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The Effect of Emotional State, Interoception, Intuitive Eating, and Self-Regulation on the Energy Intake of College Students

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THE EFFECT OF EMOTIONAL STATE, INTEROCEPTION, INTUITIVE EATING, AND SELF-REGULATION ON THE ENERGY INTAKE OF COLLEGE STUDENTS

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by

Padideh Haddadian Lovan

2020

To: Dean Tomás R. Guilarte
R.Stempel College of Public Health and Social Work

This dissertation, written by Padideh Haddadian Lovan, and entitled The Effect of Emotional State, Interoception, Intuitive Eating, and Self-Regulation on the Energy Intake of College Students, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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Catherine Coccia, Major Professor

Date of Defense: November 6, 2020

The dissertation of Padideh Haddadian Lovan is approved.

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Vice President for Research and Economic Development
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Florida International University, 2020

DEDICATION

I dedicate this dissertation to my mother Niloufar Shams and my stepfather Farrokh Pourriahi who were my rock and always believed in me. They went above and beyond to make this journey possible. I would also like to dedicate this dissertation to my husband, Ryan Lovan, who was always there for me patiently and supported me in every decision I made with love and kindness.

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ABSTRACT OF THE DISSERTATION

THE EFFECT OF EMOTIONAL STATE, INTEROCEPTION, INTUITIVE EATING, AND SELF-REGULATION ON THE ENERGY INTAKE OF COLLEGE STUDENTS

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Florida International University, 2020

Miami, Florida

Professor Catherine Coccia, Major Professor

College students are known to be susceptible to weight gain. Transitioning to college brings new stresses and challenges which may lead to unhealthy eating behaviors and weight gain. There are multiple factors which have been attributed to exacerbating determinants for college weight gain including eating in the absence of hunger, lack of self-regulation, and emotional eating. As researchers have become more aware of the disadvantages of dieting and restricted eating, cognitive related behaviors, as a way to control weight, have gained more attention recently.

The aim of this study is to examine the association between internal bodily signals of hunger and satiety, intuitive eating, eating behaviors, mood change, and self-regulation of food intake in college students. In this randomized cross-over study 60 students with the mean age of 19.8 (SD = 1.43), completed the trials successfully. Students were asked to complete 2 visits one week apart. Then, students were asked to watch an emotional movie, drink a preload drink (either low or high calorie) 30 minutes prior to lunch, and then were offered with a buffet style lunch with variety of options. Food intake was measured using plate waste methodology.

The results of the study indicated a great range of self-regulatory abilities in food consumption; however, participants showed a significant difference in energy intake affected by the calorie content of the preload. Self-regulation seemed to be greater in females and students with normal weight. According to our findings, interoception, where individuals are able to detect and respond to their internal bodily cues may be a good predictor for self-regulation. Additionally, lower intuitive eating, higher mood change, and higher restraint and emotional eating habits are significantly correlated with poorer self-regulation in college students.

In conclusion, students who have a higher ability to detect their internal bodily signals of hunger and satiety and respond to them, seem to be more successful in controlling their energy intake and maintaining their healthy weight. Students who experience more intense emotional changes seem to have difficulty controlling their consumption. Additionally, eating intuitively and lower restricted or emotional eating significantly affects self-regulation of food intake.

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ABREVIATIONS AND ACRONYMS

BAQ	Body Awareness Questionnaire
BMI	Body Mass Index
BRS	Body Responsiveness Scale
CDC	Center for Disease Control and Prevention
CI	Confidence Interval
COMPX	Compensation Index
$COMPX_{dev}$	Compensation Index Deviation
CRS	Cognitive Restraint Scale
DEBQ	Dutch Eating Behavior Questionnaire
EES	External Eating Scale
EES2	Emotional Eating Scale
FIU	Florida International University
ICC	Intra-class Correlation Coefficient
IES	Intuitive Eating Scale
KJ	Kilojoules
OV/OB	Overweight/Obese
RES	Restraint Eating Scale
SD	Standard Deviation
SE	Standard Error
TFEQ	Three Factors Eating Questionnaire
UES	Uncontrolled Eating Scale
UN/NO	Underweight/Normal weight

CHAPTER I

INTRODUCTION

The prevalence of obesity is increasing in the US population and has become a significant public health issue.[1,2] Among young adults aged 20-39 years old in the United States, the prevalence of obesity has more than doubled in the past 2 decades.[2] College students are known to be more susceptible to weight gain than the general population of young adults, especially during the first 2 years of college.[3] The transition to college brings new challenges and stresses, which may lead to unhealthy behaviors and weight change.[4,5] Weight gain in college is related to obesity and obesity-related consequences in the future, such as diabetes and cardiovascular disease.[6,7] There are multiple factors which have been attributed to exacerbating determinants for college weight gain including excessive calorie consumption, lack of self-regulation, and emotional eating.[8-11]

Excessive Calorie Consumption:

As college weight gain has become a serious concern, promoting effective weight management strategies is of great importance. Previous research has demonstrated that, outdated weight control strategies, such as restrictive diets, have had disappointing results in the long term.[12-14] Therefore, more attention has been given to modification of lifestyle behaviors that focus on internal signals including satiety, which seem to be more sustainable and effective for weight control.[15,16] One of the most common behaviors found in college students that causes excessive calorie consumption and weight gain is eating in the absence of hunger.[17-21] The feelings of hunger and satiety are the major internal mechanisms responsible for individual's food intake.[22-24] However, being able to recognize these feelings is a key component in controlling the amount of food

consumed.[25] Research has suggested that individuals with higher interoceptive awareness, or the ability to identify internal bodily states, are more likely to experience higher level of intensity in feeling physiological changes allowing them to identify the feeling of hunger.[26-30] In addition to interoceptive awareness, interoceptive responsiveness, which is the ability to respond to bodily internal cues, is known to be effective in decision-making related to food intake. People that have high interoceptive awareness and interoceptive responsiveness should be less likely to engage in excess calorie consumption. In fact, researchers have shown that higher interoceptive ability in college students, where they are both aware of and responsive to their internal signals of hunger and satiety, is associated with a higher ability to maintain their Body Mass Index (BMI).[31,32]

Self-regulation:

Just being able to be aware of hunger and satiety signals is not enough for people to effectively lose weight.[33] Many studies have shown that effective weight loss interventions need to focus on increasing individuals' ability to self-regulate their eating behaviors.[34,35] Self-regulation is described as intentional or unintentional efforts to control a behavior. Practicing self-regulation in eating assists individuals to monitor daily energy intake and maintain body weight.[34,36-41] As such, some studies have illustrated the negative correlation between college student's BMI and self-regulatory skills in food intake.[42-44]

Emotional vs. Intuitive Eating:

Other studies have shown that self-regulatory skills in eating are influenced by other internal factors such as mood and emotions.[39,45,46] Eating under the influence of

different emotions, known as emotional eating, is correlated with overconsumption in college students.[47-50] The results of the studies that measured the effect of mood and emotions on food intake in college students demonstrated that students face more overconsumption episodes under emotional or stressful circumstances.[51-54] Therefore, researchers are of the belief that these binge eating episodes are usually reactive to negative feelings including stress and boredom thus leading to higher BMI.[11,47,55]

Intuitive eating is the practice of recognizing one's hunger/satiety, which requires interoceptive awareness and responsiveness to be able to eat when hungry, and stop when full, requiring high levels of self-regulation. According to previous studies, practicing intuitive eating is correlated with lower BMI, greater ability for weight control, higher body satisfaction, and food enjoyment in college students.[56-60] Furthermore, intuitive eating has been found to aid students in regulating their negative emotions, controlling cravings, and encourage healthy eating.[61-63] However, the effect of other internal determinants such as mood and interoception on the ability to eat intuitively in college students is still unclear.

Theoretical Framework:

Bandura's Social Cognitive Theory (SCT) will be used in this study because of its nature of emphasizing on individuals' internal signals, their effects on people's behavior, and the influence from the environment.[37] This theory focuses on cognitive psychology and has been found to be useful to understand self-influence in regard to food intake. Bandura stated that there is a reciprocal determinism relationship between an individual's behavior, the environment, and personal factors.[37,64-66] Self-regulation, as an SCT construct, is one of the most crucial determinants in human behavior change and will be

the core component in this study. Furthermore, intuitive eating, interoceptive ability and mood are considered internal factors that influence regulation and food intake. The overall aim of this study is to examine the effect of interoceptive ability, intuitive eating skills, and mood on self-regulation in college students as shown in Fig.1.1 and Fig.1.3 indicates the effect of mood, intuitive eating, and self-regulation. In addition, the level of awareness and responsiveness on internal commands (interoceptive ability) and its effect on intuitive eating and self-regulation in energy intake will be measured using the model demonstrated in Fig.1.2.

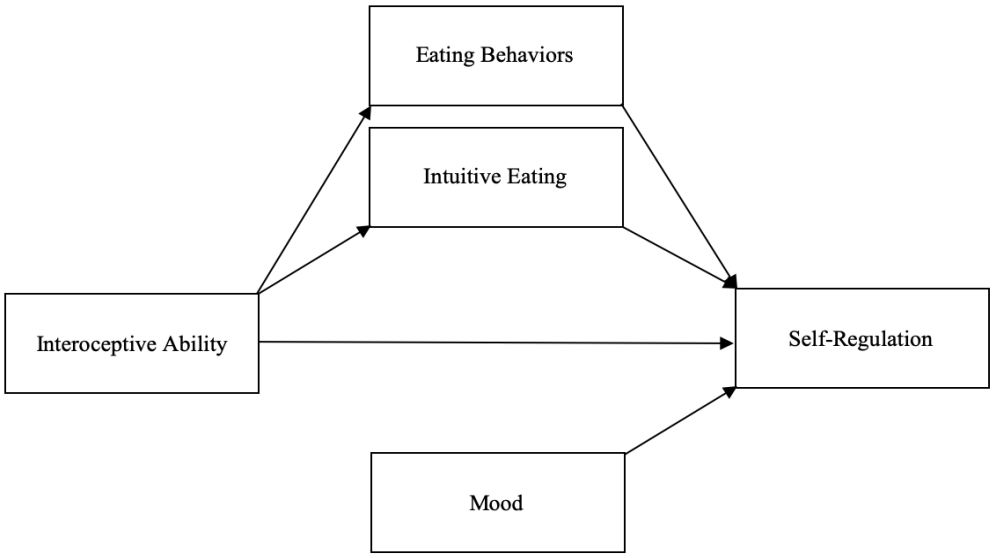
This study is important because by determining the degree of awareness and control over internal signals with regard to eating, researchers and health promoters will be able to create innovative strategies for weight control for college students. Moreover, this study will overcome two limitations found in previous studies about college weight change. First, studies have found multiple internal factors associated with overconsumption and weight gain in college including the lack of self-regulation, intuitive eating, interoception, and emotional eating, however, no study has examined the relationship between these variables to determine how they influence each other. Second, researchers have solely relied on self-reported data, whereas measurements by trained researchers may lower participant biases.

Currently, to the best of the author's knowledge, no study has evaluated self-regulatory skills in food intake among college students using an objective measure. The current study will use both a questionnaire and a compensation index (COMPX) to measure self-regulation and eating behaviors in college students. COMPX is a novel method to estimate self-regulation in food intake by focusing on internal bodily signals

without including self-reported bias. In this method, student's calorie intake during a meal is measured after manipulating their current mood and calorie intake by showing an emotional movie 2-3 hours before their meal, and serving them two different types of drinks (low calorie vs. high calorie) 30 minutes before their meal.[67-71] Based on COMPX, individuals are able to compensate they calorie intake in response to the calorie content in the preload drink. For example, participants who had the high calorie drink are expected to consume less calories afterwards and vice versa.[67,72,73]

Figure 1.

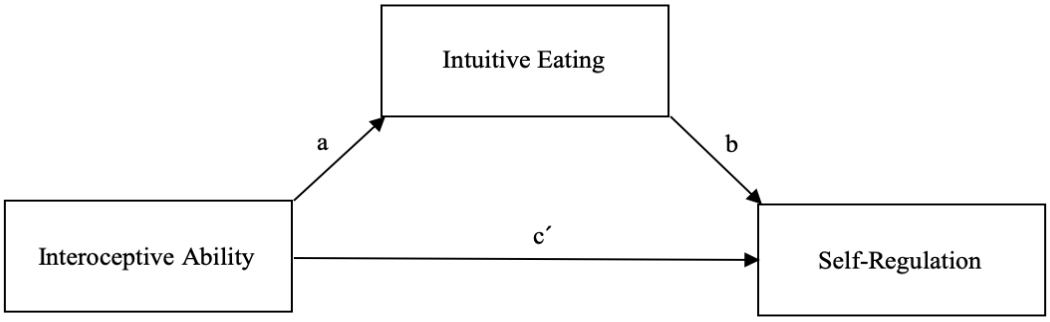
Main proposed model



Self-regulation is affected by both mood (current emotional state) and individuals' intuitive eating skills.

Figure 2.

The direct and indirect effect of interoception on self-regulation with intuitive eating as a mediator



Note: c′ is an illustration of a direct effect of a predictor on the outcome when controlling for mediators. The hypothesized indirect effect the predictor on the outcome, is illustrated by a x b through a mediation design. “Interoceptive Ability” is hypothesized to exert an indirect effect on “Self-Regulation” through “Intuitive Eating”.

Figure 3.

The direct and indirect effect of interoception on self-regulation with eating behaviors as a mediator

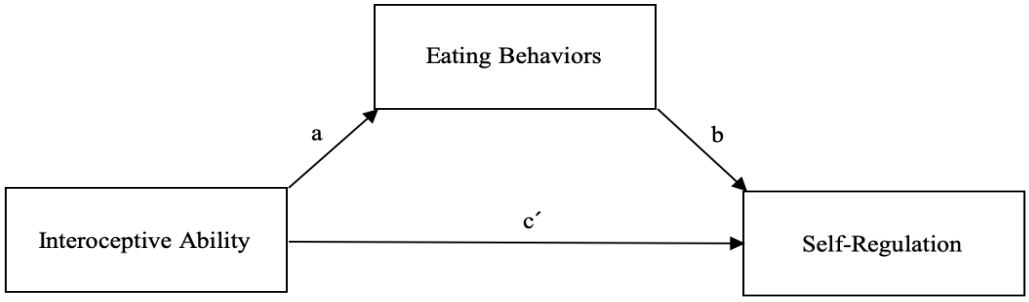
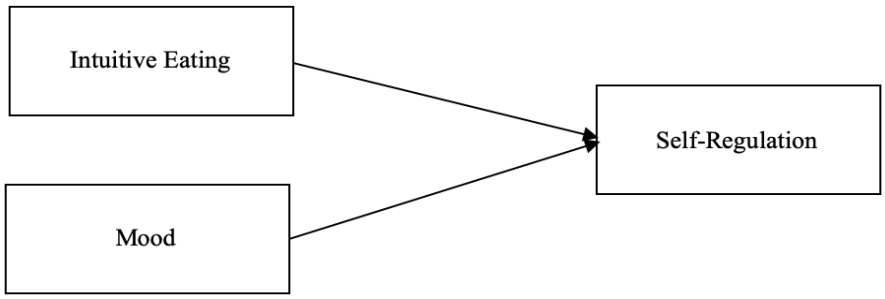


Figure 4.

Variables (intuitive eating and mood) affecting self-regulation



Specific aims and hypothesis:

The purpose of the study is to determine the effect of emotions and internal bodily signals on self-regulation in eating among college students 18-24 years of age.

- **Aim 1:** To assess self-regulation of food intake among college students using COMPX scores and its correlation with BMI and gender.
  - **Hypothesis 1:** Self-regulation will be varied in different BMI categories and genders.
- **Aim 2:** To investigate the relationship between interoceptive ability, intuitive eating, and self-regulation of food intake in college students and its comparison between different genders and different BMI categories.
  - **Hypothesis 2:** Students with lower interoceptive ability will have lower intuitive eating scores, poorer scores in eating behaviors related to self-control, and lower COMPX scores. The correlations are affected by different eating behaviors scores, BMI and genders.
- **Aim 3:** To examine the effect of mood change and intuitive eating on self-regulation of food intake/selection.

- **Hypothesis 3:** Self-regulation is affected by both mood and intuitive eating skills. Negative mood (e.g. stressed or sad) and lower intuitive eating scores will decrease college students' COMPX scores.

CHAPTER II

LITERATURE REVIEW

Prevalence of Obesity in the United States:

According to the Center for Disease Control and Prevention (CDC), the prevalence of obesity (BMI of 30 kg/m2 or greater) among US adults (20-39 years of age), was 40.3% in men and 39.7% in women in the years 2017-2018, nearly doubling in the past 2 decades.[2] The rise in overweight and obesity has become a key major public health issue, because of its related health implications such as cardiovascular disease, diabetes, and cancer.[6,7] The CDC has reported obesity as a major risk factor for many of the leading causes of death including diabetes, uncontrolled high blood pressure, and high cholesterol.[74] One particular group that is susceptible to weight gain, is college-aged adults. Due to the academic stress and changes due to campus life, students may experience weight change and adopt unhealthy eating behaviors.[17-21, 75] More than half of the college students gain weight during the first two years of college.[3] This weight gain phenomenon is often referred to as "Freshman 15," where students gain an average of 15 lbs during the first two years of college.[76] The weight gained in college is usually difficult to lose and may lead to obesity and obesity-related consequences in the future.[6,7]

Factors Associated with Obesity in College:

From a general point of view, obesity results from a calorie intake that is imbalanced due to higher energy intake compared to energy expenditure.[77] Overconsumption of food, mainly foods high in fat, sodium, sugar, and sugar-sweetened beverages are a major cause of calorie intake imbalance, which increases the prevalence of overweight and obesity.[78-80] A combination of moving into a new environment,

increasing autonomy in decision making, and having access to cheaper calorie dense foods may be a major cause in the overconsumption in college students.[81] With the stressful and extremely busy college lifestyle, students are more likely to have higher consumption of calorie dense foods, which increases daily energy intake.[82,83] In addition, environment changes, such as bigger portion sizes, higher accessibility to unhealthy calorie dense food options, professional marketing, and food advertisements are significantly affecting individuals' food choices.[8-11,84-86]

Interoceptive Ability and Hunger:

With the dramatic change in the food environment that students experience after moving to college, and higher accessibility to calorie dense foods and beverages, focusing on internal bodily factors play a major role in calorie intake.[87,88] The ability to understand the internal physiological signals and processing them in the brain is called 'Interoception'.[89,90] Interoception is one of the internal factors known to be associated with food intake.[91] Studies from neuroscience have suggested that a network of cerebral cortex area including Anterior Cingulate Cortex (ACC) and insula are responsible for visceral states in the body. Some internal stimuli such as gastrointestinal sensations are known to be activators for insula and ACC.[30,90,92-94] Oswald et al[32] proposed two parts of interoceptive ability, 'interoceptive awareness' defined as one's ability to detect internal bodily signals, and 'interoceptive responsiveness' defined as the ability to respond to these signals. In addition, Oswald et al[32] suggested that interoceptive awareness and interoceptive responsiveness play a significant role in promoting adaptive eating behaviors in college students.

In a study, Herbert et al[95] measured the degree of interoceptive sensitivity in college aged women by examining their responses to their heartbeat by asking them to count their own heartbeat silently and subjectively rate how they felt about their own cardiac signals using a likert scale from aversive to pleasant. In addition, researchers used an Electrocardiogram (ECG) to measure the true rate of participants' heartbeat. The results of the study showed that participants with lower BMI had higher sensitivity to their body signals. In another study, Herbert et al[29] showed that participants who were more sensitive to their heart beats reported a higher change and intensity of emotions during the study. They also found that interoception is significantly associated with regulatory skills. In light of that study, Merwin et al[96] found that non-acceptance of internal signals is positively associated with eating disorders or calorie deprivation. Furthermore, higher interoceptive ability is thought to be leading to increased awareness of visceral changes and higher ability in sensation of hunger which helps regulating eating behaviors.[27,32,95] Other studies that examined the role of interoceptive ability on emotional eating and the risk of obesity suggest that higher interoception may significantly decrease emotional eating and it lowers the risk of obesity in young adults.[97,98]

Self-regulation:

The ability of sensing the feeling of hunger and fullness is known to be the key to self-regulation in eating.[38] Researchers suggested that another significant factor associated with weight gain in college students, is thought to be the lack of self-regulatory skills in food intake.[8, 9, 11] Self-regulation refers to intentional or unintentional attempts to control a behavior or thought, and improvement is possible through practice.[37]

In other words, based on a homeostatic regulation in the human body, individuals have the ability to maintain energy intake during calorie consumption.[99,100] Self-regulation and focusing on inner cues of hunger and satiety has become a significant technique in controlling energy intake and understanding obesity and overconsumption patterns.[34,38] Moreover, Individuals who are more aware of their bodily signals, are more likely to have a permanent effect in committing to healthy eating behaviors in the long term compared to food restriction.[38] Studies have demonstrated the positive effect of cognitive approaches on weight control.[101,102] Additionally, an intervention by Stadler et al[35] showed that teaching self-regulatory strategies, assists participants to develop the ability to maintain healthy eating behaviors in the long term.

Since self-regulation (including goal setting and self-monitoring) as a social cognitive construct has been shown to be a significant mediator in health-related behavior change, it may be an effective way to prevent weight gain in college students.[36] Several studies have indicated the positive effect of self-regulatory practice/intervention on dietary intake improvement among college students. They also suggested that dietary change demands self-regulation and food monitoring.[36,39-41] These studies revealed the importance of the existence of self-regulatory skills among college students in order for them to be able to change unhealthy eating habits and control daily food intake. However, Strong et al[33] indicated that college students are lacking self-regulatory skills, which is a leading cause in overconsumption and weight gain in this population.

