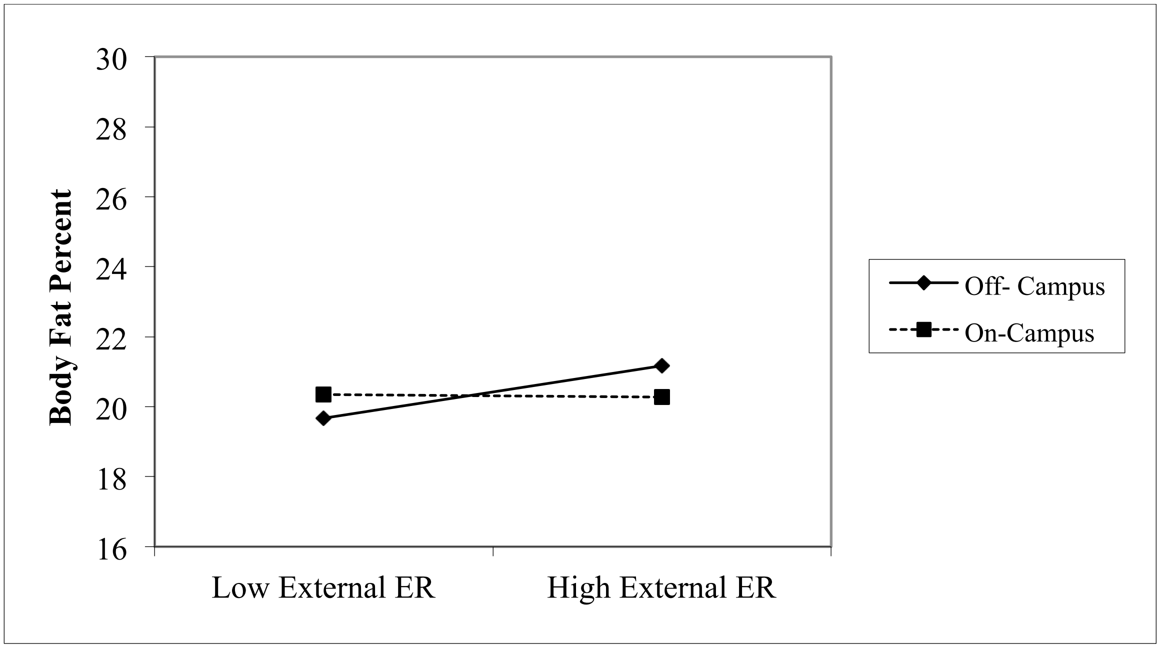


Figure 3.14: Amotivation X Residency Predict BMI