There were two qualitative studies (focus groups) by Deliens et al[103,104] conducted among European college students aged 20.7 ± 1.6 years, with the aim of examining the factors associated with students eating behaviors. The authors illustrated

that the unhealthy eating behaviors formed after moving to college are largely due to the loss of notable external influences such as parental control. Therefore, the combination of the lack of self-regulation and the absence of the external forces caused the formation of unhealthy eating behaviors and weight change. Moreover, students mentioned that they are continuously challenged to make healthy food choices as they have higher independency. Another focus group study by Metzgar et al[105] aimed to investigate the facilitators and barriers to weight loss and healthy weight maintenance among female college students in the U.S. The researchers reported lack of self-regulation as a significant barrier in maintaining healthy eating behaviors. Additionally, it was emphasized that students had a greater desire for an external source of accountability to keep them motivated to stay healthy. Furthermore, Munt et al[106] indicated the need for improvement in self-regulation among college students in order for them to develop healthy eating habits. These studies suggest that self-regulation is necessary to create healthy eating routines.[103-106] However, in order to achieve a sufficient level of self-regulatory skills in eating, it is also necessary to understand the impact of the influential factors on self-regulation for example emotions.

The Effect of Mood and Emotions on Food Intake:

Although causes of weight gain in college students are multifactorial, emotional eating has been identified as a significant issue in college weight gain.[17-21] Emotional eating is known as eating under the influence of different emotions.[47] Different emotional stages play a significant role in changing an individual's food intake patterns and food choices. As an example, negative emotions such as stress could lead to overeating and weight gain which is known to be a significant cause of weight gain among college

students.[47-50] College students experience a large number of emotional eating episodes due to their high level of stress. Stress and boredom have been reported to be major triggers of emotional eating in this population.[11] However, stress seems to have a greater impact than boredom.[107] In a study by Lowe and Fisher[108], college students were asked to monitor their mood before they snack during the day for 13 consecutive days. The results of the study showed that students with higher BMI were more likely to engage with emotional eating and they were more responsive to emotions. However, the study only tested the snack intake, not full meal consumption. Similarly, a study by Wolff et al[109] looked at mood and eating behaviors in college-aged women. Participants were asked to self-monitor their mood and eating behavior for three weeks and findings from the study suggested that binge eaters were more likely than non-binge eaters to report having a negative mood. In the same way, Bekker et al[110] tested the effect of neutral to negative emotions on self-perceived emotional eating in college students. Findings revealed that higher negative emotions were positively correlated with a higher number of binge eating episodes.

Furthermore, previous studies focusing on gender differences, have shown that the effect of emotional eating is reported to be higher among women compared to men. Women also score higher in dieting and binge eating episodes.[51,54] In addition, men reported more overeating during meal time under an emotional or stressful circumstance, but losing control in eating was higher among women when experiencing the same situation.[51-54] Additionally, a qualitative study by Bennett et al[11] demonstrated that unpleasant feelings such as boredom and anxiety trigger emotional eating in males to use it as a distraction. In contrast, females identify stress as the main cause of emotional

eating followed by guilt. Many other published studies have supported the effect of negative feelings and mood on food intake in college aged participants.[111-115] One of the challenges to measure emotional eating is to use a reliable method. A recent study that compared the results from self-reported emotional eating and food intake after remembering a memory associated with embarrassment, sadness, or anxiety in college students suggested that there was no significant relationship between the obtained scores.[116]

Intuitive Eating and Eating Behaviors:

With the increase in the prevalence of emotional eating episodes among college students, eating based on physiological cues rather than emotion has recently gained a great amount of attention and has been accepted as an adoptive eating style.[117-119] Intuitive eating is the most popular approach to eating based on bodily cues to maintain a healthy lifestyle.[57] Intuitive eating is defined as being aware of internal signals of hunger and satiety while eating. The concept of intuitive eating was categorized into three factors by Dr. Tylka.[56] The first category is unconditional permission to eat, which represents individuals' desire to eat when hungry. This category focuses on not labeling any food as forbidden, which can lead to binge eating episodes and guilt.[120] The second category is eating for physical rather than emotional reasons, which mirrors individuals' eating pattern based on either feeling physically hungry or emotional reasons.[56] The third factor is known to be reliance on hunger and satiety cues. Individuals who trust their inner cues of hunger and satiety are thought to have higher self-regulatory skills in eating.[121,122] In a recent study, Tylka and Kroon Van Diest[123] added a new domain called 'body-food

choice congruence.' This factor measures the extent to which individuals' food choices match their body needs.

Practicing intuitive eating skills have been an effective method for weight control in college students. According to previous studies, intuitive eating is associated with lower BMI, greater ability for weight control, higher body satisfaction, and food enjoyment.[56-60] Intuitive eating has a desirable effect on having a higher control on eating patterns. It helps individuals to regulate their negative emotions, control their cravings, and encourages healthy eating.[61-63] Also it appeared that students from health-related majors are more likely to be engaged with intuitive eating habits, thus, college major was used as a criteria in participants eligibility screening in this study.[124] The results from a study by Shouse and Nilsson[125] demonstrated that emotional awareness has a significant impact on female college students' eating behaviors and intuitive eating. A similar study assessed the level of intuitive eating and its correlation with BMI in male college students exclusively.[126] The findings of the study showed similar results with a negative correlation between intuitive eating and BMI. Furthermore, college students who reported trusting their bodily emotions to tell them how much they should eat, have reported less binge eating episodes and they are at a lower risk of being diagnosed with eating disorders.[127]

In regard to diet quality, in a recent study, Borelli et al.,[128] suggested that intuitive eating is not significantly correlated with diet quality and higher unconditional permission to eat scores seemed to be associated with lower diet quality and lower BMI in college students. In relation to interoception, a study showed that interoceptive abilities measured by heartbeat positively predicted two phases of intuitive eating skills including

"eating for physical rather than emotional reasons" and "reliance on internal tasks".[95] Previous studies that looked at intuitive eating, demonstrated the significance of the ability to identify internal signals of hunger and satiety in eating patterns.[56-60] However, the effect of emotions in food intake is equally important.[17-21] Consequently, the key to eating intuitively seems to be developing the ability to judge hunger and satiety cues accurately, as well as lowering/controlling the effect of emotions on food intake.

Social Cognitive Theory:

Albert Bandura's Social Cognitive Theory (SCT) highlights the relationship between personal factors, environment, and how they affect shaping a behavior. SCT suggests that humans can control their behavior in the same way they influence others, however, they need to develop the skill of managing it internally.[64] According to SCT, having a sense of control on a personal level is necessary for behavioral change. This sense of control can be achieved by developing the ability of controlling thoughts and feelings. Individuals who believe in their internal power to change, are more likely to be committed to accomplish a goal such as changing a behavior.[129] This internal power is called self-regulation in SCT. Moreover, self-regulation is a significant element in decision making and a principal factor in behavioral change.[130-133]

COMPX Score and Calorie Intake Based on Calorie Compensation:

Self-regulation can be measured by survey or by calculating Compensation Index (COMPX) scores for individuals. It is more common to use self-reported questionnaires in order to measure self-regulation among college students; however, the answers may be overestimated and the students might not have enough knowledge about their ability to self-regulate their eating behavior.[69] COMPX is an individual calculation to measure the

ability to self-regulate. It is calculated based on identification of internal cues of hunger and satiety and shows more accurate results regarding individuals' self-regulation skills. The idea is that individuals are naturally able to regulate their calorie intake internally. Hence, they will consume less calories during meal time after drinking a high energy preload drink 30 minutes prior to the meal, and conversely, they will consume more calories after being offered with a low energy preload drink.[67,68] COMPX, distinguishes the negative compensation (higher calorie intake after the high energy preload) to overcompensation (lower calorie intake after the high energy preload) and gives the researchers the opportunity to measure the self-regulatory skills.[67,68] Individuals are capable of developing the ability to precisely calorie-compensate from a young age. Children respond accurately and rapidly to calorie manipulation and show different levels of self-regulation.[73,134,135]

Higher self-regulation is shown with a better COMPX score and better calorie compensation skills. In contrast, lower self-regulation is detected via lower COMPX score and lower ability to calorie compensate.[136] The concept of calorie intake based on calorie compensation, was provided by Fomon et al[137] for the first time while studying calorie intake regulation in infants. After Fomon, a few other studies tested the effect of calorie manipulation on physiological hunger and satiety feedback cues in children, adolescents 15-17 years of age, and adults 25-35 years old.[67,68,73,135,137,138] Birch and Deysher[135] examined children's (3-5 years old) responsiveness to caloric density internal cues in food intake using COMPX methods. The results provided clear evidence showing that children were able to calorie compensate after manipulating the density of the preloads. A year after, Lipps and Deysher[73] published another study investigating a

similar concept in children (2-5 years old) and their parents (25-35 years old). The scores from COMPX demonstrated that participants were capable of calorie compensation. However, children showed higher self-regulatory skills compared to parents. In a study by Johnson[67] the ability to focus on internal cues of hunger and satiety were investigated in preschoolers calculated by COMPX. Baseline information showed a large variety of self-regulatory skills among children; however, participants showed improvement in self-regulation after being taught to focus on their own bodily signals.

Another study by Johnson and Taylor-Holloway[68] examined non-Hispanic white and Hispanic children's responsiveness to energy density signals measured using COMPX. Findings revealed a variation of responsiveness in children between 5-12 years of age. A study by Sylvestre et al.[138] explored calorie compensation skills in adolescents 15-17 years old during five consecutive days. At the conclusion of the study, subjects showed higher COMPX scores. The results of all studies showed the validity and reliability of COMPX in measuring self-regulation in food intake. Findings in all the studies showed that calorie intake after taking a low-calorie preload was shown to be higher than the ones who took the high calorie preload which indicated the existence of calorie compensation in response to calorie manipulation.[67,68,73,135,137-139] COMPX has been used to evaluate self-regulatory abilities in food intake in children in multiple recent studies that has been published within the last 2 years indicating the higher reliability of an objective method versus self-reported questionnaires to measure self-regulation.[140-142] Moreover, some studies demonstrated that adults have shown more accurate compensation over the course of several days.[138,143] However, there has been no study

examining the use of COMPX in college students to examine self-regulation in food intake.

Summary and Conclusion:

College students are more susceptible to weight gain, especially during the first 2 years of college, compared to the general population. The transition to college and its complications play a major role in forming unhealthy eating habits and weight gain. College weight gain may lead to adulthood obesity and obesity related consequences. Since current weight control strategies are ineffective in the long-term, modern research has started exploring new cognitive related strategies for weight loss that focus on internal bodily signals. Intuitive eating, mood, self-regulation, and interoceptive abilities are known to be the most influential internal skills attributed to eating habits among college students. However, the effect of each factor on one another is not clear.

The current study aims to determine the effect of mood, interoception, intuitive eating, and eating behaviors on self-regulation in eating among college students. It is hypothesized that higher emotional changes and lower ability to detect internal bodily signals of hunger and satiety as well as intuitive eating skills will lead to lower self-regulation. Self-regulation of food intake was measured using COMPX to compare the results. The effect of BMI on self-regulation was measured as well based on the assumption that participants with higher BMI will have a lower COMPX score. It is also hypothesized that self-regulation is directly and indirectly affected by individuals' interoceptive abilities with intuitive eating and eating behaviors as mediators. Thus, the assumption is that higher interoceptive ability is related to higher intuitive eating skills which would influence people's ability to self-regulate in food consumption. Even though

the significance of self-regulation in weight control among college students has been shown to be necessary, the effect of physiological feedback cues has never been tested among this population, which may be a critical step to future interventions.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

Study Design:

Participants:

Studies have shown that college students are more likely to experience significant weight gain in comparison with the general population.[3,33,144-146] For many college students, they are dealing with the transition of moving into a new environment, increasing autonomy in decision making, and having access to cheaper calorie dense foods on campus.[67,81] Participants were recruited from Florida International University (FIU), Florida. FIU is an urban, Hispanic-serving institution which has nearly 54,000 students with a high level of commuter students and recruiting at FIU provide access to a diverse population.

Recruitment:

Participants were recruited in August, September, and October 2019 via announcements in non-dietetics large general education courses. In some of the classes, students were offered with extra credits by the professors if they participated in both trials completely. In addition, each student received a $15 FIU gift card if they completed the trials. Interested students who wanted to participate in the study were asked to complete an eligibility survey online or in person on the spot. Eligible students received an additional email with more information about the study including dates and times of the lunch buffet trials. Consent forms were given to the participants on the first day of the trial prior to data collection. A copy of the consent forms was appended. This study was

reviewed and approved by FIU Institutional Review Board (IRB) with the approval number of IRB-19-0315.

Table 1.

Eligibility criteria

Inclusion criteria	Exclusion criteria
Undergraduate college students at FIU	Student athletes
Age 18-24 years old	Students with health-related conditions such as diabetes.
	Students with a diagnosed eating disorder.
	Students who are on medication that affects their appetite such as antidepressants or steroids.
	Students who are pregnant
	Students who are vegan

Power analysis and sample size:

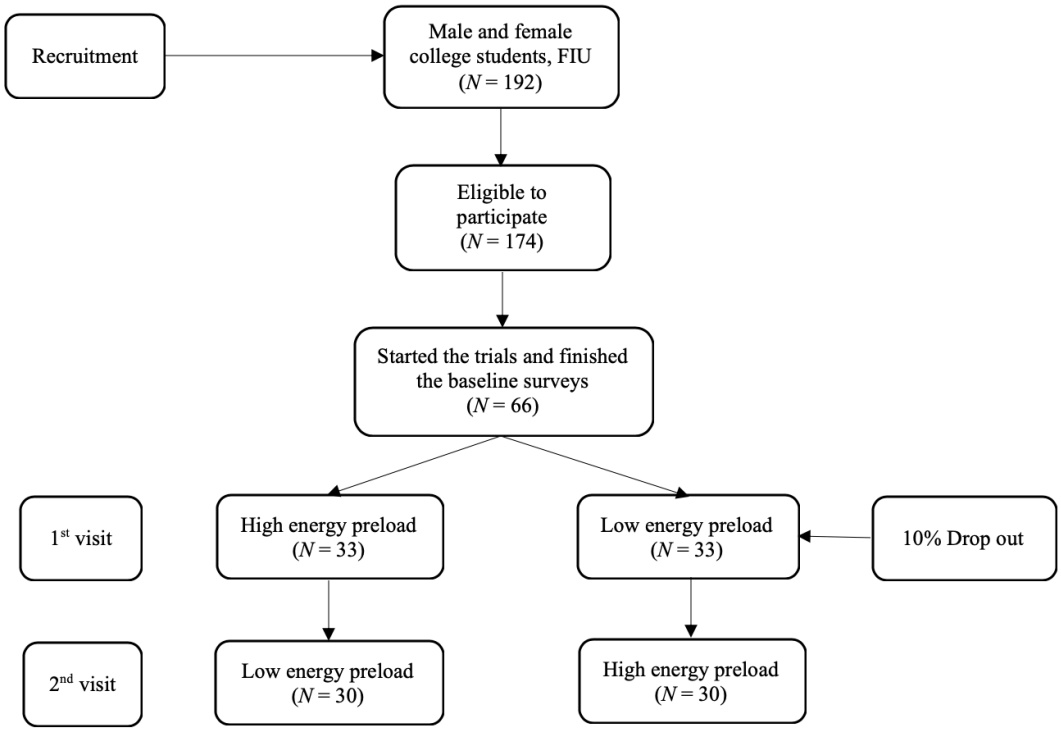
The primary aim of the study was to determine whether there is a correlation between internal factors affecting food intake including self-regulation, mood, intuitive eating, and interoception. Based on a similar study, effect size was determined 0.2 In order to calculate the sample size using G-power software.[147,148] The sample size was calculated to include a total number of 52 participants (29 per group), using linear multiple regression, with 80% power. Taking into consideration a 10% drop out based on similar previous studies, minimum 60 participants were recruited and completed the study.[72,149]

Randomized Crossover Trial:

This study was a randomized crossover trial with a one-week washout period.[67] In randomized crossover research designs, participants are randomly assigned into two different groups and receive a sequence of different treatments. Then, the treatments are exchanged between the groups and the response is assessed and compared at the end of the study. A crossover design can provide accurate outcomes in a small sample size with a low rate of drop-out. Crossover trials are useful for observations and compare individuals against themselves.[150] Moreover, randomization will prevent selection and data analysis bias in this study.[151] Randomization was be under the supervision of a statistician and was conducted using a computer program. Recruited participants were randomly assigned into two groups.

Figure 5.

Participation flow-chart



Two Week Trial:

The trials started at the end of September 2019 and ended at the beginning of November. The period of the study was 1 week with 2 visits for each participant. Based on related previous studies, the effect of calorie manipulation on food consumption was measured in two different visits, one week apart and the data obtained will be compared between weeks 1 and 2.[67,73,135] Participants were asked not to exercise on the trial day. During the visits, each individual filled out the questionnaires, had their anthropometric measurements taken, was offered with a snack (a snack pack of goldfish cracker) and watched a movie for approximately 2-3 hours. Then, participants received either a high energy or low energy preload drink 30 minutes prior to lunch (sweet iced tea). After 30

minutes they were offered with a buffet style lunch with a variety of food options. Students and lunch helpers were blinded about the type of preload drink at the trials.

Trial Timeline:

1. Individuals received a snack 3 hours prior to the trial.
2. Participants completed questionnaires and anthropometric measurements.
3. Participants were asked to watch an emotional movie.
4. Preload drinks were served 30 minutes before lunch.
5. Participants were asked to answer a mood questionnaire again.
6. The *ad libitum* lunch was served where participants can consume as much as they desired.

Table 2.

Materials/questionnaires used during the trials

	Movie	**Preload**	**TFEQ-R18**	**BMIS**	**IES-2**	**BAQ**	**BRS**
Trial 1	X	X	X	XX*	X	X	X
Trial 2	X	X		XX*			

XX*: This questionnaire will be given 2 times during each trial.

Emotional Movie:

In this study, participants were asked to watch an emotional (sad) movie to examine the effect of negative mood on self-regulation in food intake. To make sure participants had not watched the movie before, a list of 7 different movies was presented, and they were scheduled for to watch the movie they claimed they had not seen. Previous studies have proven the effect of movie watching as an effective stimulus on mood change, bodily reactions, and hormonal change.[71,152-154] In a study by Jalilifard et al[155] the

researchers used video clips to raise three emotions including neutral, relaxed, and scared to be able to classify two different emotional states in 19 participants (aged 19-32 years old). A non-invasive brain monitoring method called Electroencephalography (EEG) was used while watching the clips to monitor the participants' brain reactions. The authors reported video clips to be a reliable method to manipulate individuals' emotions. In addition, there are multiple studies that have proven the effectiveness of video clips/movies as emotional stimuli.[156,157]

For instance, another study by Yeomans and Coughlan[158] compared the self-reported self-regulatory skills in eating and emotional state manipulated by different types of movies (neutral, negative, and positive) in college students. The results showed that different types of movies caused different emotions which had a significant impact on individuals' snack intake. Furthermore, participants with lower self-regulatory skills consumed a higher number of snacks after watching the movie with negative effects. However, the results from the questionnaire showed that restraint alone is not a reliable predictor in overconsumption. Moreover, the effect of mood induction using a movie on food intake and hormonal levels in college students was tested in a study by Jampour et al[159] the students were separated into two groups and watched a 50 minutes movie (either drama or comedy). The authors concluded that the type of movie affected ghrelin, cortisol, and insulin levels as well as the type of snack choices.

Preloads:

Studies showed that, in order to explore the effect of calorie manipulation on calorie intake, participants should be provided with a preload followed by a main meal within 30 minutes.[67,68,73] Two preload drinks with the same flavor, differed in calorie

density (low calorie and high calorie) was used 20-30 minutes prior to the main meal. Preloads only differed in calorie density each time. Individuals who received a low calorie preload on the first visit, received high calorie preload on the second visit in the following week and vice versa. Each participant was offered with a 6oz of the preload drink.[73] Then, calorie intake in each visit was assessed and compared individually to examine the effect of preload on the amount of calorie intake. However, in order for the researchers to have more reliable results, it is necessary for the participants to start the trial with an equal calorie state. Thus, they were offered with a snack 3 hours prior to the meal.[67,73,135,136] Preload drinks contained 0 kcal and 210 kcal (878.64 KJ) for low and high calorie preloads respectively.

Ad Libitum Lunch:

Since college students have a variety of food options available when they are on campus on a daily basis, overconsumption may be common. The administered meal provided the participants with a variety of highly palatable food options. This setup helped the researchers to measure participants' food preference when exposed to a variety of food options as well as calorie intake.[160,161] Both healthy and unhealthy options were provided at the buffets in order to examine the food choices. Food options were selected similar to the food served at FIU's dining cafe including broccoli, grapes, bananas, turkey sandwich, and baby carrots as healthy options, mac and cheese, cheese pizza, fried chicken, and cookies as unhealthy options. As beverages, water and lemonade were served. Food was served by dietetics and nutrition student volunteers that are ServSafe certified. ServSafe is a safety training program for individuals who serve food and

beverages, administered by the National Restaurant Association (NRA). Individuals who pass this training with an acceptable score, will be certified as safe food handlers.

Food Intake Measurement:

Food intake can be measured by weighing individuals' plates before and after consumption and taking pre and post pictures of each plate in order to estimate the amount consumed by the participants.[162,163] Leftovers were assessed using standard serving sizes and the data was entered in a calorie count application to measure the amount of calories consumed by students. In order to increase the inter-rater reliability, 2 different researchers were assigned to measure the leftovers based on the final pictures and record their measurements separately estimating one serving size of each food item to one decimal point. Inter-rater reliability was reported by a third researcher. The finalized scores were compared to final plate waste weights.