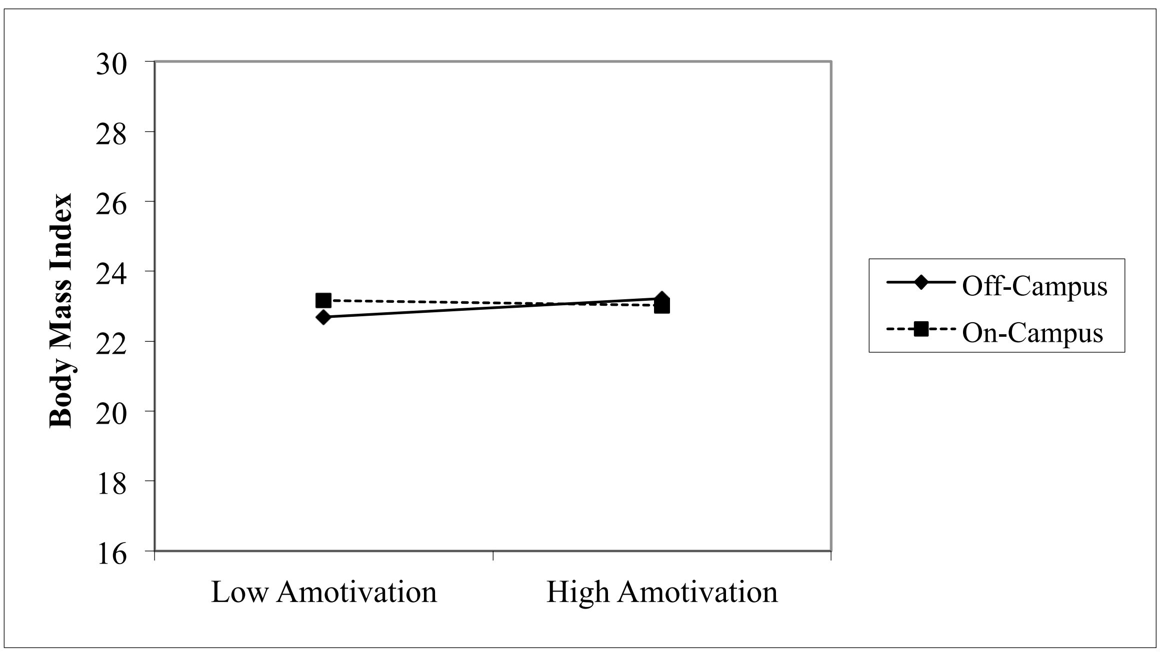


Figure 3.15: Amotivation X Residency Predict Weight

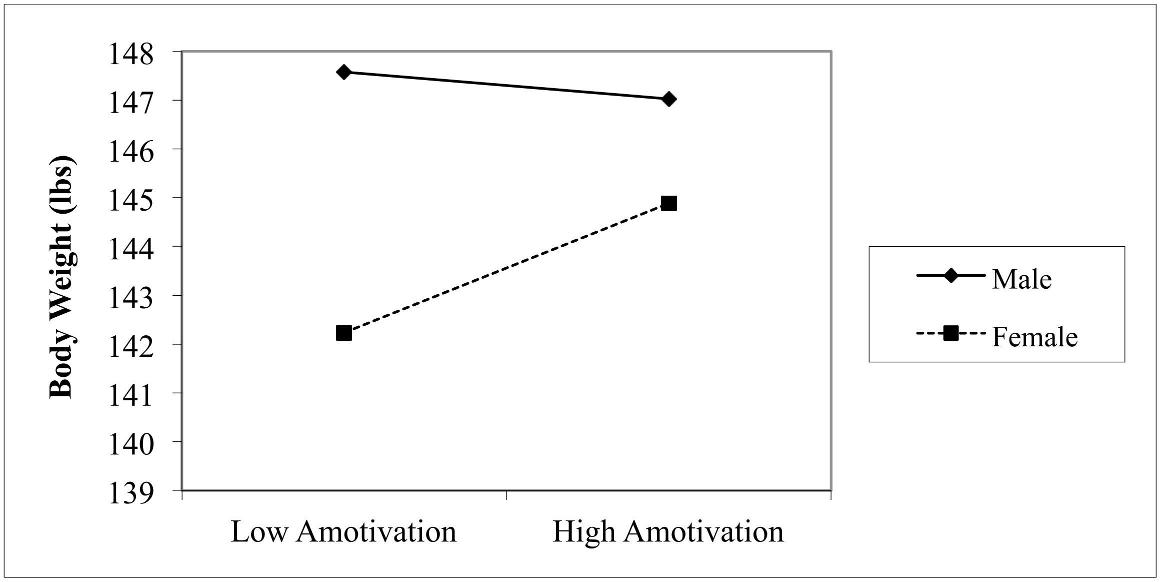
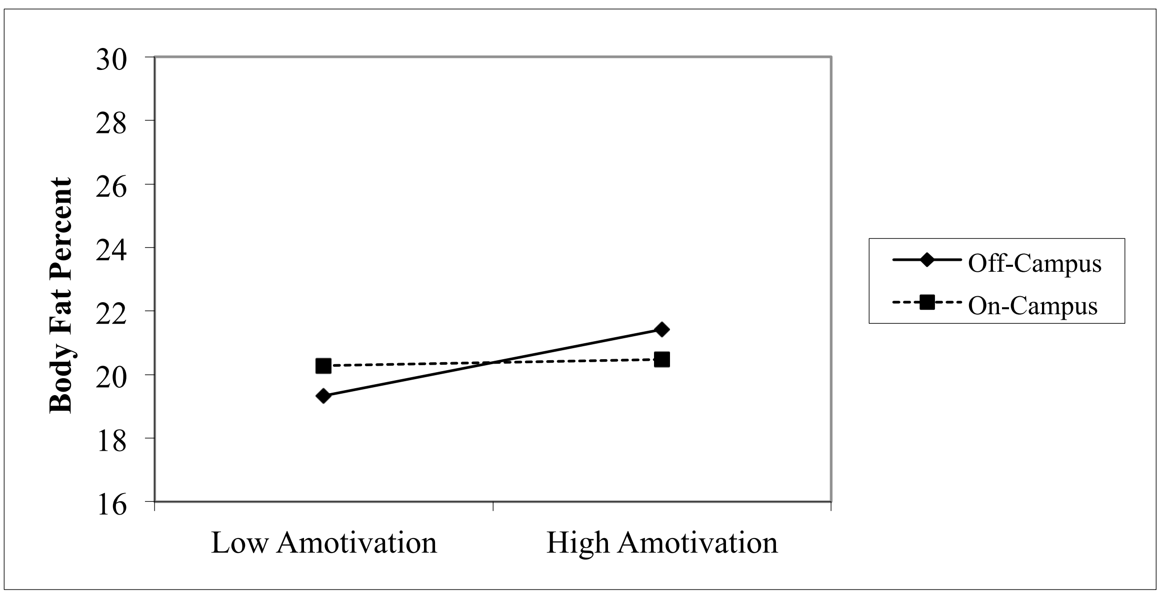
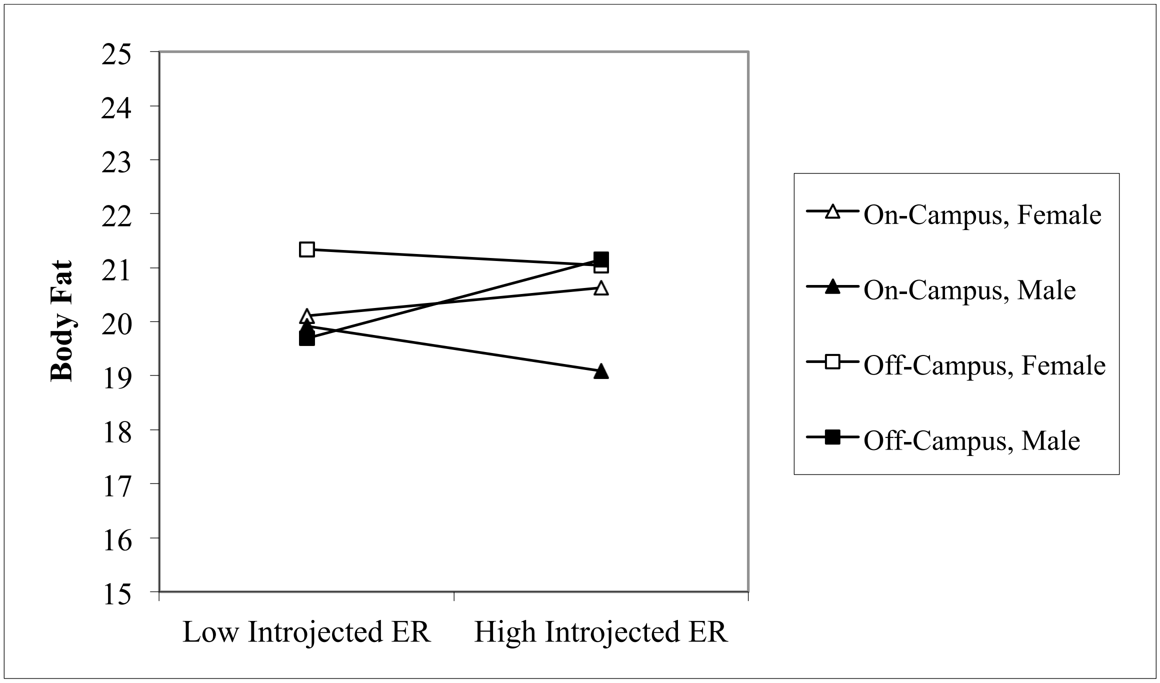