Study Measures:

The main component used from Social Cognitive Theory was self-regulation which was assessed through COMPX among college students. Mood, intuitive eating, eating behaviors, and interoceptive ability (by calculating the average of the scores obtained from both interoceptive awareness and responsiveness) was assessed using related questionnaires.

Table 3.

Study components

SCT Constructs/ Variables	Definition	Assessment via Questionnaire	Assessment via COMPX	Assessment Tools
Eating Behaviors	The power of controlling a behavior.	X	X	TFEQ-R18 DEBQ
Mood	The current emotions of the participant.	X		BMIS
Intuitive Eating	The ability to eat based on one's internal bodily signals	X		IES-2
Interoceptive Awareness	The ability to detect internal bodily signals.	X		BAQ
Interoceptive Responsiveness	The ability to respond to internal bodily signals.	X		BRS

Outcome Measures:

COMPX Score:

COMPX was calculated to examine observed self-regulation. In this study COMPX is calculated based on identification of internal cues of hunger and satiety and shows a more accurate results regarding individuals' self-regulation skills.[67,68] After measuring the calories consumed by the participants, COMPX scores were calculated using the formula below.[68]

$$\frac{Ad\ libitum\ KJ_{\ Low\ energy\ preload} - Ad\ libitum\ KJ_{\ High\ energy\ preload}}{Drink\ preload\ KJ_{\ High} - Drink\ prelooad\ KJ_{\ Low}} \text{x } 100\%$$

The calculated score is an indicator for percent compensation. It distinguishes the negative compensation (higher calorie intake after the high energy preload) to overcompensation (lower calorie intake after the high energy preload) and it makes it possible to judge the effect of preload on calorie consumption.[67,68] Considering the value of the preloads, if the COMPX score is 100% it means that there is a perfect "calorie-for-calorie" compensation and the participant consumed the exact calorie difference between the two preloads.

Three-Factor Eating Questionnaire-R18 (TFEQ-R18):

This questionnaire was used to measure individuals' eating behaviors. The original Three Factor Eating Questionnaire was a 51-item self-reported scale meant to measure cognitive and behavioral components in obese population.[164] However, the revised TFEQ known as TFEQ-R18 is an 18-item scale designed to assess three behavioral factors including cognitive restrains (α=0.75), uncontrolled eating (α=0.85), and emotional eating (α=0.87).[165] The TFEQ-R18 is coded on a four-point scale (1-4), total scores will be averaged with higher score reflecting higher self-regulatory abilities, e.g. "*I deliberately take small helpings as a means of controlling my weight", "I consciously hold back at meals in order not to gain weight."*.[166] The validity of TFEQ has been proven in previous studies including studies among young adults and was found to be easy and comprehensible among this population. Additionally, this scale was shown to be able to distinguish among different eating patterns.[166-168]

Dutch Eating Behavior Questionnaire (DEBQ):

This questionnaire will be used to measure eating behaviors as well. Both TFEQ and DEBQ are known to be conceptually related, however they reflect different

approaches to eating style assessment in college students.[169] DEBQ contains three subscales with a total of 33 questions. The first subscale is called emotional eating (DEBQ-E) which has 13 items (9 describing eating is response to label emotions and 4 describing eating in response to diffuse emotions) with the reliability of α=0.94. The second and the third subscales are restrained eating (DEBQ-R) (α=0.95) and external eating or eating in the presence of external factors (DEBQ-X) (α=0.80) with 10 items each.[157] All the questions are a 5-point Likert-type scale from "never" to "very often" reliable in both obese and non-obese participants.[170] The validity and reliability has been tested in college students in previous studies.[53,171]

Intuitive Eating Scale-2 (IES-2):

IES-2 is a revised scale questionnaire by Tylka et al.[56] IES-2 mirrors the original scale; however it includes more positive scoring (instead of reverse scoring), measures all four intuitive eating factors, and it is specifically designed for male and female college students.[123] This newly developed scale questionnaire is a 33-item scale (with 21 original items and 17 new items) meant to measure the four following key aspects of intuitive eating: a) Eating for physical rather than emotional reasons, b) unconditional permission to eat, c) reliance on internal hunger and satiety cues, d) body-food choice congruence. The questionnaire is a 5-point likert scale with 5 strongly agree and 1 strongly disagree, e.g. "*I can tell when I'm slightly full"*.[56,123] Multiple studies have reported satisfactory reliability for IES-2 and showed the construct validity among college students and adults. [115,172-174] IES-2 has been validated among male and female college students in the U.S. with the internal consistency reliability of α=0.81 and α=0.93 respectively.[174]

Brief Mood Introspection Scale (BMIS):

The BMIS is a 16-item mood adjective scale to assess participants' present mood. In this scale, items are measured on a 4-point likert from definitely do not feel to definitely feel, and it focuses on 4 mood factors: "Calm" α=0.70, "Active" α=0.60, "Positive" α=0.80, and "Negative mood" α=0.78.[175] In addition, there is a likert scale from -10 to 10 (-10= very unpleasant, 10 = very pleasant) to measure participants overall mood at the end of the questionnaire.[175] The validity of the questionnaire has been tested through multiple studies. This scale has also shown reliability in a variety of age groups and among large populations.[175-180]

Body Awareness Questionnaire (BAQ):

Interoceptive awareness was measured using BAQ. This questionnaire is an 18-item self-reported scale meant to measure individuals' sensitivity to body rhythms and cycle and the ability to sense bodily small changes in normal functioning and predicting bodily reactions. BAQ has reported as an internally reported scale with α=0.82.[181] Items are measured on a 7-point Likert (1 = not true of me at all and 7 = very true of me) e.g. *"I know in advance when I'm getting a flu".* The average of the total score will be estimated and a higher score will represent higher interoceptive awareness ability.[181] The validity of the questionnaire was proven, and it was reported as a reliable instrument for measuring self-reported body awareness. Moreover, the BAQ has indicated good internal consistency among college students.[32,181]

Body Responsiveness Scale (BRS):

Interoceptive responsiveness was examined using BRS which includes 7 items to measure the willingness of individuals to respond to their internal signals and has been

reported to be internally consistent α=0.83.[182] The responses are measured based on a 7-point likert scale (1 = not at all true of me, and 7 = always true of me), e.g. *"My bodily desires lead me to do things that I end up regretting" (reverse coded)*. The average of the scores will be measured with higher score demonstrating greater interoceptive responsiveness.[182] Internal consistency and reliability was verified among college students by Oswald et al.[32]

Demographic characteristics:

Demographic data was collected prior to the trials at baseline including gender, race, ethnicity, age, marital status, income, and living arrangements using a questionnaire. Participants were also be asked about their activity level. The questionnaire was developed by the researcher.

Anthropometrics:

Anthropometrics were collected from each participant at FIU, Department of Dietetics and Nutrition. Measurements including height (cm) and weight (kg) were taken. Body Mass Index (BMI in kg/m^2) was calculated using BMI formula ($weight/height^2$).[183] Height was measured barefoot by using a stadiometer, weight was measured without heavy clothes by using a digital scale. In addition, InBody machine was used to measure participants' body composition including body fat percentage and muscle mass. Measurements were done by asking the participants to stand on the machine barefoot and holding the handles for a few seconds until the analysis was done and the results were printed. The touched areas were sanitized after each participate.

Statistical Analysis Plan:

Data was analyzed using SPSS v23.0. and v25.0. For hypothesis 1, linear regression analysis was performed to measure the correlation between BMI and self-regulation scores (COMPX). Paired *t*-test and independent *t*-test were used to examine the effect of preload drinks on food and calorie intake between the sessions as well as comparing self-regulation results between different genders or different BMI categories. Linear Regression was also used to identify associations between mood, intuitive eating, and eating behaviors on the outcome variable (self-regulation) for the second hypothesis. Mediation analysis was conducted using PROCESS syntax, for hypothesis 2 to test the mediation effect of intuitive eating and eating behaviors when looking at the effect of interception on self-regulation. Mediation analysis was based on a model designed by Preacher and Hayes.[184] For hypothesis 3, linear regression was used to examine the correlation between mood and intuitive eating with self-regulation of food intake. Independent *t*-test was performed for hypothesis 2 and 3 to compare the results between different genders or different BMI categories.

Table 4.

Table of analysis

AIM: To determine the association between self-regulation, mood, intuitive eating, and eating behaviors among college students

Hypothesis	Independent and Dependent Variables	Outcomes	Statistical Analyses

H1: Self-regulation will be varied in different BMI categories and genders.	Independent: - Gender - BMI Dependent: - Students' COMPX scores	Individuals with higher BMI show poorer self-regulatory skills. Females have better self-regulation compared to male students.	- Linear Regression - Independent *t*-test - Paired *t*-test
H2: Students with lower interoceptive ability will have lower intuitive eating scores, poorer scores in eating behaviors related to self-control, and lower COMPX scores. The correlations are affected by different eating behaviors scores, BMI and genders.	Independent: - Interoceptive ability - Intuitive eating - Eating behaviors Dependent: - Students' COMPX scores	Students with better interoceptive abilities, higher intuitive eating scores, lower emotional eating and restraint eating scores, seem to have better self-regulation of food intake.	- Linear Regression - Independent *t*-test
H3: Self-regulation is affected by both mood and intuitive eating skills. Negative mood (e.g. stressed or sad) and lower intuitive eating scores will decrease college students' COMPX scores.	Independent: - Mood - Intuitive eating Dependent: - Students' COMPX scores	Students who show higher mood change and lower intuitive eating scores, appear to have poorer self-regulation of food intake.	- Linear Regression - Independent *t*-test

Table 5.

Study timetable

Activities	**Aug 19**	**Sep 19**	**Oct 19**	**Nov 19**	**Dec 19**	**Jan 20**	**Feb 20**	**Mar 30**
IRB	X	X						
Recruitment and screening		X	X					
Randomization and baseline		X	X					
Trials		X	X	X				
Data cleaning and analysis					X	X	X	X

CHAPTER IV

RESULTS

Descriptive analysis:

Participants' demographics:

Participants were recruited from large educational classes at both FIU campuses. A total of 192 college students were recruited. Student athletes and students who were pregnant or vegan, individuals who were on medications that affected their appetite, and students who were diagnosed with some conditions such as diabetes or eating disorders were excluded. Out of 174 eligible students, 66 completed the baseline questionnaires and anthropometric measures. Only 60 participants completed both trials successfully (10% drop out rate) and their data was used in COMPX and food intake related analysis. Participants' mean age was 19.8 years old (SD = 1.43). The majority of the participants were White Hispanics (75.8%), living with their parents (72.7%), with an annual income of lower than $25,000 (93.9%). Further demographics are shown in table 6.

Table 6.

Participants' characteristics

		N	Percentage
Gender	Male	25	37.9
	Female	41	62.1
Race	White	50	75.8
	Black or African American	12	18.2
	Asian	3	4.5
	American Indian	1	1.5
Ethnicity	Hispanic	49	74.2
	Non-Hispanic	17	25.8

Class Standing	Freshman	13	19.7
	Sophomore	22	33.3
	Junior	19	28.8
	Senior	12	18.2
Marital status	Single	66	100
	Married	0	0
	Divorced or widowed	0	0
Personal income	<$25,000	62	93.9
	$25,000-$34,999	3	4.5
	$35,000-$49,999	1	1.5
	>$50,000	0	0
Living arrangement (1)	On campus dorms	10	15.2
	Off-campus dorms	9	13.6
	Apartment/condo/house	47	71.2
Living arrangement (2)	Alone	1	1.5
	With parents	48	72.7
	With roommate	15	22.7
	With partner	2	3

Note. N: sample size.

Participants' anthropometrics:

Most of the students (40.9%) reported a medium activity level throughout the week (150-300 minutes per week), 37.9% claimed that they have low activity (less than 150 minutes per week), 10% reported inactivity (no activity beyond daily life), and 4% declared high level of activity (more than 300 minutes per week). Anthropometric measures were done using a stadiometer and an In-Body machine. The data showed that the mean weight was 69.07 ± 15.96 kg with most of the population in the normal weight category (63.6%). The mean height was 167.72 ± 8.72 cm. Table 7 shows participants' anthropometrics data based on BMI cutoffs.

Table 7.

Participants' anthropometrics by BMI cutoffs

BMI category	*N*	%	Total body water (kg) M±SD	Dry lean mass (kg) M±SD	Lean body mass (kg) M±SD	Body fat mass (kg) M±SD	Skeletal muscle mass (kg) M±SD
Underweight	2	3	28.05±1.91	10.10±0.42	38.15±2.33	10.30±0.42	20.60±1.55
Normal	42	63.6	35.15±11.29	12.85±4.01	48.00±15.30	14.92±10.50	26.91±8.51
Overweight	16	24.2	37.73±8.170	13.86±2.90	51.59±11.06	23.44±5.89	28.83±6.86
Obese	6	9.1	42.6±10.10	15.72±3.76	58.32±13.86	44.20±13.38	32.92±8.54
Total	66	100	36.24±10.53	13.27±3.78	49.51±14.30	19.51±12.95	27.73±8.14

Note. Data expressed as means±standard deviation.

Inter-rater reliability for food intake:

To increase inter-rater reliability to analyze the plate waste pictures, 2 researchers estimated the leftover foods using pictures of the plates after eating independently. We performed Intraclass Correlation Coefficient (ICC) (a two-way mixed effect model, absolute agreement) in order to examine the inter-rater reliability for participants' food intake between 2 raters. The variation of ICC was between 1.000 to 0.892, with pizza (CI = 1.000-1.000), turkey sandwich (CI = 1.000-1.000), grapes (CI = 1.000-1.000), carrots (CI =1.000-1.000) the highest, and cookies the lowest (CI = 0.845-0.825), varying from excellent to good. In addition, final plate weights based on the leftover estimations were compared to the actual final plate weights obtained during the buffets using a scale. These measures were used to estimate total ICC for all 9 food items between the 2 raters (liquids were not included since they were measured directly on the scale instead of via pictures). The results showed that the total ICC was good with ICC = 0.891 (CI = 0.704-0.947) (table 8).

Table 8.

Inter-rater reliability results of plate waste data calculating 2-way mixed-effects model

		95% Confidence Interval		*F* Test with True Value 0			
	Intraclass Correlation	Lower Bound	Upper Bound	Value	*df*1	*df*2	Sig.
Mac and Cheese	0.94	0.91	0.95	16.71	119	119	.000
Pizza	1.00	1.00	1.00	7738.58	119	119	.000
Turkey Sandwich	1.00	1.00	1.00	5771.57	119	119	.000
Grapes	1.00	0.99	1.00	2389.70	119	119	.000
Banana	0.99	0.99	0.99	480.14	119	119	.000
Carrots	1.00	1.00	1.00	3223073.83	119	119	.000
Broccoli	0.99	0.99	0.99	860.41	119	119	.000
Chips	0.99	0.99	0.99	279.15	119	119	.000
Cookie	0.89	0.84	0.92	9.25	119	119	.000

Note. Intraclass Correlation interpretation: <0.50, poor; between 0.50 and 0.75, fair, between 0.75 and 0.90 good; above 0.90, excellent.

Aim 1: To assess self-regulation of food intake among college students using COMPX scores and its association with BMI and gender.

Hypothesis 1: There will be a wide variety of self-regulation scores among college students. Self-regulation will be varied in different BMI categories and genders.

Comparison of means in energy intake (KJ) between different genders and BMI categories:

The descriptive data showed that the mean KJ intake after the low energy preload drink was 3276.14 (SD = 1281.71) and 2823.99 (SD = 1230.00) after the high energy

preload drink among 60 participants who completed the study. Paired *t*-test was conducted to compare the energy intake between both sessions and to test the effect of the calorie content of the preload drink on food intake. Students showed significantly lower energy intake during lunch after drinking a high energy preload compared to when they were offered with a low energy preload drink ($t = 2.83$, $P = .006$; Cohen's $d = 0.36$). The results from examining the effect of the preload drinks on calorie intake between genders indicated that female students showed higher sensitivity to the calorie content of the preload drink and had a lower energy consumption after the high energy preload drink ($t = 2.86$, $P = .007$; Cohen's $d = 0.46$) whereas there seems to be no significant difference in energy intake between both lunch sessions among male students ($P = .173$). In addition, we divided the participants into two different categories based on their BMI information including underweight and normal UN/NO ($n = 41$) and overweight and obese OV/OB ($n = 19$). There was a significant difference in energy intake during two lunches only in UN/NO students ($t = 2.31$, $P = .026$; Cohen's $d = 0.38$).

To compare the food intake (KJ) between male and female students, an independent *t*-test analysis was performed using the data from 60 participants who completed both trials. P values under .05 was consider not significant in this study. The results showed that the mean KJ intake in male students after low calorie preload drink (3836.73 ± 1421.20) was significantly higher than females (2902.42 ± 1040.58) ($t = 2.94$, $P = .005$; Hedges' $g = 0.77$). Similarly, after drinking the high energy preload drink, males showed a significant higher KJ intake (3372.65 ± 1465.74) compared to female students (2458.22 ± 891.34) (t (58) = 3.01, $P = .004$; Hedges' $g = 0.79$). When looking at the effect of the energy content of the preload on KJ intake between the two BMI

categories, no significant difference was found (P = .988 after low energy preload, P = .976 after the high energy preload).

Table 9.

Mean comparison between male and female students' energy (KJ) intake

Intake	Male (n = 24)		Female (n = 36)			
	M	SD	*M*	SD	*t* statistic	Sig.
KJ energy intake after low calorie preload	3836.73	1421.20	2902.42	1040.58	2.94	.005**
KJ energy intake after high energy preload	3372.65	1465.74	2458.22	891.34	3.01	.004**

Note. M=means. SD=standard deviation.
**. Correlation is significant at the .01 level (2-tailed).

Assessing COMPX scores in college students and comparison between different genders and BMI categories:

Compensation index (COMPX) were calculated as a score based on the students' food intake during 2 *ad-libitum* buffet style lunches using COMPX formula. The range of COMPX scores were from -433.8 for students who ate more after the high calorie preload (under compensation) to 362.38 for students who ate very little during lunch (overcompensation) with the mean of 51.46 (SD = 140.91).

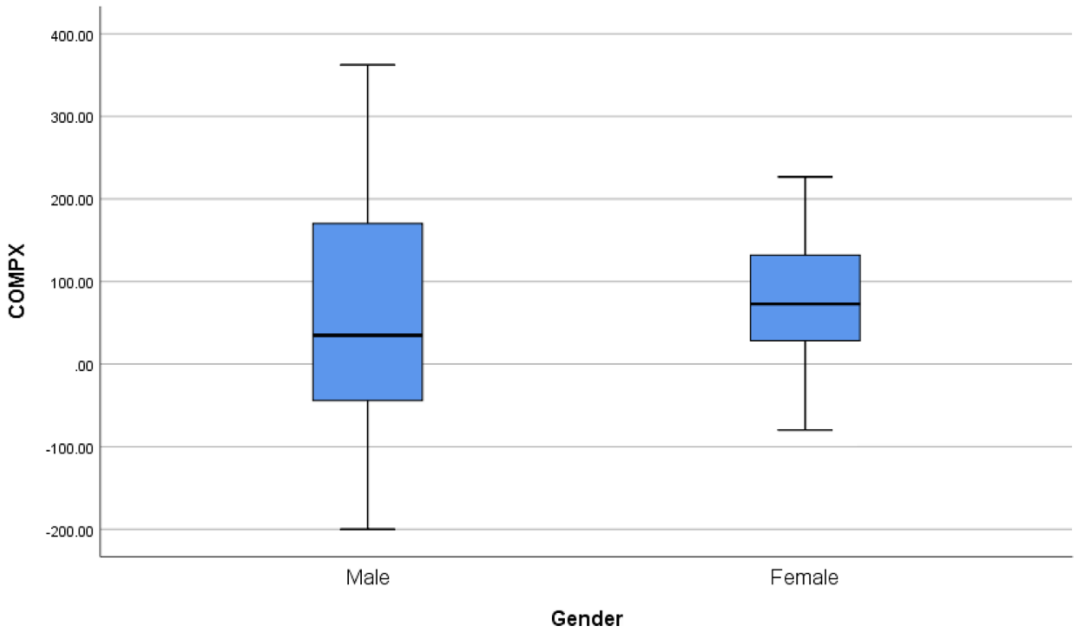
Sample characteristics:

A Shapiro-Wilk's test (P > .05) was performed to test the normality of COMPX scores in male and female students.[185,186] In addition, a visual inspection of their histogram, normal Q-Q plots and box plots showed that the scores were approximately normality distributes in both genders with a skewness of -0.491 (SE = 0.472) and a

kurtosis of -0.762 (SE = 0.918) for males and a skewness of -0.675 (SE = 0.393) and a kurtosis of 0.491 (SE = 0.768) for females.

Figure 6.