Figure 3.16: Amotivation X Residency Predict Percent Body Fat



Significant Three-Way Interaction:

Figure 3.17: Residency X Gender X Introjected Eating Regulation Predict Percent Body Fat



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Appendices

Appendix A. Institutional Review Board Approval Letter.

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

Appendix B. Correlations, Standard Deviation, and Means of BMI, Weight, Percent Body Fat, Autonomous Eating Regulation and Subscales, Controlled Eating Regulation and Subscales, Gender, Residency, and Cohort.

	T1%Bfat	T6%Bfat	T1BMI	T6BMI	T1Wt	T6 Wt	T6 Auto ER	T6 Con ER	T6 Intr Mot	T6 Inte ER	ID ER	Intro ER	Ext ER	Amo	M=0 F=1	Res	Cohort
T1 %Bfat	1																
T6 %Bfat	0.913	1															
T1 BMI	0.348	0.337	1														
T6 BMI	0.28	0.391	0.907	1													
T1Weight	-.067~	-.044*	0.838	0.79	1	.											
T6 Weight	-0.111	.001***	0.758	0.85	0.947	1											
T6 Auto ER	.032*	-.010~	.014*	-.032*	.029*	-.004**	1										
T6 Con ER	.040*	0.115	-.024*	.009*	-.051*	-.024*	0.126	1									
T6 Intr Mot	.006*	-.037*	-.030*	-.076~	-.004**	-.036*	0.873	.061~	1								
T6 Inte ER	-.039*	-.074~	-.020*	-.061~	.001***	-.028*	0.87	0.121	0.634	1							
T6 ID ER	0.15	.123*	0.112	.084~	.088~	.070~	0.797	0.146	0.576	0.529	1						
T6 Intro ER	.057~	.087~	-0.112	-.083~	-0.139	-0.112	0.358	0.724	0.267	0.281	0.382	1					
T6 Ext ER	.059~	.112*	.005**	.026*	-.017*	.000***	0.18	0.787	0.12	0.197	0.139	0.395	1				
T6 Amo	-.045*	.031*	.064~	.081~	.055~	.068~	-0.341	0.538	-0.313	-0.287	-0.27	.083~	0.134	1			
M=0,F=1	0.739	0.704	-0.225	-0.261	-0.561	-0.575	.082~	.075~	.077~	.019*	0.134	0.133	.085~	-.078~	1		
Residency	.069~	.074~	-0.199	-0.176	-0.228	-0.207	.088~	.040*	0.143	.085~	-.010~	.088~	.049*	-.070~	0.262	1	
Cohort	.085~	.055~	-.027*	.020*	-.030*	-.006*	-.001*	-.086~	.002**	.049*	-.064~	.016*	-.085~	-0.113	-.031*	-.031*	1
Mean	18.965549	20.408232	22.5	23.05	141.856037	145.557683	4.8593	2.8141	4.9512	4.1255	5.4975	3.9812	2.4942	1.9731	0.66	0.6098	1.5274
Std. Dev	7.2532816	7.3071512	3.322	3.46	27.7055285	29.2941979	1.16673	0.8908	1.39759	1.53461	1.17714	1.27221	1.44521	1.13649	0.476	0.48855	0.50001
N	328	328	328	328	328	328	328	328	328	328	328	328	328	328	328	328	328

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

**Auto= Autonomous ER, Cont= Controlled ER, Int Mot= Intrinsic Motivatio, Inte= Integrated ER, Intro= Introjected ER, Ext= External ER, Amo= Amotivation, 0= Male (M), 1= Female (F)*

Appendix C. Regression analyses examining the moderating role gender and residency in the relation between the type of eating regulation and body mass index (BMI)

Body Mass Index				
Predictor	**Autonomous Eating Regulation**		**Controlled Eating Regulation**	
	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		0.822***		0.822***
T 1 Body Mass Index	0.944(.02)***		0.944(.02)***	
Step 2		0.007**		0.007*
Female	-0.434(.18)*		-0.475(.18)*	
Every Resident	0.166(.17)		0.137(.17)	
T_6 Eating Regulation	-0.125(.07)~		0.150(.09)~	
Step 3		0.004~		0.003
Female X Every Resident	0.403(.35)		0.321(.35)	
Female X T_6 Eating Regulation	-0.356(.15)*		0.102(.21)	
Eating Regulation X Every Resident	-0.047(.15)		-0.405(.19)*	
Step 4		0.00		0.002~
Female X Eating Regulation X Every Resident	0.158(.30)		0.709(.41)~	
Total R^2		0.833		0.833
Number of Subjects *(n)*		328		328

$*p < .05$ $**p < .01$ $***p < .001$ $\sim p = .05\text{-}1.0$

Body Mass Index Autonomous Eating Regulation						
Predictor	***Intrinsic Motivation***		***Integrated Regulation***		***Identified Regulation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		0.822 ***		0.822 ***		0.822 ***
T_1 Body Fat	0.944(.02)***		0.944(.02)***		0.944(.02)***	
Step 2		0.008 **		0.008 **		0.006*
Female	-0.441(.18)*		-0.457(.18)		-0.449(.18)*	
Every Resident	0.188(.17)		0.170(.17)		0.141(.17)	
Eating Regulation	-0.119(.06)*		-0.103(.05)*		-0.017(.07)	
Step 3		0.003		0.003		0.005*
Female X Every Resident	0.424(.35)		0.393(.35)		0.267(.35)	
Female X Eating Regulation	-0.255(.13)*		-0.166(.11)		-0.424(.14)*	
Eating Regulation X Every Resident	0.046(.12)		-0.104(.11)		-0.026(.14)	
Step 4		0.00		0.00		0.001
Female X Eating Regulation X Every Resident	0.067(.25)		-0.171(.225)		0.470(.29)	
Total R^2		0.832		0.832		0.834
Number of subjects (*n*)		328		328		328

$^*p < .05$ $^{**}p < .01$ $^{***}p < .001$ $\sim p = .05\text{-}1.0$

Body Mass Index Controlled Eating Regulation						
Predictor	***Introjected Regulation***		***External Regulation***		***Amotivation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		0.822 ***		0.822* **		0.822 ***
T_1 Body Mass Index	0.944(.02) ***		0.944(.02)***		0.944(.02) ***	
Step 2		0.006*		0.006*		0.006*
Female	-0.475(.18) *		-0.473(.18)*		- 0.445(.18)*	
Every Resident	0.134(.17)		0.136(.17)		0.151(.17)	
Eating Regulation T_6	0.067(.06)		0.070(.06)		0.078(.07)	
Step 3		0.004~		0.002		0.003
Female X Every Resident	0.375(.35)		0.347(.35)		0.290(.35)	
Female X T_6 Eating Regulation	-0.294(.15)*		0.207(.13)		0.231(.16)	
Eating Regulation X Every Resident	-0.123(.14)		-0.186(.12)		- 0.300(.15)~	
Step 4		0.003 **		0.00		0.00
Female X Eating Regulation X Every Resident	0.685(.30)*		0.207(.27)		0.037(.31)	
Total R^2		0.835		0.831		0.831
Number of subjects (*n*)		328		328		328