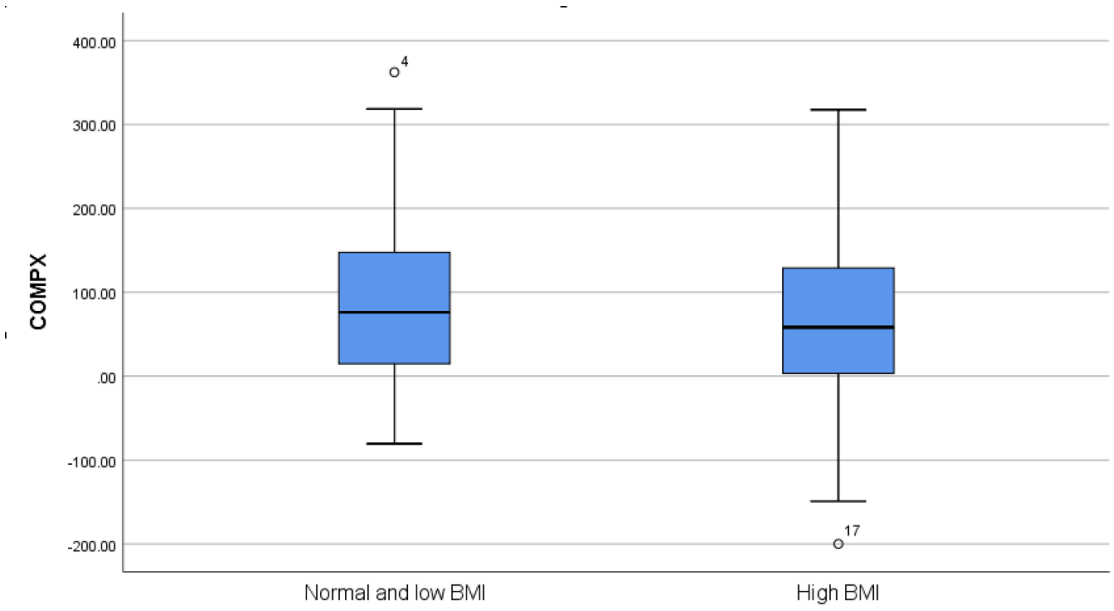
Box plot for self-regulation scores in male and female students



We used the same test to examine the normality of COMPX scores in UN/NO and OV/OB students. The results showed that the scores were normally distributed in both BMI categories with a skewness of -0.775 (SE = 0.369) and a kurtosis of 2.412 (SE = 0.724) for UN/NO students and a skewness of -0.004 (SE = 0.524) and a kurtosis of -0.356 (SE = 1.014) for OV/OB students.

Figure 7.

Box plot for self-regulation scores in UN/NO and OV/OB students



After using box plot to plot the distribution of the COMPX data in different genders, the data for 5 participants (1 male and 4 females) was identified as outliers and was removed for all the COMPX related analysis. Consequently, COMPX scores range changed to -200.00 to 362.38 with the mean of 75.84 (SD = 114.90). Since there was a wide range of the scores and neither of the ends were ideal, COMPX deviation ($COMPX_{dev}$) scores were calculated by subtracting the absolute value of COMPX by 100% using the formula below.

$$COMPX_{dev} = | \text{COMPX scores} - 100\% |$$

After using the above mentioned formula, $COMPX_{dev}$ scores range changed into 4.76-300.00 with the mean of 95.57 (SD = 71.19) with lower scores showing better self-regulation of food intake. The results from the *t*-test revealed that there was a significant difference in $COMPX_{dev}$ scores between males (130.87 ± 83.59) and females (65.04 ±

44.69) (t (53) = 3.77, P = .002; Hedges' g = 1.03), with females showing a higher ability to self-regulate in food intake.

Table 10.

Mean comparison between male and female students $COMPX_{dev}$ scores

Intake	Male (n = 23)		Female (n = 32)			
	M	SD	*M*	SD	*t*	Sig.
Self-regulation	130.87	83.59	65.04	44.69	3.77	.002**

Note. M=means. SD=standard deviation.
**. Correlation is significant at the .01 level (2-tailed).

When looking at the self-regulation scores and BMI data, we found that the mean of $COMPX_{dev}$ scores was 85.28 (SD = 61.68) in UN/NO and 107.57 (SD = 87.67) in OV/OB participants. Table 11 indicates $COMPX_{dev}$ scores in different genders based on BMI cutoffs for 60 participants. The comparison of $COMPX_{dev}$ score means between different BMI categories did not show any significant difference (P = .342).

Table 11.

$COMPX_{dev}$ scores in male and female college students based on BMI cutoffs

Genders	BMI cat.	*N*	Range	Min.	Max.	*M*	SD
Males	UN/NO	16	254.76	7.62	262.38	116.75	67.66
	OV/OB	7	288.10	11.90	300.00	163.12	111.51
Females	UN/NO	21	163.81	4.76	168.57	61.29	44.93
	OV/OB	11	155.24	24.76	180.00	72.21	45.50

Note. M=means. SD=standard deviation.

Even though there was no significant difference between the means of $COMPX_{dev}$ scores in different BMI categories; however, the results from the Regression analysis revealed that there was a significant positive linear relationship between participants'

actual BMI and $COMPX_{dev}$ scores ($F = 10.71$, $P < .001$; $R^2 = 0.292$, Adj-$R^2 = 0.265$) with gender as control variable as indicated in table 12.

Table 12.

Linear Regression Analysis results between BMI and $COMPX_{dev}$ controlled for gender

Variable	*B*	*SE B*	*β*	*t*	Sig.	*F*	Sig.	R^2 (Adj-R^2)
Constant	85.79	53.48		1.60	.115	10.71	.000	0.292 (0.265)
Gender	-61.58	16.78	-0.43	-3.67	.001			
BMI	4.25	1.75	0.28	2.42	.019			

Note: $COMPX_{dev}$ is dependent variable.

In addition, we looked at the relationship between BMI and COMPX in different genders separately. The results showed that there was a positive linear correlation between BMI and self-regulation in different genders; however, it was not statistically significant (presented in table 13 and figure 8).

Table 13.

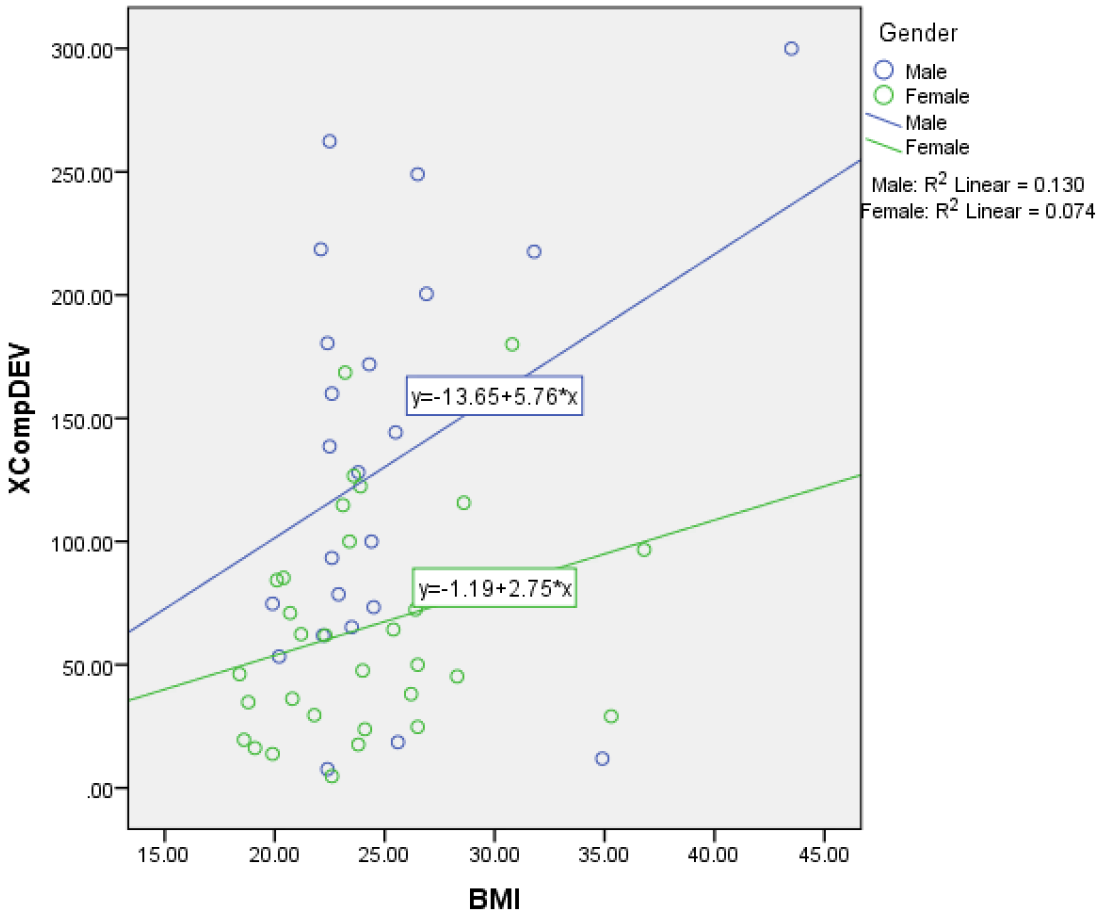
Linear Regression Analysis results between BMI and $COMPX_{dev}$ in different genders separately

Variable	*B*	*SE B*	*β*	*t*	Sig.	*F*	Sig.	R^2 (Adj-R^2)
Constant	22.14	1.96		11.24	.000	3.15	.091	0.130 (0.089)
Male	0.02	0.01	0.36	1.77	.091			
Constant	22.35	1.367	0.27	16.35	.000	2.39	.132	0.074 (0.043)
Female	0.02	0.01		1.54	.132			

Note: $COMPX_{dev}$ is dependent variable.

Figure 8.

Line graph for absolute self-regulation scores ($COMPX_{dev}$) by BMI in male and female students



Food intake:

When comparing food intake between male and female students (n = 60), male students showed a higher consumption of turkey sandwich after drinking the low-energy preload (t = 4.27, P < .001). Food intake details can be found in table 14.

Table 14.

An average of food intake from both trials in male and female college students

Food item	Gender	*N*	Mean	Standard Deviation
Pizza	Male	24	0.74	0.71
	Female	36	0.61	0.53
Mac and cheese	Male	24	0.93	0.82
	Female	36	0.63	0.56
Broccoli	Male	24	0.32	0.52
	Female	36	0.37	0.46
Carrot	Male	24	0.14	0.28
	Female	36	0.13	0.28
Grapes	Male	24	0.67	0.61
	Female	36	0.54	0.47
Turkey sandwich	Male	24	1.14	0.73
	Female	36	0.58	0.52
Bananas	Male	24	0.20	0.36
	Female	36	0.12	0.26
Chips	Male	24	0.19	0.35
	Female	36	0.27	0.42
Cookies	Male	24	0.56	0.90
	Female	36	0.84	0.97
Lemonade	Male	24	0.11	0.24
	Female	36	0.08	0.24

Food/nutrients selection and intake comparison in different BMI categories:

Food selection/intake:

We looked at the impact of the calorie content of the preload drink on participants' food choices and food consumption for all 10 food items separately based on BMI cutoffs as indicated in tables 15 and 16. According to the results, there was a significant difference between low energy preload session and high energy preload session in selecting mac and cheese ($t = 2.05$, $P = .047$) and broccoli ($t = 2.22$, $P = .032$)

and the consumption of mac and cheese ($t = 2.37$, $P = .023$) and broccoli ($t = 2.70$, $P = .010$) in UN/NO students. No significant difference was found in OV/OB students; thus, the calorie content of the preload did not seem to affect the overweight students' food selection or consumption. The comparison was performed between the two groups (UN/NO and OV/OB students) for each food item independently, therefor, Bonferroni adjustment was not necessary.[187]

Table 15.

Comparison of average food selected in UN/NO and OV/OB college students between two buffet sessions

Food	UN/NO (n = 41)					OV/OB (n = 19)				
	Low Cal preload M(SD)	High Cal preload M(SD)	t	Sig.	Cohen's d	Low Cal preload M(SD)	High Cal preload M(SD)	t	Sig.	Cohen's d
Pizza	0.78(0.65)	0.78(0.79)	0.00	1.00	0.00	0.78(0.71)	0.68(0.67)	0.70	.494	0.14
Mac and Cheese	0.90(0.94)	0.63(0.54)	2.05	.047*	0.35	1.21(1.23)	0.95(0.70)	0.84	.413	0.26
Broccoli	0.51(0.64)	0.37(0.54)	2.22	.032*	0.23	0.32(0.58)	0.37(0.49)	-0.44	.667	0.10
Carrots	0.24(0.43)	0.15(0.35)	1.43	.160	0.23	0.16(0.37)	0.26(0.45)	-1.00	.331	0.24
Grapes	0.73(0.67)	0.63(0.58)	1.27	.210	0.16	0.53(0.51)	0.58(0.61)	-0.44	.667	0.09
Turkey Sandwich	0.95(0.74)	0.88(0.78)	0.68	.498	0.10	0.79(0.79)	0.84(0.69)	-0.37	.716	0.07
Banana	0.17(0.38)	0.24(0.43)	-1.14	.262	0.17	0.26(0.45)	0.10(0.31)	1.84	.083	0.41
Chips	0.29(0.46)	0.29(0.51)	0.00	1.00	0.00	0.21(0.42)	0.26(0.56)	-0.57	.578	0.10
Cookies	0.95(1.32)	0.80(1.29)	1.10	.279	0.11	0.84(0.96)	0.68(0.82)	0.61	.546	0.18
Lemonade	0.17(0.44)	0.15(0.36)	0.37	.710	0.05	0.05(0.23)	0.10(0.31)	-0.57	.578	0.18

Note: *: Comparison is significant at the 0.05 level (2-tailed)

Table 16.

Comparison of average food consumed in UN/NO and OV/OB college students between two buffet sessions

Food	UN/NO (n = 41)					OV/OB (n = 19)				
	Low Cal preload M(SD)	High Cal preload M(SD)	t	Sig.	Cohen's d	Low Cal preload M(SD)	High Cal preload M(SD)	t	Sig.	Cohen's d
Pizza	0.70(0.64)	0.67(0.73)	0.41	.687	0.04	0.64(0.59)	0.59(0.62)	0.49	.628	0.08
Mac and Cheese	0.79(0.93)	0.52(0.47)	2.37	.023*	0.37	1.11(1.26)	0.82(0.62)	1.04	.312	0.29
Broccoli	0.48(0.61)	0.29(0.48)	2.70	.010*	0.35	0.25(0.52)	0.29(0.44)	-0.44	.666	0.08
Carrots	0.16(0.33)	0.13(0.32)	0.64	.527	0.09	0.10(0.31)	0.11(0.26)	-0.08	.936	0.03
Grapes	0.68(0.66)	0.58(0.55)	1.26	.216	0.16	0.50(0.49)	0.52(0.56)	-0.19	.854	0.04
Turkey Sandwich	0.86(0.75)	0.80(0.75)	0.56	.582	0.08	0.75(0.77)	0.76(0.68)	-0.04	.968	0.01
Banana	0.13(0.34)	0.16(0.36)	-0.50	.623	0.08	0.22(0.40)	0.10(0.31)	1.53	.142	0.33
Chips	0.26(0.42)	0.24(0.49)	0.25	.807	0.04	0.18(0.36)	0.23(0.52)	-0.52	.610	0.11
Cookies	0.83(1.21)	0.66(1.13)	1.04	.305	0.14	0.84(0.96)	0.53(0.74)	1.38	.184	0.36
Lemonade	0.11(0.28)	0.10(0.27)	0.27	.786	0.04	0.05(0.23)	0.07(0.24)	-0.28	.780	0.08

Note: *: Comparison is significant at the 0.05 level (2-tailed)

Nutrients selection/intake:

A paired t-test was performed to examine the effect of calorie manipulation on calorie and nutrient selection and intake in UN/NO and OV/OB students independently. The outcomes showed a significant difference in fiber ($t = 2.14$, $P = .039$) selection, calorie consumption ($t = 2.31$, $P = .026$) and the consumption of fiber ($t = 2.14$, $P = .039$), fat ($t = 2.16$, $P = .037$), and saturated fat ($t = 2.19$, $P = .035$) among UN/NO students. No significant difference was seen in food selection or food consumption in response to calorie manipulation between both sessions among OV/OB students. Further information is provided in tables 17 and 18. Trans-fat was "0" in all the food items, therefore, it is not mentioned in the data table.

Table 17.

Comparison of average nutrient selected in UN/NO and OV/OB college students between two buffet sessions

Nutrients	UN/NO (n = 41)					OV/OB (n = 19)				
	Low Cal preload M(SD)	High Cal preload M(SD)	t	Sig.	Cohen's d	Low Cal preload M(SD)	High Cal preload M(SD)	t	Sig.	Cohen's d
Calorie	891.32 (317.38)	787.05 (343.07)	1.95	.058	0.31	939.47 (350.11)	783.05 (256.03)	1.41	.176	0.51
Protein	43.68 (14.08)	39.17 (19.75)	1.47	.150	0.26	42.42 (16.31)	39.21 (13.68)	0.88	.389	0.21
CHO	92.05 (36.39)	83.58 (35.63)	1.62	.112	0.23	82.58 (32.05)	74.84 (26.41)	1.01	.326	0.26
Fiber	8.78 (2.86)	7.61 (3.29)	2.14	.039*	0.38	7.94 (2.63)	7.31 (1.63)	0.99	.334	0.29
Sugar	34.36 (20.77)	29.85 (17.47)	1.83	.075	0.23	27.63 (14.29)	27.10 (17.15)	0.12	.907	0.03
Fat	31.88 (15.11)	28.15 (15.59)	1.68	.100	0.24	33.21 (13.40)	28.73 (11.86)	1.11	.280	0.35
Saturated fat	15.17 (7.73)	13.17 (7.34)	1.76	.086	0.26	16.37 (7.30)	13.84 (6.13)	1.15	.266	0.37
Cholesterol	84.41 (34.09)	74.51 (40.94)	1.59	.120	0.26	88.05 (36.64)	77.47 (31.45)	1.08	.296	0.31
Sodium	1535.88 (547.08)	1369.22 (760.96)	1.52	.136	0.25	1518.37 (574.11)	1372.89 (525.11)	0.10	.333	0.26

Note: *: Comparison is significant at the 0.05 level (2-tailed). CHO: Carbohydrate.

Table 18.

Comparison of average nutrient consumed in UN/NO and OV/OB college students between two buffet sessions

Nutrients	UN/NO (n = 41)					OV/OB (n = 19)				
	Low Cal preload M(SD)	High Cal preload M(SD)	t	Sig.	Cohen's d	Low Cal preload M(SD)	High Cal preload M(SD)	t	Sig.	Cohen's d
Calorie	783.41 (315.34)	674.15 (313.69)	2.31	.026*	0.35	782.16 (294.30)	676.68 (254.16)	1.60	.127	0.38
Protein	38.78 (15.90)	34.36 (18.43)	1.65	.107	0.26	37.89 (16.04)	34.16 (14.36)	1.40	.178	0.24
CHO	78.95 (33.18)	71.61 (33.32)	1.74	.089	0.22	71.10 (26.25)	64.84 (26.31)	.96	.349	0.24
Fiber	7.63 (2.92)	6.58 (3.31)	2.14	.039*	0.34	6.95 (2.65)	6.16 (1.95)	1.19	.250	0.34
Sugar	29.19 (17.05)	25.58 (14.99)	1.92	.062	0.22	25.37 (14.26)	23.79 (16.41)	.35	.730	0.10
Fat	28.29 (14.84)	23.97 (13.76)	2.16	.037*	0.30	29.63 (12.86)	24.68 (11.30)	1.58	.132	0.41
Saturated fat	13.44 (7.49)	11.19 (6.49)	2.19	.035*	0.32	14.58 (7.30)	12.05 (5.57)	1.42	.172	0.39
Cholesterol	74.95 (35.68)	64.29 (37.32)	1.95	.058	0.29	77.95 (35.97)	67.47 (30.74)	1.43	.171	0.31
Sodium	1351.39 (591.29)	1187.41 (689.55)	1.78	.082	0.25	1336.31 (537.49)	1185.37 (530.84)	1.48	.157	0.28

Note: *: Comparison is significant at the 0.05 level (2-tailed). CHO: Carbohydrate.

Independent *t*-test was performed to compare average food intake between UN/NO and OV/OB students. According to the results, consumption of mac and cheese is significantly higher in OV/OB group compared to UN/NO group after drinking the high energy preload (t = -2.11, P = .039; Hedges' g = 0.57). There was no significant difference in nutrients intake.

Aim 2: To investigate the relationship between interoceptive ability, intuitive eating, different eating behaviors and self-regulation of food intake in college students and its comparison between different genders and different BMI categories.

Hypothesis 2: Students with lower interoceptive ability will have lower intuitive eating scores, lower scores in eating behaviors related to self-control, and lower COMPX scores. The associations are affected by different eating behaviors scores, BMI and genders.

Subscale division:

The results from the baseline questionnaires of 66 participants were used to examine the correlation between interoception, intuitive eating, and self-regulation. The answers were self-reported based on the participants' understanding of their own internal abilities. Table 4.9 indicates the correlation matrix between all the variables. Interoception was divided into two scales including Body Responsiveness Scale (BRS) and Body Awareness Questionnaire (BAQ) which were measured independently using different questionnaires. Intuitive eating (IE) was calculated as a total intuitive eating score (IES-total) in addition to 4 different subscales including Unconditional permission to eat, Eating for physical rather than emotional, Reliance on hunger and satiety cues, Body-food choice congruence. To measure the ability to regulate food intake and eating

behaviors, two questionnaires were used including Three Factors Eating Questionnaires (TFEQ) and Dutch Eating Behavior Questionnaires (DEBQ). Both questionnaires contained different eating behavior scales which included Uncontrolled Eating Scale (UES), Cognitive Restraint Scale (CRS), Restraint Eating Scale (RES), External Eating Scale (EES), as well as Emotional Eating Scale (EES2) which was the only common scale in both questionnaires. The relationships between the variables were also compared between different genders and different BMI categories. Table 19 presents the frequency of UN/NO and OV/OB among 66 participants who completed the baseline questionnaires.

Table 19.