*$p < .05$ **$p < .01$ ***$p < .001$ ~$p = .05$-1.0

Appendix D. Regression analyses examining the moderating role of gender and residency in the relation between the types of eating regulation and weight

	Weight			
Predictor	**Autonomous Eating Regulation**		**Controlled Eating Regulation**	
	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		0.897***		0.897***
T 1 Body weight	1.001(.02)***		1.001(.02)***	
Step 2		0.004*		0.004**
Female	-3.804(1.33)**		-4.119(1.33)**	
Every Resident	1.305(1.10)		1.142(1.10)	
T_6 Eating Regulation	-0.667(.45)		0.968(.58)~	
Step 3		0.002		0.002~
Female X Every Resident	2.231(2.24)		1.808(2.25)	
Female X T_6 Eating Regulation	-2.053(.95)*		0.808(1.33)	
Eating Regulation X Every Resident	-0.368(.95)		-3.025(1.24)*	
Step 4		0.00		0.001~
Female X Eating Regulation X Every Resident	1.281(1.95)		4.873(2.66)~	
Total R^2		0.903		0.904
Number of Subjects *(n)*		328		328

$*p < .05$ $**p < .01$ $***p < .001$ $\sim p = .05\text{-}1.0$

Weight Autonomous Eating Regulation						
Predictor	***Intrinsic Motivation***		***Integrated Regulation***		***Identified Regulation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		0.897 ***		0.897 ***		0.897 ***
T_1 Body Weight	1.001(.02)***		1.001(.02)***		1.001(.02)***	
Step 2		0.004 **		0.004		0.003*
Female	-3.856(1.33)**		-3.986(1.32)**		-3.998(1.36)**	
Every Resident	1.431(1.11)		1.338(1.10)		1.172(1.10)	
Eating Regulation	-0.648(.37)~		-0.581(.34)~		-0.024(.45)	
Step 3		0.001		0.001		0.003*
Female X Every Resident	2.340(2.26)		2.162(2.25)		1.456(2.27)	
Female X Eating Regulation	-1.427(.82)~		-0.924(.70)		-2.552(.92)**	
Eating Regulation X Every Resident	0.296(.80)		-0.681(.71)		-0.298(.92)	
Step 4		0.00		0.00		0.001~
Female X Eating Regulation X Every Resident	0.291(1.64)		-0.849(1.45)		3.525(1.86)~	
Total R^2		0.902		0.902		0.904
Number of subjects (*n*)		328		328		328

$^*p < .05$ $^{**}p < .01$ $^{***}p < .001$ $\sim p = .05\text{-}1.0$

Weight Controlled Eating Regulation						
Predictor	***Introjected Regulation***		***External Regulation***		***Amotivation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		0.897***		0.897***		0.897***
T_1 Body Weight	1.001(.02)***		1.001(.02)***		1.001(.02)***	
Step 2		0.004*		0.004*		0.004*
Female	-4.113(1.33)**		-4.145(1.33)**		-3.948(1.33)**	
Every Resident	1.106(1.1)		1.134(1.10)		1.228(1.10)	
Eating Regulation T_6	0.522(.41)		0.437(.36)		0.416(.46)	
Step 3		0.002*		0.001		0.002
Female X Every Resident	2.175(2.25)		1.965(2.25)		1.568(2.26)	
Female X T_6 Eating Regulation	-1.751(.95)~		1.424(.87)		1.466(1.00)	
Eating Regulation X Every Resident	-1.175(.88)		-1.261(.77)		-2.126(1.00)*	
Step 4		0.002*		0.00		0.00
Female X Eating Regulation X Every Resident	4.703(1.89)*		1.723(1.73)		-0.132(2.01)	
Total R^2		0.905		0.902		0.902
Number of subjects (*n*)		328		328		328