The frequency of UN/NO and OV/OB students in different genders among participants who completed the baseline questionnaires

Gender	BMI Category	*N*	Percentage
Male	UN/NO	17	68.0
	OV/OB	8	32.0
Female	UN/NO	27	65.9
	OV/OB	14	34.1

Correlation matrix between all the variables (excluding COMPX) in the study:

According to the correlation matrix shown in table 20, BMI is negatively correlated with reliance on hunger and satiety cues (r = -0.41, P = .001), and positively correlated with restraint eating (DEBQ-RES) (r = 0.40, P = .001). Body fat percentage showed positive correlations with emotional eating scales from both TFEQ (r = 0.38, P = .002) and DEBQ (r = 0.31, P = .010) questionnaires and negative associations with total IES scores (r = -0.32, P = .008), eating for physical rather than emotional reasons scale

(r = -.29, P = .016), reliance on hunger and satiety cues (r = -0.31, P = .010), and BRS scores (r = -0.37, P = .002). BRS showed the strongest significant positive associations with some of the variables including total IES scores (r = 0.53, P < .001), eating for physical rather than emotional reasons (r = 0.42, P < .001), reliance on hunger and satiety cues (r = 0.44, P < .001), body-food choice congruence (r = 0.42, P < .001) and negative correlations with emotional eating scores from both questionnaires [TFEQ: (r = -0.34, P = .004), DEBQ: (r = -0.36, P = .003)], TFEQ-UES (r = -0.35, P = .004), DEBQ-RES (r = -0.26, P = .029), DEBQ-EES (r = -0.25, P = .041). In contrast, there were only 2 significant correlations found between BAQ, reliance on hunger and satiety cues (r = 0.27, P = .032) and body-food choice congruence (r = 0.29, P = .016).

Table 20.

Correlation matrix examining the association between interoception, intuitive eating, and different eating behaviors based on the baseline questionnaires

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1. BMI	1	.27*	-.24	-.18	.08	-.41**	-.18	.07	.01	.22	.40**	-.00	-.09	-.22	-.00
2. %Body fat		1	-.32**	.11	-.29*	-.31**	-.21	.38**	.12	-.43	.17	.32**	.19	-.37**	-.43
3. IES-total			1	.37**	.73**	.66**	.29*	-.65**	-.37**	-.23	-.38**	-.6**	-.11	.54**	.20
4. IES1				1	-.08	.15	-.45**	-.2	-.01	-.55**	-.53**	.03	.31*	-.6	-.14
5. IES2					1	-16	.20	-.77**	-.47**	-.02	-.04	-.76	-.42**	.42**	.13
6. IES3						1	.32**	-.29*	-.08	-.04	-.27*	-.23	.19	.45**	.27*
7. IES4							1	-.08	-.1	.24*	.02	-.09	-.25*	.42**	.29*
8. TFEQ-EMS2								1	.39**	.00	.11	.78**	.23	-.35**	-.06
9. TFEQ-UES									1	-.08	-.12	.42**	.65**	-.35**	-.22
10. TFEQ-CRS										1	.72**	.01	-.13	-.05	.05
11. DEBQ-RES											1	.08	-.16	-.27*	-.01
12. DEBQ-EES2												1	.32**	-.36**	-.11
13. DEBQ-EES													1	-.25*	-.01
14. BRS														1	.45**
15. BAQ															1

Note: IES1: Unconditional permission to eat. IES2: Eating for physical rather than emotional. IES3: Reliance on hunger and satiety cues. IES4: Body-food choice congruence.
Note: **. Correlation is significant at the .01 level (2-tailed). *. Correlation is significant at the .05 level (2-tailed).
Note: Numbers in the top row of the table are similar items as the variables in the left column.

Correlation between Interoception and Intuitive Eating scale in different genders:

Independent *t*-test was performed to test the difference between interoceptive abilities between male and female students. The mean scores of body awareness were 4.91±0.77 in males and 4.68±0.72 in females. The mean scores of body responsiveness were 5.11±2.00 and 4.55±0.97 in males and females respectively. There was no statistically significant difference between the body awareness score means ($P = .236$); however, the mean difference for body responsiveness scores appeared to be significant ($t = 2.27$, $P = .027$) with male students showing a higher score. Table 21 presents the intuitive eating scores in different genders. The *t*-test showed that the only significant difference was in eating for physical rather than emotional scores between male and female college students ($t = 2.17$, $P = .033$).

Table 21.

Intuitive eating scores in male and female college students

Intuitive eating subscales	Genders	*N*	Mean	Standard Deviation
Total intuitive eating score	Male	25	3.57	0.49
	Female	41	3.36	0.48
Unconditional permission to eat	Male	25	3.35	0.96
	Female	41	3.43	0.84
Eating for physical rather than emotional	Male	25	3.53	0.95
	Female	41	3.03	0.88
Reliance on hunger and satiety cues	Male	25	3.84	0.85
	Female	41	3.64	0.72
Body-food choice congruence	Male	25	3.56	0.82
	Female	41	3.54	0.95

Note: N=sample size.

We used multiple linear regression to test the correlation between interoception and intuitive eating subscales. Since gender had no significant effect on the correlation with unconditional permission to eat facet, and resulted into negative Adjusted R^2, it was taken out from that model. The results from multiple linear regression analysis presented in table 22, indicate the significant positive relationship between interocpetion, total intuitive eating scores ($F = 8.57$, $P < .001$; $R^2 = 0.293$, Adj-$R^2 = 0.259$), reliance on hunger and satiety cues ($F = 5.31$, $P = .003$; $R^2 = 0.204$, Adj-$R^2 = 0.166$), body-food choice congruence ($F = 5.29$, $P = .003$; $R^2 = 0.204$, Adj-$R^2 = 0.165$), and eating for physical rather than emotional reasons ($F = 5.40$, $P = .002$; $R^2 = 0.207$, Adj-$R^2 = 0.169$). The findings show that the impact of gender is not significant in this model and intuitive eating may have less to do with body awareness compared to body responsiveness.

Table 22.

Multiple linear regression results between interoception and intuitive eating subscales in college students

Variables	*B*	*SE B*	*β*	*t*	*P*	*F*	Sig.	R^2 (Adj- R^2)
Total intuitive eating score						8.57	.000	0.293 (0.259)
Body awareness	-0.03	0.08	-0.05	-0.43	.667			
Body responsiveness	0.26	0.06	0.54	4.39	.000			
Gender	-0.06	0.11	-0.06	-0.58	.566			
Reliance on hunger and satiety cues						5.31	.003	0.204 (0.166)
Body awareness	0.08	0.13	0.08	0.60	.549			
Body responsiveness	0.32	0.10	0.41	3.14	.003			

Gender	-0.00	0.19	-0.00	-0.01	.993			
Body-food choice congruence						5.29	.003	0.204 (0.165)
Body awareness	0.16	0.15	0.13	1.05	.300			
Body responsiveness	0.35	0.12	0.39	3.00	.004			
Gender	0.22	0.22	0.12	1.01	.318			
Eating for physical rather than emotional reasons						5.40	.002	0.207 (0.169)
Body awareness	-0.09	0.16	-0.07	-0.59	.557			
Body responsiveness	0.38	0.12	0.41	3.17	.002			
Gender	-0.31	0.22	-0.16	-1.36	.177			
Unconditional permission to eat						0.42	.736	0.019
Body awareness	-0.17	0.17	-0.14	-1.01	.317			
Body responsiveness	0.00	0.12	0.01	0.04	.968			

Regression analysis between interoceptive abilities and intuitive eating scores between different genders revealed that there was a significant positive correlation between interoception (BRS), total intuitive eating scores ($F = 8.06$, $P = .001$; $R^2 = 0.298$, Adj-$R^2 = 0.261$), eating for physical rather than emotional reasons scale ($F = 4.09$, $P = .024$; $R^2 = 0.177$, Adj-$R^2 = 0.134$), reliance on hunger and satiety cues score ($F = 5.07$, $P = .011$; $R^2 = 0.211$, Adj-$R^2 = 0.169$), and body-food choice congruence ($F = 4.45$, $P = .018$; $R^2 = 0.190$, Adj-$R^2 = 0.147$) among female students. Male students showed no significant relationship between interoception and intuitive eating subscales.

Correlation between Interoception and different eating behaviors in different genders:

Eating behavior scores obtained from TFEQ and DEBQ questionnaires are presented in table 23. T-test comparison signified the mean difference between only one variable from TFEQ (emotional eating) between male and female students (t = -2.09, P = .041) which was shown to be higher among females.

Table 23.

Eating behaviors scores in male and female college students

Eating Behaviors	Gender	*N*	Mean	Standard Deviation
TFEQ-Emotional eating	Male	25	34.22	28.67
	Female	41	48.78	26.74
TFEQ-Uncontrolled eating	Male	25	41.37	16.17
	Female	40	38.83	14.91
TFEQ-Cognitive restraint	Male	25	41.11	15.04
	Female	41	43.63	17.37
DEBQ-restraint eating	Male	25	2.04	0.66
	Female	41	2.25	0.77
DEBQ-Emotional eating	Male	25	2.17	0.97
	Female	41	2.55	0.84
DEBQ-External eating	Male	25	3.40	0.64
	Female	41	3.47	0.71

Note: N=sample size.

Table 24 indicates the results from multiple linear regression to examine the correlation between interoception and different eating behaviors when controlled for gender. The findings indicated that there was a slight effect of gender and body awareness on the students' eating behaviors, however, body responsiveness seems to have a significant effect in this model. There was a significant negative correlation between interoception and TFEQ emotional eating scale (F = 3.89, P = .013; R^2 = 0.158,

Adj-R^2 = 0.118), DEBQ emotional eating scale (F = 3.66, P = .017; R^2 = 0.150 Adj-R^2 = 0.109), and TFEQ uncontrolled eating scale (F = 3.95, P = .012; R^2 = 0.163 Adj-R^2 = 0.121).

Table 24.

Multiple linear regression results between interoception and different eating behaviors in college students

Variables	*B*	*SE B*	*β*	*t*	*P*	*F*	Sig.	R^2 (Adj- R^2)
TFEQ Emotional Eating Scale						3.89	.013	0.158 (0.118)
Body awareness	4.61	4.97	0.12	0.93	.357			
Body responsiveness	-9.86	3.75	-0.35	-2.63	.011			
Gender	10.04	6.99	0.17	1.44	.156			
TFEQ Uncontrolled Eating Scale						3.95	.012	0.163 (0.121)
Body awareness	-1.56	2.70	-0.08	-0.58	.566			
Body responsiveness	-5.58	2.04	-0.37	-2.74	.008			
Gender	-6.11	3.81	-0.19	-1.60	.114			
TFEQ Cognitive Restraint Scale						0.31	.737	0.010
Body awareness	2.10	3.12	0.09	0.67	.504			
Body responsiveness	-1.52	2.29	-0.09	-0.66	.509			
DEBQ Restraint Eating						2.11	.108	0.093 (0.049)
Body awareness	0.14	0.13	0.14	1.06	.292			
Body responsiveness	-0.23	0.10	-0.31	-2.25	.0128			

Gender	0.11	0.19	0.07	-.56	.574			
DEBQ Emotional Eating						3.66	.017	0.150 (0.109)
Body awareness	0.09	0.16	0.07	0.57	.570			
Body responsiveness	-0.33	0.12	-0.37	-2.71	.009			
Gender	0.22	0.22	0.12	0.98	.329			
DEBQ External Eating						1.76	.165	0.078 (0.034)
Body awareness	0.12	0.12	0.13	0.99	.327			
Body responsiveness	-0.21	0.09	-0.32	-2.25	.028			
Gender	-0.02	0.18	-0.01	-0.11	.913			

In addition, we looked at the effect of interoception on different eating behaviors in male and female college students separately. The results showed that there was a negative correlation between interoception, TFEQ uncontrolled eating scale ($F = 9.95$, $P < .001$; $R^2 = 0.350$, Adj-$R^2 = 0.315$), DEBQ emotional eating scale ($F = 3.48$, $P = .041$; $R^2 = 0.155$, Adj-$R^2 = 0.110$), and DEBQ external eating scale ($F = 4.49$, $P = .018$; $R^2 = 0.191$, Adj-$R^2 = 0.148$) in female students. Furthermore, there was a negative association between interoception and DEBQ restraint eating scale ($F = 5.11$, $P = .015$; $R^2 = 0.317$, Adj-$R^2 = 0.255$) in male students. BAQ did not seem to have a significant impact on eating behaviors ($P > .05$).

Correlation between interoception, intuitive eating, and different eating behaviors on self-regulation in different genders:

Multiple linear regression analysis was used to investigate the effect of interoception on $COMPX_{dev}$ scores using gender as a control variable. The results

presented that the relationship between interoception and $COMPX_{dev}$ scores is statistically significant ($F = 5.56$, $P = .002$; $R^2 = 0.247$, Adj-$R^2 = 0.202$) with gender indicating a significant effect ($P < .001$). Additionally, only the effect of total intuitive eating scores ($F = 9.20$, $P < .001$; $R^2 = 0.261$, Adj-$R^2 = 0.233$) and one intuitive eating subscales (unconditional permission to eat) on $COMPX_{dev}$ scores seems to be statistically significant with gender having a strong effect on the model ($F = 10.22$, $P < .001$; $R^2 = 0.282$, Adj-$R^2 = 0.255$). Among eating behaviors, higher TFEQ cognitive restraint scale was shown to have statistically significant association with poorer $COMPX_{dev}$ when controlled for genders ($F = 8.67$, $P = .001$; $R^2 = 0.250$, Adj-$R^2 = 0.221$). Gender had a significant effect in the model (negatively) ($P < .001$). Table 25 presents the details.

Table 25.

Regression analysis results showing the significant associations between eating behaviors and cognitive abilities on COMPX

Variables	*B*	*SE B*	*β*	*t*	*P*	*F*	Sig.	R^2 (Adj-R^2)
COMPX						5.56	.002	0.247 (0.202)
Gender	-69.63	18.32	-0.49	-3.80	.000			
Body responsiveness	-12.33	9.56	-0.18	-1.30	.198			
Body awareness	16.09	12.51	0.18	1.29	.204			
COMPX						9.20	.000	0.261 (0.233)
Gender	-71.12	17.28	-0.49	-4.12	.000			
Total intuitive eating score	-31.24	16.72	-0.23	-1.87	.067			
COMPX						10.22	.000	0.282 (0.255)
Gender	-62.02	16.89	-0.43	-3.67	.001			

Unconditional permission to eat	-20.65	9.15	-0.27	-2.26	.028			
COMPX						8.67	.001	0.250 (-.221)
Gender	-69.94	17.36	-0.49	-4.03	.000			
TFEQ cognitive restraint	19.37	11.90	0.19	1.63	.110			

The findings from looking at the correlation between self-regulation and interocpetion after splitting the data into males and females showed that there was no significant relationship between the variables in neither of the genders. No significant association was found between $COMPX_{dev}$ and intuitive eating subscales. However, better $COMPX_{dev}$ scores seemed to be significantly associated with lower cognitive restraint scale (TFEQ) ($F = 4.95$, $P = .037$; $R^2 = 0.191$) and DEBQ restraint eating ($F = 4.70$, $P = .042$; $R^2 = 0.183$) in male students.

Correlation between Interoception and Intuitive Eating in different BMI categories:

The mean scores of interoceptive abilities were compared between UN/NO and OV/OB students. BAQ mean scores were 4.78±0.76 in UN/NO and 4.75±0.71 in OV/OB students. The mean scores of BRS appeared to be 4.90±1.03 in UN/NO and 4.48±0.93 in OV/OB college students. The mean comparison showed no difference between groups. Table 26 indicated the details of intuitive eating scores in different BMI categories. Independent *t*-test was performed to compare the intuitive eating score means between different BMI categories. UN/NO students showed a higher score in reliance on hunger and satiety cues ($t = 3.36$, $P = .001$) and body-food choice congruence ($t = 2.02$, $P = .048$).

Table 26.

Intuitive eating scores in UN/NO and OV/OB college students

Intuitive eating subscales	BMI cat.	*N*	Mean	Standard Deviation
Total intuitive eating score	UN/NO	44	3.56	0.43
	OV/OB	22	3.20	0.53
Unconditional permission to eat	UN/NO	44	3.50	0.96
	OV/OB	22	3.19	0.68
Eating for physical rather than emotional	UN/NO	44	3.27	0.88
	OV/OB	22	3.12	1.03
Reliance on hunger and satiety cues	UN/NO	44	3.93	0.66
	OV/OB	22	3.29	0.83
Body-food choice congruence	UN/NO	44	3.70	0.92
	OV/OB	22	3.24	0.78

Note: N=sample size.

We examined the effect of interoception on intuitive eating scores using BMI categories as a control variable. Based on the results of this regression we found no significant correlation between interoception and uncontrolled permission to eat (P = .335); however, there were significant correlations between interoception and total intuitive eating (F = 9.05, P < .001; R^2 = 0.305, Adj-R^2 = 0.271), reliance on hunger and satiety cues (F = 9.42, P < 0.001; R^2 = 0.313, Adj-R^2 = 0.280) with BMI having a significant effect in the model (P = .003), body food choice congruence (F = 5.26, P = .003; R^2 = 0.203, Adj-R^2 = 0.164), and eating for physical rather than emotional (F = 5.79, P = .001; R^2 = 0.219, Adj-R^2 = 0.181). Details are presented in table 27.

Table 27.

Multiple linear regression results between interoception and intuitive eating subscales in college students

Variables	*B*	*SE B*	*β*	*t*	*P*	*F*	Sig.	R^2 (Adj-R^2)
Total intuitive eating score						9.05	.000	0.305 (0.271)
Body awareness	-0.02	0.08	-0.03	-0.29	.772			
Body responsiveness	0.25	0.06	0.52	4.28	.000			
BMI	-0.01	0011	-0.13	-1.17	.247			
Reliance on hunger and satiety cues						9.42	.000	0.313 (0.280)
Body awareness	0.12	0.12	0.12	0.99	.328			
Body responsiveness	0.24	0.09	0.32	2.63	.011			
BMI	-0.06	0.02	-0.34	-3.13	.003			
Body-food choice congruence						5.26	.003	0.203 (0.164)
Body awareness	0.17	0.15	0.14	1.12	.269			
Body responsiveness	0.29	0.12	0.33	2.53	.014			
BMI	-0.02	0.02	-0.11	-0.96	.339			
Eating for physical rather than emotional reasons						5.79	.001	0.219 (0.181)
Body awareness	-0.12	0.16	-0.09	-0.73	.465			
Body responsiveness	0.47	0.12	0.51	3.91	.000			
BMI	0.04	0.02	0.19	1.67	.099			
Unconditional permission to eat						1.15	.335	0.053 (0.007)
Body awareness	-0.14	0.17	-0.12	-0.85	.398			
Body responsiveness	-0.04	0.12	-0.04	-0.32	.752			

BMI	-0.04	0.02	-0.19	-1.48	.143

We split the 2 BMI categories and looked at the effect of interoception on each intuitive eating facet separately in which we found no significant effect from BAQ ($P >$ .05). OV/OB group appeared to have a significant positive relationship between interoception and eating for physical rather than emotional ($F = 8.92$, $P = .002$; $R^2 = 0.484$, Adj-$R^2 = 0.430$). On the other hand, UN/NO students showed a significant positive relationship between interoception, reliance on hunger and satiety ($F = 4.38$, $P = .019$; $R^2 = 0.176$, Adj-$R^2 = 0.136$), and body food choice congruence ($F = 4.69$, $P = .015$; $R^2 = 0.186$, Adj-$R^2 = 0.146$). Both UN/NO ($F = 3.91$, $P = .028$; $R^2 = 0.160$, Adj-$R^2 = 0.120$) and OV/OB ($F = 10.76$, $P = .001$; $R^2 = 0.531$, Adj-$R^2 = 0.482$) groups appeared to have a significant positive correlation between total intuitive eating scores and interocpetion with OV/OB showing a stronger association.

Correlation between Interoception and eating behaviors in different BMI categories:

The mean eating behavior scores were compared between different BMI categories using independent *t*-test. The results from the analysis showed that OV/OB students showed a higher score in DEBQ-restraint eating ($t = -2.98$, $P = .004$). Table 28 shows the details of the eating behavior scores.

Table 28.

Eating behaviors scores in different BMI categories in college students

Eating Behaviors	BMI cat.	*N*	Mean	Standard Deviation
TFEQ-Emotional eating	UN/NO	44	40.91	29.33
	OV/OB	22	47.98	25.75

TFEQ-Uncontrolled eating	UN/NO	44	39.91	16.78
	OV/OB	21	39.58	12.12
TFEQ-Cognitive restraint	UN/NO	44	40.28	16.43
	OV/OB	22	47.47	15.78
DEBQ-restraint eating	UN/NO	44	1.99	0.68
	OV/OB	22	2.53	0.70
DEBQ-Emotional eating	UN/NO	44	2.31	0.80
	OV/OB	22	2.60	1.08
DEBQ-External eating	UN/NO	44	3.47	0.75
	OV/OB	22	3.39	0.52

Note: N=sample size.

The results from the regression analysis presented that BMI has a slight non-significant effect on the association between interoception, TFEQ, and DEBQ subscales; however there seems to be a significant effect of BMI on interocpetion and restraint eating behavior ($P = .004$). Interoception showed significant correlations with TFEQ emotional eating ($F = 4.72$, $P = .012$; $R^2 = 0.130$), TFEQ uncontrolled eating scales ($F = 3.10$, $P = .033$; $R^2 = 0.131$, Adj-$R^2 = 0.089$), DEBQ-restraint eating ($F = 5.35$, $P = .002$; $R^2 = 0.206$, Adj-$R^2 = 0.167$), and DEBQ emotional eating ($F = 3.52$, $P = .020$; $R^2 = 0.146$, Adj-$R^2 = 0.104$). Table 29 presents the details of the results.

Table 29.

Multiple linear regression results between interoception and different eating behaviors in college students

Variables	*B*	*SE B*	*β*	*t*	*P*	*F*	Sig.	R^2 (Adj-R^2)
TFEQ Emotional Eating Scale						3.10	.033	0.131 (0.089)
Body awareness	4.50	5.08	0.12	0.88	.379			
Body responsiveness	-11.26	3.82	-0.40	-2.95	.005			
BMI	-0.12	0.74	-0.02	-0.16	.875			

TFEQ Uncontrolled Eating Scale						3.06	.035	0.131 (0.088)
Body awareness	-1.29	2.77	-0.06	-0.45	.643			
Body responsiveness	-5.06	2.08	-0.34	-2.43	.018			
BMI	-0.20	0.41	-0.06	-0.49	.622			
TFEQ Cognitive Restraint Scale						1.19	.319	0.055 (0.009)
Body awareness	1.52	3.09	0.07	0.49	.625			
Body responsiveness	-0.56	2.33	-0.03	-0.24	.811			
BMI	0.78	0.45	0.22	1.72	.091			
DEBQ Restraint Eating						5.35	.002	0.206 (0.167)
Body awareness	0.09	0.13	0.10	0.78	.436			
Body responsiveness	-0.17	0.09	-0.24	-1.81	.075			
BMI	0.06	0.02	0.35	3.03	.004			
DEBQ Emotional Eating						3.52	.020	0.146 (0.104)
Body awareness	0.10	0.16	0.08	0.62	.535			
Body responsiveness	-0.38	0.12	-0.42	-3.11	.003			
BMI	-0.02	0.02	-0.09	-0.79	.434			
DEBQ External Eating						2.43	.074	0.105 (0.062)
Body awareness	0.14	0.12	0.16	1.15	.256			
Body responsiveness	-0.24	0.09	-0.36	-2.59	.012			
BMI	-0.02	0.02	-0.17	-1.36	.177			

Looking at the effect of interoception on different eating behaviors in different BMI categories separately signifies that in OV/OB group, interoception is negatively corelated with TEEQ emotional eating ($F = 17.94$, $P < .001$; $R^2 = 0.654$, Adj-$R^2 = 0.617$)

and DEBQ emotional eating ($F = 4.86$, $P = .020$; $R^2 = 0.338$, Adj-$R^2 = 0.269$). No significant association was found in UN/NO ($P > .05$).

Correlation between interoception, intuitive eating, and different eating behaviors on self-regulation in different BMI categories:

Findings showed that there was a significant negative correlation between $COMPX_{dev}$ and one of intuitive eating subscales (unconditional permission to eat) ($F = 5.63$, $P = .021$; $R^2 = 0.096$). However, the multiple regression analysis results showed that interoception and different eating behaviors are not significantly correlated with $COMPX_{dev}$ when controlled for BMI ($P = .444$). Among intuitive eating subscales, unconditional permission to eat seemed to have a higher negative effect on $COMPX_{dev}$ ($F = 3.11$, $P = .053$; $R^2 = 0.107$), but it was marginally significant. Details are presented in table 30. When looking at the association between self-regulation and intuitive eating subscales in different BMI categories, we found that $COMPX_{dev}$ is negatively associated with unconditional permission to eat in OV/OB students ($F = 6.97$, $P = .018$; $R^2 = 0.551$). No significant correlation was found when using eating behaviors in the model.

Table 30.

Regression analysis results showing the significant associations between eating behaviors and cognitive abilities on COMPX

Variables	*B*	*SE B*	*β*	*t*	*P*	*F*	Sig.	R^2 (Adj- R^2)
COMPX						0.91	.444	0.051 (-0.005)
BMI	20.56	21.26	0.14	0.97	.338			
Body responsiveness	-0.18	10.58	-0.003	-0.02	.987			
Body awareness	15.65	14.25	0.17	1.09	.277			

COMPX						3.11	.053	0.107 (0.072)
BMI	15.76	19.92	0.10	0.79	.432			
Unconditional permission to eat	-22.80	10.27	-0.29	-2.22	.031			

Mediation test:

A hierarchical multiple regression analysis was conducted to test the hypothesis that the students' self-regulation of food intake is affected by interoception indirectly with intuitive eating or eating behaviors as mediators when controlled for gender. Since only the total intuitive eating scores, unconditional permission to eat and restraint eating scores were significantly correlated with $COMPX_{dev}$, we did not use the other variables in the model. In addition, because PROCESS syntax does not recognize 2 variables as independent variables, only body responsiveness was used as X since body awareness did not show any significant associations with any of the variables. First, we used total intuitive eating scores as a mediator and the results are as followed: in step 1 of the mediation model, the regression of body responsiveness with self-regulation, when ignoring the effect of the mediator, was not significant, $B = -7.14$, $t = -0.83$, $P = .410$. Step 2 indicated that regression of body responsiveness on the mediator, total intuitive eating scores, was significant $B = 0.25$, $t = 4.25$, $P < .001$. Step 3 of the mediation process showed that the mediator (total intuitive eating scores), controlling for body responsiveness was not significant $B = -32.35$, $t = -1.65$, $P = .105$. Step 4 showed that, controlling for the mediator (intuitive eating), body responsiveness was not significant predictor of self-regulation of food intake, $B = 1.10$, $t = 0.11$, $P = .911$. Sobel test found

non-significant mediation in the model (z = -1.50, P = .133). In this case the effect size was -8.24 (95% CI = -25.56 - 3.04).

Table 31.

Test of hypothesized mediator of total intuitive eating scores

Criteria	*B*	*SE*	*t*	*P*	Lower CI	Upper CI
Step 1: Effect of interoception on self-regulation when ignoring the mediator (path c´).						
Body responsiveness	-7.14	8.59	-0.83	.410	-24.39	10.12
Gender	-70.62	18.42	-3.83	.000	-107.58	-33.66
Step 2: Effect of interoception on the mediator intuitive eating (path a).						
Body responsiveness	0.25	0.06	4.25	.000	0.13	0.37
Gender	0.001	0.13	0.01	.989	-0.25	0.26
Step 3 and 4: Effect of the mediator intuitive eating on self-regulation (path b) and the indirect of interoception on self-regulation (path c).						
Body responsiveness	1.10	9.82	0.11	.911	-18.62	20.82
Intuitive eating	-32.35	19.59	-1.65	.104	-71.69	6.99
Gender	-70.57	18.12	-3.89	.000	-106.95	-34.19
Indirect effect of X on Y	Effect	Lower CI	Upper CI	*SE*	*Z*	*P*
	-8.24	-25.56	3.04	5.48	-1.50	.133

Note: SE = Standard Error. CI = Confidence Interval.

We replaced total intuitive eating scores with unconditional permission to eat and tested the model again. In step 1, the regression of body responsiveness with self-regulation, when ignoring the effect of the mediator, was not significant, B = -7.14, t = -0.83, P = .410. Step 2 indicated that regression of body responsiveness on the mediator, unconditional permission to eat scores, was also not significant B = -0.01, t = -0.08, P = .937. However, step 3 of the mediation process showed that the mediator (unconditional permission to eat), controlling for body responsiveness was significant B = -20.73, t = -2.26, P = .028. Step 4 showed that, controlling for the mediator (unconditional

permission to eat), body responsiveness was not significant predictor of self-regulation of food intake, B = -7.34, t = -0.89, P = .379. Sobel test found non-significant mediation in the model (z = 0.07, P = .942). In this case the effect size was 0.20 (95% CI = -5.29 – 6.88).

Table 32.

Test of hypothesized mediator of unconditional permission to eat scores

Criteria	*B*	*SE*	*t*	*P*	Lower CI	Upper CI
Step 1: Effect of interoception on self-regulation when ignoring the mediator (path c′).						
Body responsiveness	-7.14	8.59	-0.83	.410	-24.39	10.12
Gender	-70.62	18.42	-3.83	.000	-107.58	-33.66
Step 2: Effect of interoception on the mediator unconditional permission to eat (path a).						
Body responsiveness	-0.01	0.12	-0.08	.937	-0.26	0.24
Gender	0.17	0.27	0.66	.511	-0.36	0.71
Step 3 and 4: Effect of the mediator unconditional permission to eat on self-regulation (path b) and the indirect of interoception on self-regulation (path c).						
Body responsiveness	-7.34	8.28	-0.89	.379	-23.96	9.27
Unconditional permission to eat	-20.73	9.17	-2.26	.028	-39.14	-2.33
Gender	-66.93	17.81	-3.76	.000	-102.69	-31.19
Indirect effect of X on Y	Effect	Lower CI	Upper CI	*SE*	*Z*	*P*
	0.20	-5.29	6.88	2.84	0.07	.942

Note: SE = Standard Error. CI = Confidence Interval.

To perform mediation analysis using eating behaviors as a mediator TFEQ cognitive restraint eating score was used as it was the only eating behavior with a significant correlation with $COMPX_{dev}$. In step 1, the regression of body responsiveness with self-regulation, when ignoring the effect of the mediator, was not significant, B = -7.14, t = -0.83, P = .410. Step 2 indicated that regression of body responsiveness on the

mediator, cognitive restraint eating, was also not significant B = -0.58, t = -0.26, P = .795. But, step 3 of the mediation process showed that the mediator (cognitive restraint eating), controlling for body responsiveness was significant B = 1.13, t = 2.18, P = .034. Step 4 showed that, controlling for the mediator (cognitive restraint eating), body responsiveness was not significant predictor of self-regulation of food intake, B = -6.48, t = -0.78, P = .439. Sobel test found non-significant mediation in the model (z = -0.24, P = .813). In this case the effect size was -0.66 (95% CI = -6.46 – 5.51).

Table 33.

Test of hypothesized mediator of cognitive restraint eating scores

Criteria	*B*	*SE*	*t*	*P*	Lower CI	Upper CI
Step 1: Effect of interoception on self-regulation when ignoring the mediator (path c′).						
Body responsiveness	-7.14	8.59	-0.83	.410	-24.39	10.12
Gender	-70.62	18.42	-3.83	.000	-107.58	-33.66
Step 2: Effect of interoception on the mediator cognitive restraint eating (path a).						
Body responsiveness	-0.58	2.21	-0.26	.795	-5.02	3.86
Gender	4.14	4.74	0.87	.387	-5.37	13.65
Step 3 and 4: Effect of the mediator cognitive restraint eating on self-regulation (path b) and the indirect of interoception on self-regulation (path c).						
Body responsiveness	-6.48	8.31	-0.78	.439	-23.16	10.20
Cognitive restraint eating	1.13	0.52	2.18	.033	0.09	2.18
Gender	-75.32	17.92	-4.20	.000	-111.29	-39.35
Indirect effect of X on Y	Effect	Lower CI	Upper CI	*SE*	*Z*	*P*
	-0.66	-6.64	5.51	2.78	-0.24	.813

Note: SE = Standard Error. CI = Confidence Interval.

Aim 3: To examine the effect of mood change and intuitive eating on self-regulation of food intake.

Hypothesis 3: Self-regulation is affected by both mood and intuitive eating skills. Negative mood (e.g. stressed or sad) and lower intuitive eating score will decrease college students' COMPX scores.

Generally, the average of overall mood scores between both sessions (n = 60) showed that after watching the emotional movie, 69.6% of males and 83.9% of females showed a mood change. The average overall mood change between both visits was -2.021±2.752 in males and -3.057±3.533 in females. The items in the mood questionnaire were divided into 2 mood groups including positive and negative moods (8 items each). The average positive mood change was -0.304±0.431 and -0.467±0.377 in males and females respectively. The average negative mood change was 0.188±0.468 in males and 0.130±0.376 in female students. For all the mood related analysis, all 3 forms of average mood changes including overall, positive, and negative mood changes were examined independently. However, negative mood change did not seem to be significantly correlated with any nutrient intake in different genders or BMI categories.

Self-regulation and mood change:

The analysis showed that overall mood change (n = 55) seems to positively affect self-regulation score among the college students however it was not significant (P = .263). Emotional eating scores did not show any significant correlations with $COMPX_{dev}$ scores (P = .399) with TFEQ and (P = .726) with DEBQ. We picked TFEQ emotional eating scale since it showed a better correlation with self-regulation compared to DEBQ emotional scale and tested the effect of mood on self-regulation controlled for emotional

eating score. Findings showed a significant association in the model with gender having the highest effect; however, the effect of mood and emotional eating scores was marginally significant as shown in table 4.24 ($F = 6.00$, $P = .001$; $R^2 = 0.265$, Adj-$R^2 = 0.221$). In addition, we found significant correlations when replacing the total mood change with positive mood change ($F = 6.78$, $P = .001$; $R^2 = 0.311$, Adj-$R^2 = 0.265$) or negative mood change ($F = 4.76$, $P = .005$; $R^2 = 0.222$, Adj-$R^2 = 0.176$) with females showing a more significant correlation. Details are shown in table 34.

Table 34.

Regression analysis results examining the effect of overall mood change, positive mood change and negative mood change on $COMPX_{dev}$ controlled for emotional eating scores and gender

Variables	*B*	*SE B*	*β*	*t*	*P*	*F*	Sig.	R^2 (Adj-R^2)
COMPX						6.00	.001	0.265 (0.221)
Average total mood change	2.32	2.72	0.11	0.85	.397			
Emotional eating score	0.60	0.32	0.24	1.94	.058			
Gender	-68.65	17.83	-0.48	-3.85	.000			
COMPX						6.78	.001	0.311 (0.265)
Average positive mood change	37.88	23.77	0.20	1.59	.118			
Emotional eating score	0.88	0.36	0.32	2.44	.019			
Gender	-73.79	19.33	-0.50	-3.82	.000			
COMPX						4.76	.005	0.222 (0.176)
Average negative mood change	-7.42	21.28	-0.04	-0.35	.729			
Emotional eating score	0.42	0.32	0.17	1.31	.195			

Gender	-67.16	17.88	-0.49	-3.76	.000

Furthermore, female students showed that $COMPX_{dev}$ scores are positively associated with average total mood change ($F = 5.49$, $P = .026$; $R^2 = 0.159$) and average positive mood change ($F = 5.62$, $P = .025$; $R^2 = 0.167$). Male students showed no significant association between $COMPX_{dev}$ and any mood change. When looking at the correlations between mood change and self-regulation when controlled for emotional eating scores between different genders separately, we found that the only significant association was with overall mood change in female students ($F = 3.39$, $P = .048$; $R^2 = 0.195$, Adj-$R^2 = 0.137$).

No significant correlation was found between $COMPX_{dev}$ and mood change when controlled for BMI categories ($P = .237$) or both BMI categories and emotional eating scores ($P = .412$). A significant positive correlation was found between average positive mood change and KJ energy intake among OV/OB students after consuming both the low energy preload drink ($F = 12.80$, $P = .003$; $R^2 = 0.667$) and the high energy preload drink ($F = 7.59$, $P = .014$; $R^2 = 0.576$). The association was not significant in UN/NO college students neither in separated genders ($P > .05$).

Self-regulation, intuitive eating, and mood change:

Multiple regression analysis was performed to investigate the correlation between intuitive eating and mood change on self-regulation. According to the results, poorer self-regulation of food intake is significantly associated with lower uncontrolled permission to eat scores and higher positive mood change ($F = 3.28$, $P = .047$; $R^2 = 0.125$, Adj-$R^2 = 0.087$) and higher overall mood change ($F = 4.37$, $P = .018$; $R^2 = 0.146$, Adj-$R^2 = 0.113$).

In the same model, there were higher number of significant correlations when controlled for gender. The results indicated that mood change and all intuitive eating subscales were significantly associated with self-regulation in food intake when controlled for genders. Gender seems to have the strongest effect in the model. Furthermore, unconditional permission to eat scores seemed to be the only subscale with a statistically significant correlation in the model. Details are presented in table 35.

Table 35.

Regression analysis results examining the effect of mood change and intuitive eating on $COMPX_{dev}$ controlled for gender

Variables	*B*	*SE B*	*β*	*t*	*P*	*F*	Sig.	R^2 (Adj-R^2)
COMPX						7.22	.000	0.302 (0.260)
Average mood change	0.48	2.68	0.02	0.18	.859			
Unconditional permission to eat	-25.02	9.71	-0.31	-2.58	.013			
Gender	-57.40	17.17	-0.40	-3.34	.002			
COMPX						4.46	.007	0.211 (0.164)
Average mood change	1.74	2.80	0.08	0.08	.537			
Eating for physical rather than emotional reasons	-3.00	9.50	-0.04	-0.04	.753			
Gender	-63.71	18.75	-0.45	-0.45	.001			
COMPX						4.92	.005	0.228 (0.181)
Average mood change	2.21	2.80	0.10	0.79	.434			
Reliance on hunger and satiety cues	-11.72	10.78	-0.14	-1.09	.282			
Gender	-63.68	18.00	-0.45	-3.54	.001			
COMPX						4.56	.007	0.215 (0.168)
Average mood change	2.01	2.83	0.09	0.71	.481			

Body-food choice congruence	-5.88	10.29	-0.07	-0.57	.570
Gender	-62.49	18.11	-0.44	-3.45	.001

When looking at the effect of mood change and intuitive eating scales on self-regulation of food intake when controlled for intuitive eating scores between genders, the only significant association were shown to be with unconditional permission to eat (F = 5.13, P = .013, R^2 = 0.268, Adj- R^2 = 0.216) in female students.

We replaced gender by BMI categories in the same above-mentioned model and the findings showed that higher mood change and lower unconditional permission to eat score are significantly associated with lower ability to self-regulate when controlled for BMI (F = 3.06, P = .037, R^2 = 0.155, Adj- R^2 = 0.104). When positive mood change was used in the model, the association was marginally significant (F = 2.69, P = .058, R^2 = 0.152, Adj- R^2 = 0.095). Correlations were not significant when examined the model with negative mood change or in different BMI categories separately. Table 36 presents the details of the association between mood change, in intuitive eating and self-regulation of food intake.

Table 36.

Regression analysis results examining the effect of mood change and intuitive eating on $COMPX_{dev}$ controlled for BMI categories

Variables	*B*	*SE B*	*β*	*t*	*P*	*F*	Sig.	R^2 (Adj-R^2)
COMPX						3.06	.037	0.155 (0.104)
Average mood change	2.41	3.03	0.11	0.79	.431			
Unconditional permission to eat	-26.65	10.94	-0.33	-2.44	.018			

BMI	14.85	20.51	0.09	0.72	.472			
COMPX						1.13	.346	0.063 (0.007)
Average mood change	4.29	3.08	0.19	1.39	.171			
Eating for physical rather than emotional reasons	6.85	10.10	0.09	0.68	.501			
BMI	28.66	21.13	0.19	1.36	.181			
COMPX						0.99	.403	0.056 (0.000)
Average mood change	4.37	3.11	0.19	1.41	.166			
Reliance on hunger and satiety cues	-3.67	12.84	-0.04	-0.29	.776			
BMI	24.42	22.72	0.16	1.07	.288			
COMPX						0.98	.410	0.055 (-0.001)
Average mood change	4.36	3.12	0.19	1.40	.168			
Body-food choice congruence	-2.11	11.52	-0.03	-0.18	.855			
BMI	26.07	21.50	0.17	1.21	.231			

The results from looking at the correlation between positive and negative mood change and intuitive eating on self-regulation with gender as a control variable indicated that higher positive mood and lower intuitive eating scores are significantly correlated with better self-regulation with gender having the highest effect on the model. On the other hand, lower negative mood and lower intuitive eating scores are associated with self-regulatory abilities in food consumption. However, when having eating for physical rather than emotional reasons scores in the model, it shows that COMPX scores are affected by higher intuitive eating scores and negative mood.

Table 37.

Regression analysis results examining the effect of positive mood change and intuitive eating on $COMPX_{dev}$ controlled for gender

Variables	*B*	*SE B*	*β*	*t*	*P*	*F*	Sig.	R^2 (Adj-R^2)
COMPX						5.81	.002	0.279 (0.231)
Average positive mood change	20.22	24.37	0.11	0.83	.411			
Unconditional permission to eat	-19.42	10.14	-0.25	-1.91	.062			
Gender	-59.39	19.13	-0.40	-3.10	.003			
COMPX						4.37	.009	0.226 (0.174)
Average positive mood change	27.80	24.89	0.15	1.12	.270			
Eating for physical rather than emotional reasons	-5.99	10.89	-0.08	-0.55	.585			
Gender	-65.10	20.81	-0.44	-3.13	.003			
COMPX						4.83	.005	0.243 (0.193)
Average positive mood change	27.74	24.58	0.15	1.13	.265			
Reliance on hunger and satiety cues	-13.51	11.51	-0.15	-1.17	.247			
Gender	-63.23	19.62	-0.43	-3.22	.002			
COMPX						4.39	.009	0.227 (0.175)
Average positive mood change	26.51	25.05	0.14	1.06	.269			
Body-food choice congruence	-6.61	10.90	-0.08	-0.61	.547			
Gender	-61.76	19.78	-0.42	-3.12	.003			

Table 38.