*p < .05 **p < .01 ***p < .001 ~p = .05-1.0

Appendix E: Regression analyses examining the moderating role of gender and residency in the relation between the types of eating regulation and percent body fat

Percent Body Fat				
Predictor	**Autonomous Eating Regulation**		**Controlled Eating Regulation**	
	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		0.833***		0.833***
T 1 Body fat	0.919(.02)***		0.919(.02)***	
Step 2		0.004~		0.008*
Female	1.044(.55)~		0.891(.54)~	
Every Resident	0.005(.36)		-0.059(.35)	
T_6 Eating Regulation	-0.275(.14)~		0.618(.18)**	
Step 3		0.006*		0.004*
Female X Every Resident	0.993(.71)		0.720(.71)	
Female X T_6 Eating Regulation	-0.847(.30)**		0.439(.42)	
Eating Regulation X Every Resident	-0.292(.30)		-1.088(.39)*	
Step 4		0.001		0.001
Female X Eating Regulation X Every Resident	0.719(.62)		-1.046(.84)	
Total R^2		0.844		0.846
Number of Subjects *(n)*		328		328

*p < .05 **p < .01 ***p < .001 ~p = .05-1.0

Percent Body Fat Autonomous Eating Regulation						
Predictor	***Intrinsic Motivation***		***Integrated Regulation***		***Identified Regulation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		0.833***		0.833***		0.833***
T_1 Body Fat	0.919(.02)***		0.919(.02)***		0.919(.02)***	
Step 2		0.005~		0.004		0.003
Female	1.056(.55)~		1.031(.55)~		0.990(.55)~	
Every Resident	0.050(.36)		0.007(.36)		-0.047(.36)	
Eating Regulation	-0.254(.12)*		-0.199(.11)~		-0.110(.14)	
Step 3		0.006*		0.004*		0.004*
Female X Every Resident	1.111(.71)		0.931(.72)		0.783(.73)	
Female X Eating Regulation	-0.808(.26)**		-0.422(.22)~		-0.698(.30)*	
Eating Regulation X Every Resident	-0.008(.25)		-0.340(.23)		-0.229(.29)	
Step 4		0.000		0.000		0.002~
Female X Eating Regulation X Every Resident	0.481(.52)		-0.099(.46)		1.040(.60)~	
Total R^2		0.844		0.841		0.841
Number of subjects (n)		328		328		328

$*p < .05$ $**p < .01$ $***p < .001$ $\sim p = .05\text{-}1.0$

Percent Body Fat Controlled Eating Regulation						
Predictor	***Introjected Regulation***		***External Regulation***		***Amotivation***	
	β (SE)	ΔR^2	β (SE)	ΔR^2	β (SE)	ΔR^2
Step 1		0.833 ***		0.833 ***		0.833 ***
T_1 Body Fat	0.919(.02) ***		0.919(.02)***		0.919(.02)***	
Step 2		0.003		0.005 *		0.008*
Female	0.891(.55)		0.927(.54)~		1.092(.54)*	
Every Resident	-0.059(.36)		-0.062(.35)		-0.018(.35)	
Eating Regulation T_6	0.173(.13)		0.275(.11)*		0.479(.15)**	
Step 3		0.002		0.003 ~		0.005*
Female X Every Resident	0.861(.72)		0.802(.72)		0.601(.71)	
Female X T_6 Eating Regulation	-0.275(.31)		0.379(.28)		0.622(.31)*	
Eating Regulation X Every Resident	-0.244(.28)		-0.560(.25)*		-0.851(.31)**	
Step 4		0.002 *		0.000		0.000
Female X Eating Regulation X Every Resident	1.306(.61)*		0.358(.55)		-0.436(.63)	
Total R^2		0.840		0.842		0.846
Number of subjects (*n*)		328		328		328

$*p < .05$ $**p < .01$ $***p < .001$ $\sim p = .05\text{-}1.0$