Regression analysis results examining the effect of negative mood change and intuitive eating on $COMPX_{dev}$ controlled for gender

Variables	*B*	*SE B*	*β*	*t*	*P*	*F*	Sig.	R^2 (Adj-R^2)
COMPX						5.89	.002	0.261 (0.217)
Average negative mood change	0.21	0.65	0.04	0.33	.741			
Unconditional permission to eat	-19.16	9.08	-0.26	-2.11	.040			
Gender	-57.93	16.96	-0.42	-3.42	.001			
COMPX						4.05	.012	0.196 (0.147)
Average negative mood change	0.33	0.67	0.06	0.49	.626			
Eating for physical rather than emotional reasons	1.32	9.57	0.02	0.14	.891			
Gender	-60.61	18.37	-0.44	-3.29	.002			
COMPX						4.09	.011	0.197 (0.149)
Average negative mood change	0.29	0.68	0.5	0.43	.668			
Reliance on hunger and satiety cues	-3.98	11.13	-0.05	-0.36	.722			
Gender	-62.25	17.78	-0.45	-3.50	.001			
COMPX						4.07	.012	0.196 (0.148)
Average negative mood change	0.31	0.67	0.06	0.46	.647			
Body-food choice congruence	-2.43	9.88	-0.03	-0.25	.807			
Gender	-61.55	17.63	-0.45	-3.49	.001			

CHAPTER V

DISCUSSION

Overview:

The purpose of this study was to examine the correlation between mood, internal body signals, eating behaviors, and intuitive eating on self-regulation of food intake among college students, 18-24 years of age. There were 3 aims in this study: first, to assess self-regulation of food intake among college students using COMPX scores and determine their correlation with BMI and gender; second, to investigate the relationship between interoceptive ability, intuitive eating, different eating behaviors, and self-regulation of food intake in college students; and third, to examine the effect of mood change and intuitive eating on self-regulation of food intake. In the current study, a combination of objective methodology and questionnaires were used to validate the data. This study primarily focuses on internal bodily signals of hunger and satiety and an objective method was used to measure self-regulation of food intake via COMPX as data collected from questionnaires may come with self-reported bias.[116]

Participants were 66 enrolled undergraduate college students who completed the baseline questionnaires; with 60 students completing both trials (10% drop out ratio). Students who participated in this study included both men (37.9%) and women (69.1%) with a small age range between 18-24 years old and a mean age of 19.8 (SD = 1.43). Additionally, the majority of participants were white (75.8%), Hispanic (74.2%) with a reasonable distribution between college class standings including freshmen (19.7%), sophomores (33.3%), juniors (28.8%), and seniors (18.2%). These sample characteristics make our study sample unique when compared to similar studies in college students that

typically include a sample population of only one gender or include a small number of Hispanic students with a large age range.[32,95,123-125] The majority of the students were in the normal weight category (63.6%) with a BMI of 18.5-24.9, 24.4% were overweight (BMI: 25-29.9), 9.1% were obese (BMI ≥ 30), and 3% were underweight (BMI < 17.9). BMI rates in our sample population seemed to be fairly similar to other studies done among US college students; however, our study sample showed a slightly lower rate of underweight students.[188,189]

Participants were asked to participate in 2 visits one week apart. During the visits participating students completed questionnaires and anthropometrics measures were taken. Then they were asked to watch an emotional movie, drink a preload drink 30 minutes prior to lunch, and were served an *ad-libitum* buffet style lunch with a variety of food options where they were able to eat as much quantity and variety as they desired. The exposure to a wide assortment of options provided the researchers with the opportunity to examine the effect of calorie manipulation on participants' food choices.[160,161] Mood change was measured by asking the participants to fill out a mood questionnaire before and after watching the emotional movie. Food intake was measured using plate weights and plates' pictures taken before and after eating.[162,163] In order to have an accurate estimation of participants' consumption and increase inter-rater reliability, 2 trained researchers estimated the amount of leftover foods using pictures taken before and after eating.[190] Intraclass correlation coefficient results showed that in general, there was a high reliability between the raters; however, the consumption measures of pizza, turkey sandwich, grapes, and carrots had the highest inter-rater reliability (similar portion estimation between the raters) and cookies had the lowest

inter-rater reliability (dissimilar portion estimation between the raters). This may largely be due to the raters' acuity in visual estimation difficulties when food residuals are taken into consideration (ie. cookie crumbles) as estimated leftovers are more accurate when the appearance of the food and the picture of the food are indistinguishable.[191] For instance, a slice of pizza has a triangular shape lending itself better for geometric approximation post consumption versus cookies which tend to crumble and leave residuals that may affect the final plate weights.

Discussion of Hypotheses

Hypothesis 1: There will be a wide variety of self-regulation scores among college students. Self-regulation will be varied in different BMI categories and genders.

In this study, we aimed to assess the ability of college students to self-regulate their food intake. To assess self-regulation, we used COMPX, an objective measure of self-regulation. Hypothesis 1 was supported by the findings of this study. Our results showed that while students exhibited a wide range of compensation scores in food consumption, females displayed higher self-regulatory skills during the calorie manipulation trials. Most importantly, the results demonstrated a significant positive correlation between BMI and self-regulation. Indeed, students with lower BMI showed higher self-regulatory skills for food intake compared to OV/OB students, which may be due to higher ability to detect and respond to their bodily signals of hunger and satiety. To the best of our knowledge, this is the first study to examine self-regulation of food intake among college students ages 18-24 using an objective methodology. By improving our understanding of self-regulation of energy intake among college students, our

findings may facilitate targeted interventions to improve food-related habits and prevent weight change among young adults who transition to college.

Compensation scores were calculated to assess students' ability to effectively detect and respond to internal bodily eating related cues in response to calorie manipulation known as self-regulation. According to the results, none of the participants had a perfect (100%) compensation score or were able to demonstrate a perfect calorie-for-calorie compensation. In this study, a perfect calorie compensation would have occurred if a participant consumed exactly 210 kcal (878.64 KJ) less during lunch after drinking the high-energy preload drink compared to when they drank the low-energy drink; that caloric difference being the exact difference between the low and high energy preload drinks. Similar studies that used COMPX in children also showed, even though young children appeared to have closer scores to 100% compared to college students, there was no perfect compensation score for any of the participants.[67,68,73,135,137,138]

The range of COMPX scores were from -433.8% for students who ate more after the high calorie preload (under compensation) to 362.38% for students who ate very little during lunch (overcompensation) with the mean of 51.46% (SD = 140.91%). These results demonstrate limited self-regulatory skills in calorie consumption among college students. However, the average calorie intake seemed to be significantly higher during the low calorie preload session compared to the high calorie preload session. This finding indicates that college students may have the ability to calorie compensate to some degree. Previous studies that assessed self-regulation in college students using focus groups suggested that college students lacked self-regulation of food intake, which results in adaptation to unhealthy eating behaviors. In addition, during the focus groups, students

reported that the greatest barrier they face in order to keep a healthy weight in college is the inability to self-regulate their energy consumption.[103-105] Our results were consistent with these findings by showing a wide range of self-regulatory skills in food consumption scores in college aged participants.

To our knowledge there is only one study that has utilized COMPX to measure compensation in adults 25-35 years old published by Birch and Deysher.[73] In that study, self-regulation was examined among both children and adults and the authors reported clearer evidence of calorie compensation in children compared to adults. Birch and Deysher[73] suggested the possibility that adults may lose self-regulatory skills by ignoring physiological hunger and satiety cues as individuals age. The lower levels of self-regulation in our study seem to reinforce these findings. Thus, further studies are needed to understand the developmental patterns related to self-regulatory skills in food intake and individuals age.

Another key finding in the current study was the relationship between gender and self-regulation with females showing significantly better self-regulation than males. This is relatively similar to previous studies that measured self-regulation in different genders in college students via questionnaires or focus groups. The results of those studies revealed that male students are more likely to engage with unhealthy eating behaviors that leads to weight gain such as consuming more meals. On the other hand, female students have a higher ability to adapt to healthy eating behaviors resulting in controlling their calorie consumption.[103,192,193] The evidence therefore suggests that food self-regulation may be gender dependent, yet more research is required to clarify this relationship.

Furthermore, the present study provides important information about the correlation between students' BMI and self-regulation. The mean self-regulation absolute score among UN/NO and OV/OB students were 85.28 (SD = 61.68) and 107.57 (SD = 87.67), respectively, indicating that individuals with higher BMI scores had lower self-regulation of food consumption. We also examined calorie compensation which represents self-regulatory abilities in food intake across the two conditions and found that calorie compensation was only significant in the UN/NO group. In other words, students who were UN/NO had a lower calorie consumption following the high energy preload drink compared to the consumption following the low energy preload drink exhibiting higher self-regulation in this group. Previous studies (many of which have been under-powered) have suggested that children with higher adiposity and elevated body weights tended to have less evidence of self-regulatory capacity; however, the linear analysis between BMI z-scores and COMPX scores did not seem to be statistically significant.[67,68,121,139,194] Another study in college students using survey methodology also indicated no direct significant association between self-regulation and BMI.[195] Interestingly, in contrast to those studies, we found that there was a significant positive linear association between BMI and COMPX scores when we controlled for gender. Similarly, the results from studies that measured self-regulation via a questionnaire among undergraduate students, exhibited lower weight status for students with higher ability to self-regulate their eating.[196,197] Taking these analyses together, the results from our study indicate that students who have a higher ability to identify their internal bodily signals of hunger and satiety seem to exhibit lower BMIs.

Finally, we investigated the effect of the calorie content of the preload drinks on students' energy intake during lunch by analyzing the food and nutrient consumption and selection in both sessions. In examining overall selection during the lunch periods, we found differences between genders and weight status. Male students had slightly higher intake in most of the food items, and turkey sandwiches seemed to be a popular lunch option among the various choices offered during the trial. Students who are OV/OB had no changes in food choice or intake as a result of the calorie manipulation. However, the UN/NO students selected more mac and cheese and broccoli after consuming the low calorie preload drink when compared to the high calorie preload drink. This supported the premise that college students with higher weights are thought to have lower self-regulation of food intake.[198] Additionally, UN/NO students had a significantly higher consumption of fiber, fat, and saturated fat following the low energy preload drink compared to when they drank the high energy drink showing higher calorie compensation. In one of the previous COMPX trials done in children, researchers found that children showed similar intake of foods that were high in carbohydrates and fat in both sessions despite the effect of the calorie content of the preload.[194] Additionally, our previous research, in children ages 4-10 years old, indicates that OV/OB children consume a higher amount of fat intake after high energy preload when compared to UN/NO children (Coccia C, Lovan P, Macchi A, et al. Unpublished data, 2020). It is clear from both studies that there is lower self-regulation in OV/OB participants compared to UN/NO. In general, OV/OB students had a higher intake of calorie dense foods in our study. This may be the reason those college students have a higher weight status as there is a positive correlation between calorie-dense and high fat food

consumption and college weight gain.[5] Lower self-regulation in OV/OB college students may be one of the most important causes of weight gain during college years.[4]

Hypothesis 2: Students with lower interoceptive ability will have lower intuitive eating scores, poorer scores in eating behaviors related to self-control, and lower COMPX scores. The correlations are affected by different eating behaviors scores, BMI, and gender.

The second hypothesis aims to discover if there is an association between interoception, intuitive eating, eating behaviors, and self-regulation of food intake. In addition, based on the findings from Hypothesis 1, these associations were compared between different genders and different BMI categories (UN/NO and OV/OB) among college students. The study results partially supported Hypothesis 2. Interoception, known as the extent to which students are aware of and responsive to their hunger and satiety cues, appeared to have a significant influence on some behavioral aspects of food intake. Students with higher levels of interoception seem to have lower levels of restricted eating and less response to emotional stimuli that may trigger overconsumption. These abilities may lead to fewer numbers of uncontrolled and emotional eating episodes in college students. Moreover, interoception was significantly associated with intuitive eating skills, where individuals rely on physiological cues and bodily needs for energy consumption. These relationships revealed to be more notable in female students; however, in males interoception was directly correlated with cognitive restraint. In addition, students with higher BMI scores had lower interoceptive abilities, higher levels of emotional eating, and poorer self-regulation. They also were more likely to restrict their food intake compared to students with lower BMI.

First, we examined interoception. Studies have revealed that lower interoception scores are associated with lower volitional control in calorie consumption.[199,200] Our results suggest these cognitive abilities may facilitate food choices based on physiological signals. Therefore, individuals who rely on internal bodily signals when hungry and satiated may experience better caloric self-regulation. When examining gender difference in interoceptive ability, the results indicated a slight difference in interoceptive awareness scores between genders. Male students had significantly better interoceptive responsiveness scores compared to females, which is in line with previously reported outcomes.[201] Male students appeared to have a higher ability to respond to their internal food intake commands, which may be why more males were classified as UN/NO than females. In contrast to our study, a study that examined interoceptive awareness in college aged population suggested that female college students may have higher emotional distress when receptive to bodily signals, whereas males students find their bodies more safe and appeared to concern less about their bodily sensations.[202] Despite these findings, our study suggests that male college students seem to have a better ability to respond to their bodily signals when compared to females. When looking directly at interoception and weight, a study published by Herbert et al[95,31] indicated that higher sensitivity to bodily signals (measured objectively by heart rate) may improve college students' BMI status. However, our findings failed to show any significant correlations between participants BMI and interoceptive abilities. It is possible that the greater number of normal weight students in our sample population or the utilization of questionnaires instead of an objective measure may have caused these conflicting findings.

Next we examined the correlation between interoception and intuitive eating. In our study we found a significant correlation between interoception, and the intuitive eating subscales: reliance on hunger and satiety cues, body-food choice congruence, and eating for physical rather than emotional reasons along with the full intuitive eating score. Two previous studies have examined the relationship between these variables finding similar results.[32,95] However, one study utilized an objective measure of interoception and only showed correlations between interoceptive sensitivity and two subscales of intuitive eating (reliance on hunger and satiety cues and eating for physical rather than emotional reasons).[95] The other study used a questionnaire to assess interoception similar to our study and found significant relationships between interoceptive abilities and all the facets of intuitive eating.[32] In contrast, our study did not find a significant association between interoception and unconditional permission to eat. One notable difference between our study and the previous studies is that we utilized a newer measure to assess intuitive eating which includes a fourth facet of intuitive eating called body-food choice congruence. Body-food choice congruence examines the degree to which individuals are able to choose food based on their bodily needs.[123] All of the intuitive eating facets are known to rely on acknowledging inner bodily commands.[56] Hence, these findings indicate that higher awareness and responsiveness to internal bodily cues may assist students to focus on physiological needs and avoid external forces which improves their ability to eat intuitively. Interestingly, in the present study, this correlation appeared to be significant among female students not males. It is important to note that there were different associations between interoception and intuitive eating when students were classified by weight status. According to our findings, only UN/NO students exhibited a

significant positive association between interoception, reliance on hunger and satiety cues, and body-food choice congruence.

We also looked at the relationship between BMI and intuitive eating. Previous findings in college students have shown that total intuitive eating scores are negatively correlated with body weight.[57,95,123,128] Comparing the mean scores of the intuitive eating subscales between different BMI categories revealed that students who are UN/NO had significantly higher intuitive eating scores, reliance on hunger and satiety cues, and body-food choice congruence compared to OV/OB students. Other studies have reported negative correlations between reliance on hunger and satiety cues and BMI.[95,123] However in contrast to our findings, these studies also noted a relationship between eating for physical rather than emotional reasons and BMI. When looking at these findings it is important to note that students weight status may be greatly impacted by relying on physiological needs than environmental prompts. Students who have lower BMI, seem to show a higher ability to recognize and trust their internal bodily demands, which may also help them to avoid emotional triggers of overconsumption and weight gain.

In addition to examining the relationship between interoception and intuitive eating, we also examined the role of interoception on the various eating behaviors. The association between interoception (both interoceptive awareness and responsiveness) and eating behaviors has never been tested in college students before which makes our study outcomes unique. Our findings demonstrated negative correlations between interoception and the three eating behaviors; emotional eating, uncontrolled eating, and external eating. Participants with higher levels of interoception, had lower levels of emotional and

uncontrolled eating episodes as well as lower levels of external eating. When we stratified by gender, these associations were only significant among females. In male students, interoception was negatively correlated with cognitive restraint. Men are known to have lower emotional eating and restraint eating scores than females, [203] which corresponds to our findings showing that male students reported lower restraint eating scores compared to female students.

In relation to weight status, OV/OB students had higher levels of cognitive restraint when compared to their UN/NO peers. These results were similar to previous reports that noted higher cognitive restraint eating in college students were correlated with higher BMI scores.[204] Moreover, emotional eating is reported to be higher in college students who are OV/OB.[204,205] We found a significant negative correlation between interoception and emotional eating scores in OV/OB students. These results combined may reveal the fact that practicing interoception, where individuals learn to detect and respond to their internal commands, may assist students to control their weight during college. However, further research is needed to clarify this association.

Finally, we examined the relationship between self-regulation, intuitive eating, and eating behaviors. Our results showed that individuals who are able to self-regulate energy intake may have higher ability to avoid eating restrictions (lower restraint eating).[101] Additionally, higher levels of unconditional permission to eat is related to better self-regulation of food. This correlation has been found to be significant in male college students. These results appeared to be different than a previous study that examined the relationship between self-regulation and intuitive eating in which the authors reported significant associations between self-regulation, eating for physical

rather than emotional, and body-food choice congruence, not unconditional permission to eat.[195] Additionally, OV/OB students who had lower unconditional permission to eat scores were more likely to have poorer self-regulatory skills. In light of this, dieting, restrictions, and limiting food options purposefully did not seem to improve self-regulatory skills in our study. The ability to avoid restrictions in food choices may facilitate regulations in calorie consumption which may lead to maintaining healthy body weight in college students.

Finally, intuitive eating and eating behaviors were analyzed to see if they mediated the relationship between interoception and self-regulation. Previous findings have demonstrated the positive effect of intuitive eating on eating regulations.[195,206] In addition, intuitive eating has been shown to mediate the association between self-regulation and BMI.[195] According to our findings, there was a significant direct effect of interoception on self-regulation of food intake, thus, interoception may be a reliable predictor for self-regulation in college students. On the other hand, higher unconditional permission to eat and lower restraint eating appeared to improve self-regulatory skills. However, the overall mediation analyses were not significant in this study showing that there was no indirect correlation between interoception and self-regulation with intuitive eating or eating behaviors as mediators.

Hypothesis 3: Self-regulation is affected by both mood and intuitive eating skills. Negative mood (e.g. stressed or sad) and lower intuitive eating scores will decrease college students' COMPX scores.

The final hypothesis examined the role of mood and intuitive eating on the self-regulation of food intake in college students. This hypothesis was supported by our

findings. Our findings revealed that while mood change may be considered a strong predictor of self-regulation in college students, intuitive eating may play a role as well. The results suggest that students' mood changes play an important role in their control of food intake and that two subscales of intuitive eating; lower mood change and higher unconditional permission to eat were associated with better self-regulation in calorie consumption among college students. In other words, students who are able to allow themselves to eat what they desire with no restrictions, have a better ability to improve their energy intake. These effects may be further influenced by gender, as we also found that female students exhibited greater mood changes as well as higher self-regulation of food intake compared to male students. In addition, mood change seemed to have a significant association with self-regulation only in female students. On the other hand, in students with different weight status, self-regulation appeared to be influenced differently by mood change. OV/OB students demonstrated poorer self-regulation affected by a higher mood change when exposed to an emotional stimulus compared to UN/NO students. These findings are important, as they may be advantageous in future weight gain prevention programs for college students during a time where individuals may experience dramatic emotional/mood changes.

This study used a movie to manipulate students' emotions prior to the compensation trials. Multiple studies have shown the effectiveness of watching a movie and mood change in college students previously.[71,152-154] We categorized participants into 3 groups based on the type of mood change they experienced after watching the movie; average total mood change, positive mood change, and negative mood change.[207] Our results suggested that students' mood change played an important role in controlling their

food intake. These results were similar to previous findings which demonstrated that students who experienced higher emotional ups and downs showed lower self-regulatory skills and consumed a higher amount of food/snacks.[158,159] However, those studies were done with limited food items (1 or 2 snack foods) whereas our study offered an unlimited amount of food with a variety of food options via a buffet style lunch. This methodology more closely imitated students' daily life on campus. Consequently, higher emotional changes seemed to make it difficult for the students to regulate their intake based on their bodily physiological commands during the buffet paradigm.

When examining the role of gender, we found that females exhibited greater mood changes. These outcomes align with previous studies,[208,209] showing that female students appeared to be more influenced by the emotional changes. Male students showed lower emotional changes in general. Weight status also influenced the relationship between mood and self-regulation in the current study. Our data showed that students with higher BMI exhibited a higher food intake and poorer self-management in calorie consumption whereas UN/NO students seemed to have better self-regulation when exposed to a negative emotional stimulus. Students who are OV/OB also showed higher emotional eating scores compared to UN/NO students, indicating their higher sensitivity to emotional experiences which may lead to poorer self-regulation of food intake. A previous observational study suggested that underweight individuals tend to undereat while overweight individuals overeat during negative emotional states.[210] Another study that tested stress, mood, and stress-related eating behaviors among female college students reported higher food consumption due to stress among obese students finding no effect between food consumption and stress in normal weight students.[211] Altogether, our

findings contribute to the existing knowledge and suggest the importance of the possible effect of emotional sensitivity and mood status on the ability to control healthy weights among college students.

With regard to the relationship between mood, intuitive eating skills, and self-regulation of food intake, the results of the present study suggest that even though mood change may have a strong impact on self-regulation in college students, intuitive eating may also influence student's intake. Self-regulation in college students seems to be positively correlated with all the facets of intuitive eating, but unconditional permission to eat appeared to have the highest effect when combined with mood change. This association was significant only among female students which may be related to the way each gender responds to negative emotions where females showed a higher mood change. Similar to our results, a study by Lynch et al.[45] found a positive relationship between poor regulatory behaviors in food intake and negative emotions in females; however, their findings did not suggest the same correlations in males. The current study reveals a more congruent image by evaluating the effect of both variables on food intake showing that higher emotional changes combined with lower unconditional permission to eat may cause poorer self-regulatory skills in eating.

When BMI was in the model, there was a significant association between average mood change, unconditional permission to eat, and self-regulation. Thus, higher unconditional permission to eat and lower mood change appeared to be predictors for self-regulation of food intake even when controlled for students BMI. However, this association was not significant in OV/OB and UN/NO student groups separately. Interestingly enough, when we examined the effect of positive mood change and negative

mood change in the same model when controlled for students' gender, all the correlations seemed to be statistically significant. Both higher positive and negative mood change seemed to affect student's self-regulatory skills in a negative way causing poorer calorie self-regulation. Other studies that compared food intake after positive and negative mood indicated that negative mood may have a greater impact on higher food consumption.[212,213] In light of this information, college students seem to demonstrate better self-control in calorie consumption where they show a higher connection with their bodily prompts when hungry or satiated, allow themselves to eat, and experience less emotional changes. However, further studies are needed to clarify the effect of different emotions combined with intuitive eating on self-regulation of food intake.

Strengths and limitations:

This study has several strengths and limitations. The most noticeable strength of the study is the sample size. In this study, 66 participants completed the baseline measurements and 60 participants finished both trials successfully, which is greater than the number of participants in previous studies using COMPX to measure self-regulation.[67,73,134,135,214] In addition, a large portion of the population is Hispanic, providing valuable insights into a group that has been underrepresented in this area of research. Another strength is the use of buffet style lunch in this study. To date most studies using the COMPX methodology has utilized a pre-set meal for each participant. By using the buffet instead of a pre-set meal, researchers were able to offer a variety of healthy and unhealthy options in the trials in order to examine student's food choices in a setting more akin to the real-world. Another strength of the study was using pictures and weights to examine food intake during lunch. This methodology has been shown to be

faster and more reliable in comparison with self-reported data or measuring food intake in real time.[215] Using 2 different raters to assess food consumption resulted in higher inter-rater reliability and validity of the food intake data.

In regard to limitations, there was a larger proportion of female when compared to male students, which may have underpowered the analyses among male students. According to FIU's gender reports, the student population contains 43% males and 57% females.[216] Nonetheless, the gender ratio in this study was representative of the student population at the university where this study was conducted. Additionally, we know that the effect of ambience is a significant factor in food intake and food choices.[217] Thus, students' intake may have been influenced by the presence of the researchers or other students or other environmental stimuli including the lighting and the smells.

Future direction:

The present study improves our understanding of the effects of cognitive and visceral signals on college students' food intake and eating behaviors. Our study highlights the disadvantages of restrictive eating and dieting and its influence on higher BMI and poorer self-regulation among college students. We used an objective methodology to examine self-regulation in college students however the other variables in this study were examined using questionnaires. Since results from questionnaires may increase the chance of self-reported bias,[116] future research can investigate the association between similar variables where they are all collected via objective methods. Additionally, to the best of our knowledge, COMPX has only been done in young children, and there is very limited data regarding objective measure of self-regulation of food intake among older individuals. More COMPX data from older children and adults,

will provide the researchers with the opportunity to be able to create a developmental pattern of regulatory skills in energy intake.

Another aim of this study was to determine the effect of negative/sad mood on students' self-regulatory skills in food consumption. In the future the effect of different emotions such as happy/excited or neutral should be examined using the same group of participants. Studies with larger sample sizes may be able to elucidate mediators and mechanistic pathways for self-regulation, intuitive eating, and food-related behaviors among college students. Moreover, in order to have a higher generalizability, further similar studies should be done among college students with different races and ethnicities.

Conclusion:

The current study validated the use of an unlimited buffet lunch paradigm to assess self-regulation of food intake based on cognitive commands in college students. This novel method provided complete autonomy for the students throughout the trials and aided the researchers to also investigate participants' food choices. Even though self-regulatory abilities in food consumption seems to be limited among college students, the students showed the ability to calorie compensate. Internal bodily signals seem to play a major role in controlling students' energy intake as well as maintaining their healthy weights. That may be the reason OV/OB students indicated lower ability to detect their physiological cues followed by poorer self-regulation of food intake. Additionally, mood change is another contributing factor in uncontrolled consumption in college students, nevertheless, focusing on physiological commands seems to improve the effect of emotional changes on self-regulation. Therefore, learning how to detect and respond to

internal bodily cues may result in better self-regulatory skills in energy intake leading to lower emotional and restraint eating behaviors, which may consequently increase dietary quality of college students. Future research with a higher number of participants may provide a clear mediation effect in this model.

LIST OF REFERENCES

1. Puhl RM, Heuer CA. Obesity stigma: important considerations for public health. *Am J Public Health.* 2010;100(6):1019-1028. doi:10.2105/AJPH.2009.159491. Accessed July 30, 2020.

2. Hales CM, Carroll MD, Fryar CD, Ogden CL. Prevalence of obesity and severe obesity among adults: United States, 2017–2018. 2017. Center for Disease Control and Prevention website. https://stacks.cdc.gov/view/cdc/85451. Published February, 2020. Accessed July 2020.

3. Vadeboncoeur C, Townsend N, Foster C. A meta-analysis of weight gain in first year university students: is freshman 15 a myth? *BMC obes.* 2015;2(1):22. doi:10.1186/s40608-015-0051-7.

4. Racette SB, Deusinger SS, Strube MJ, Highstein GR, Deusinger RH. Weight changes, exercise, and dietary patterns during freshman and sophomore years of college. *J Am Coll Health.* 2005;53(6):245-251. doi: 10.3200/JACH.53.6.245-251.

5. Levitsky DA, Halbmaier CA, Mrdjenovic G. The freshman weight gain: a model for the study of the epidemic of obesity. *Int J Obes.* 2004;28(11):1435. doi:10.1038/sj.ijo.0802776.

6. Grundy SM. Multifactorial causation of obesity: implications for prevention. *Am J Clin Nutr.* 1998;67(3):563S-572S. doi:10.1093/ajcn/67.3.563S.

7. Abdelaal M, le Roux CW, Docherty NG. Morbidity and mortality associated with obesity. *Ann Transl Med.* 2017;5(7). doi:10.21037/atm.2017.03.107.

8. Vella-Zarb RA, Elgar FJ. Predicting the 'freshman 15': Environmental and psychological predictors of weight gain in first-year university students. *Health Educ J.* 2010;69(3):321-332. doi:10.1177/0017896910369416.

9. Dennis EA, Potter KL, Estabrooks PA, Davy BM. Weight gain prevention for college freshmen: comparing two social cognitive theory-based interventions with and without explicit self-regulation training. *J Obes.* 2012;2012. doi:10.1155/2012/803769.

10. Deforche B, Van Dyck D, Deliens T, De Bourdeaudhuij I. Changes in weight, physical activity, sedentary behaviour and dietary intake during the transition to higher education: a prospective study. *Int J Behav Nutr Phys Act.* 2015;12(1):16. doi:10.1186/s12966-015-0173-9.

11. Bennett J, Greene G, Schwartz-Barcott D. Perceptions of emotional eating behavior. A qualitative study of college students. *Appetite.* 2013;60:187-192. doi:10.1016/j.appet.2012.09.023.

12. Miller WC. How effective are traditional dietary and exercise interventions for weight loss? *Med Sci Sports Exerc.* 1999;31(8):1129-1134. doi:10.1097/00005768-199908000-00008.

13. Lowe MR, Timko CA. Dieting: really harmful, merely ineffective or actually helpful? *Br J Nutr.* 2004;92(S1):S19-S22. doi:10.1079/BJN20041136.

14. Hill AJ. Does dieting make you fat? *Br J Nutr.* 2004;92(S1):S15-S18. doi:10.1079/BJN20041135.

15. Ho M, Garnett SP, Baur L, et al. Effectiveness of lifestyle interventions in child obesity: systematic review with meta-analysis. *Pediatr.* 2012;130(6):e1647-e1671. doi:10.1542/peds.2012-1176.

16. Ochner CN, Tsai AG, Kushner RF, Wadden TA. Treating obesity seriously: when recommendations for lifestyle change confront biological adaptations. *Lancet Diabetes Endocrinol.* 2015;3(4):232-234. doi:10.1016/S2213-8587(15)00009-1.

17. Balantekin KN, Birch LL, Savage JS. Eating in the absence of hunger during childhood predicts self-reported binge eating in adolescence. *Eat Behav.* 2017;24:7-10. doi:10.1016/j.eatbeh.2016.11.003.

18. Phillips KE, Kelly-Weeder S, Farrell K. Binge eating behavior in college students: What is a binge? *Appl Nurs Res.* 2016;30:7-11. doi:10.1016/j.apnr.2015.10.011.

19. Jung J-Y, Kim K-H, Woo H-Y, et al. Binge eating is associated with trait anxiety in Korean adolescent girls: a cross sectional study. *BMC Womens Health.* 2017;17(1):8. doi:10.1186/s12905-017-0364-4.

20. Pelletier JE, Lytle LA, Laska MN. Stress, health risk behaviors, and weight status among community college students. *Health Educ Behav.* 2016;43(2):139-144. doi:10.1177/1090198115598983.

21. Fisher JO, Birch LL. Eating in the absence of hunger and overweight in girls from 5 to 7 y of age. *Am J Clin Nutr.* 2002;76(1):226-231. doi:10.1093/ajcn/76.1.226.

22. Tolkamp BJ, D'Eath RB. Hunger associated with restricted feeding systems. In: Phillips C, ed. *Nutrition and the Welfare of Farm Animals. Animal Welfare*. Vol 16. Springer; 2016:11-27. doi:10.1007/978-3-319-27356-3_2.

23. Vieira FT, Faria SLCM, Dutra ES, et al. Perception of Hunger/Satiety and Nutrient Intake in Women Who Regain Weight in the Postoperative Period After Bariatric Surgery. *Obes Surg.* 2019;29(3):958-963. doi:10.1007/s11695-018-03628-z.

24. Brobeck JR. Neural control of hunger, appetite, and satiety. *Yale J Biol Med*. 1957;29(6):565-574. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2603744/. Accessed March 2019.

25. Bernstein H, Santos M. Definitions of hunger and fullness among youth enrolled in a pediatric weight management program. *Clin Nutr ESPEN.* 2018;23:167-170. doi:10.1016/j.clnesp.2017.10.006.

26. Pollatos O, Herbert BM. Interoception: Definitions, Dimensions, Neural Substrates. In: Hauke G, Kritikos A, eds. *Embodiment in Psychotherapy*. Springer; 2018:15-27. doi:10.1007/978-3-319-92889-0_2.

27. Herbert BM, Herbert C, Pollatos O, et al. Effects of short-term food deprivation on interoceptive awareness, feelings and autonomic cardiac activity. *Bio Psych.* 2012;89(1):71-79. doi:10.1016/j.biopsycho.2011.09.004.

28. Wiens S. Interoception in emotional experience. *Curr Opin Neurol.* 2005;18(4):442-447. doi:10.1097/01.wco.0000168079.92106.99.

29. Herbert BM, Pollatos O, Schandry R. Interoceptive sensitivity and emotion processing: an EEG study. *Int J Psychophysiol.* 2007;65(3):214-227. doi:10.1016/j.ijpsycho.2007.04.007.

30. Pollatos O, Schandry R, Auer DP, Kaufmann C. Brain structures mediating cardiovascular arousal and interoceptive awareness. *Brain Res.* 2007;1141:178-187.doi:10.1016/j.brainres.2007.01.026.

31. Herbert BM, Pollatos O. Attenuated interoceptive sensitivity in overweight and obese individuals. *Eat Behav.* 2014;15(3):445-448. doi:10.1016/j.eatbeh.2014.06.002.

32. Oswald A, Chapman J, Wilson C. Do interoceptive awareness and interoceptive responsiveness mediate the relationship between body appreciation and intuitive eating in young women? *Appetite.* 2017;109:66-72. doi:10.1016/j.appet.2016.11.019.

33. Strong KA, Parks SL, Anderson E, Winett R, Davy BM. Weight gain prevention: identifying theory-based targets for health behavior change in young adults. *J Am Diet Assoc.* 2008;108(10):1708-1715. doi:10.1016/j.jada.2008.07.007.

34. De Ridder D, De Vet E, Stok M, Adriaanse M, De Wit J. Obesity, overconsumption and self-regulation failure: The unsung role of eating appropriateness standards. *Health Psychol Rev.* 2013;7(2):146-165. doi:10.1080/17437199.2012.706987.

35. Stadler G, Oettingen G, Gollwitzer PM. Intervention effects of information and self-regulation on eating fruits and vegetables over two years. *Health Psychol.* 2010;29(3):274. doi:10.1037/a0018644.

36. Poddar KH, Hosig KW, Anderson ES, Nickols-Richardson SM, Duncan SE. Web-based nutrition education intervention improves self-efficacy and self-regulation related to increased dairy intake in college students. *J Am Diet Assoc.* 2010;110(11):1723-1727. doi:10.1016/j.jada.2010.08.008.

37. Bandura A. Social cognitive theory of self-regulation. *Organ Behav Hum Decis Process.* 1991;50(2):248-287. http://www.uky.edu/~eushe2/BanduraPubs/Bandura1991OBHDP.pdf. Accessed February 2019.

38. Lowe MR. Self-regulation of energy intake in the prevention and treatment of obesity: is it feasible? *Obes Res.* 2003;11(S10):44S-59S. doi:10.1038/oby.2003.223.

39. Schnoll R, Zimmerman BJ. Self-regulation training enhances dietary self-efficacy and dietary fiber consumption. *J Am Diet Assoc.* 2001;101(9):1006-1011. doi:10.1016/S0002-8223(01)00249-8.

40. Kitsantas A, Gilligan TD, Kamata A. College women with eating disorders: Self-regulation, life satisfaction, and positive/negative affect. *J Psychol.* 2003;137(4):381-395. doi:10.1080/00223980309600622.

41. Gokee-LaRose J, Gorin AA, Wing RR. Behavioral self-regulation for weight loss in young adults: a randomized controlled trial. *Int J Behav Nutr Phys Act.* 2009;6(1):10. doi:10.1186/1479-5868-6-10.

42. Taylor MB, Daiss S, Krietsch K. Associations among self-compassion, mindful eating, eating disorder symptomatology, and body mass index in college students. *Transl Issues Psychol Sci.* 2015;1(3):229. doi:10.1037/tps0000035.

43. Lafrance Robinson A, Kosmerly S, Mansfield-Green S, Lafrance G. Disordered eating behaviours in an undergraduate sample: Associations among gender, body mass index, and difficulties in emotion regulation. *Can J Behav Sci.* 2014;46(3):320. doi:10.1037/a0031123.

44. Hill ML, Masuda A, Latzman RD. Body image flexibility as a protective factor against disordered eating behavior for women with lower body mass index. *Eat Behav.* 2013;14(3):336-341. doi:10.1016/j.eatbeh.2013.06.003.

45. Lynch WC, Everingham A, Dubitzky J, Hartman M, Kasser T. Does binge eating play a role in the self-regulation of moods? *Integr Psychol Behav Sci.* 2000;35(4):298-313. https://link.springer.com/content/pdf/10.1007/BF02688792.pdf. Accessed January 2019.

46. Whiteside U, Chen E, Neighbors C, Hunter D, Lo T, Larimer M. Difficulties regulating emotions: Do binge eaters have fewer strategies to modulate and tolerate negative affect? *Eat Behav.* 2007;8(2):162-169. doi:10.1016/j.eatbeh.2006.04.001.

47. Kandiah J, Yake M, Jones J, Meyer M. Stress influences appetite and comfort food preferences in college women. *Nutr Res.* 2006;26(3):118-123. doi:10.1016/j.nutres.2005.11.010.

48. Geliebter A, Aversa A. Emotional eating in overweight, normal weight, and underweight individuals. *Eat Behav.* 2003;3(4):341-347. doi:10.1016/S1471-0153(02)00100-9.

49. Wichianson JR, Bughi SA, Unger JB, Spruijt-Metz D, Nguyen-Rodriguez ST. Perceived stress, coping and night-eating in college students. *Stress Health.* 2009;25(3):235-240. doi:10.1002/smi.1242.

50. Liu C, Xie B, Chou C-P, et al. Perceived stress, depression and food consumption frequency in the college students of China Seven Cities. *Physiol Behav.* 2007;92(4):748-754. doi:10.1016/j.physbeh.2007.05.068.

51. Striegel-Moore RH, Rosselli F, Perrin N, et al. Gender difference in the prevalence of eating disorder symptoms. *Int J Eat Disord.* 2009;42(5):471-474. doi:10.1002/eat.20625.

52. Pettit ML, Jacobs SC, Page KS, Porras CV. An assessment of perceived emotional intelligence and eating attitudes among college students. *Am J Health Educ.* 2010;41(1):46-52. doi:10.1080/19325037.2010.10599126.

53. Galloway AT, Farrow CV, Martz DM. Retrospective reports of child feeding practices, current eating behaviors, and BMI in college students. *Obes.* 2010;18(7):1330-1335. doi:10.1038/oby.2009.393.

54. Edman JL, Yates A, Aruguete MS, DeBord KA. Negative emotion and disordered eating among obese college students. *Eat Behav.* 2005;6(4):308-317. doi:10.1016/j.eatbeh.2005.05.004.

55. Diggins A, Woods-Giscombe C, Waters S. The association of perceived stress, contextualized stress, and emotional eating with body mass index in college-aged Black women. *Eat Behav.* 2015;19:188-192. doi:10.1016/j.eatbeh.2015.09.006.

56. Tylka TL. Development and psychometric evaluation of a measure of intuitive eating. *J Couns Psychol.* 2006;53(2):226. doi:10.1037/0022-0167.53.2.226.

57. Smith T, Hawks SR. Intuitive eating, diet composition, and the meaning of food in healthy weight promotion. *Am J Health Educ.* 2006;37(3):130-136. doi:10.1080/19325037.2006.10598892.

58. Humphrey L, Clifford D, Morris MN. Health at every size college course reduces dieting behaviors and improves intuitive eating, body esteem, and anti-fat attitudes. *J Nutr Educ Behav.* 2015;47(4):354-360. doi:10.1016/j.jneb.2015.01.008.

59. Anderson LM, Reilly EE, Schaumberg K, Dmochowski S, Anderson DA. Contributions of mindful eating, intuitive eating, and restraint to BMI, disordered eating, and meal consumption in college students. *Eat Weight Disord-Studies on Anorexia, Bulimia and Obesity.* 2016;21(1):83-90. doi:10.1007/s40519-015-0210-3.

60. Hawks S, Madanat H, Hawks J, Harris A. The relationship between intuitive eating and health indicators among college women. *J Health Educ.* 2005;36(6):331-336. doi:10.1080/19325037.2005.10608206.

61. Kristeller JL, Wolever RQ. Mindfulness-based eating awareness training for treating binge eating disorder: the conceptual foundation. *Eat Disord.* 2010;19(1):49-61. doi:10.1080/10640266.2011.533605.

62. Kristeller JL, Baer RA, Quillian-Wolever R. *Mindfulness-based treatment approaches: Clinician's guide to evidence base and applications.* Lexington, KY: Elsevier; 2006;75.

63. Jordan CH, Wang W, Donatoni L, Meier BP. Mindful eating: Trait and state mindfulness predict healthier eating behavior. *Pers Individ Dif.* 2014;68:107-111. doi:10.1016/j.paid.2014.04.013.

64. McAlister AL, Perry CL, Parcel GS. *How individuals, environments, and health behaviors interact. Social cognitive theory*. In: Glanz K, Rimer BK, Viswanath K. *Health behavior and health education: theory, research, and practice.* 4th ed. San Francisco, CA: John Wiley & Sons; 2008:170-188.

65. Sheeshka JD, Woolcott DM, MacKinnon NJ. Social cognitive theory as a framework to explain intentions to practice healthy eating behaviors 1. *J Appl Soc Psychol.* 1993;23(19):1547-1573. doi:10.1111/j.1559-1816.1993.tb01047.x.

66. Bandura A. Human agency in social cognitive theory. *Am Psychol.* 1989;44(9):1175. doi:10.1037/0003-066X.44.9.1175.

67. Johnson SL. Improving preschoolers' self-regulation of energy intake. *Pediatr.* 2000;106(6):1429-1435. doi:10.1542/peds.106.6.1429.

68. Johnson SL, Taylor-Holloway LA. Non-Hispanic white and Hispanic elementary school children's self-regulation of energy intake. *Am J Clin Nutr.* 2006;83(6):1276-1282. doi:10.1093/ajcn/83.6.1276.

69. Fairburn CG, Beglin SJ. Assessment of eating disorders: Interview or self-report questionnaire? *Int J Eat Disord.* 1994;16(4):363-370. doi:10.1002/1098-108X(199412)16:4<363::AID-EAT2260160405>3.0.CO;2-%23.

70. Gonyea RM. Self-reported data in institutional research: Review and recommendations. *New Direct Inst Res.* 2005;2005(127):73-89. doi:10.1002/ir.156.

71. Odić A, Tkalčič M, Tasič J, Košir A. Personality and social context: impact on emotion induction from movies. CEUR-WS website. https://bia.unibz.it/bitstream/handle/10863/5337/empire2013_paper_5.pdf?sequence=2&isAllowed=y. Published 2013. Accessed March 2019.

72. Johnson SL, Birch LL. Parents' and children's adiposity and eating style. *Pediatr.* 1994;94(5):653-661. https://pediatrics.aappublications.org/content/pediatrics/94/5/653.full.pdf. Accessed December 2018.

73. Lipps L, Deysher M. Calorie compensation and sensory specific satiety: Evidence for self regulation of food intake by young children. *Appetite.* 1986;7(4):323-331. doi:10.1016/S0195-6663(86)80001-0.

74. Johnson NB, Hayes LD, Brown K, Hoo EC, Ethier KA. CDC National Health Report: leading causes of morbidity and mortality and associated behavioral risk and protective factors—United States, 2005–2013. https://www.cdc.gov/mmwr/preview/mmwrhtml/su6304a2.htm. Published October 31,2014. Accessed February 2019.

75. Haidar SA, De Vries NK, Karavetian M, El-Rassi R. Stress, anxiety, and weight gain among university and college students: A systematic review. *J Acad Nutr Diet.* 2018;118(2):261-274. doi:10.1016/j.jand.2017.10.015.

76. Brown C. The information trail of the 'Freshman 15'—a systematic review of a health myth within the research and popular literature. *Health Inf Libr J.* 2008;25(1):1-12. doi:10.1111/j.1471-1842.2007.00762.x.

77. Tremblay A, Pérusse L, Bouchard C. Energy balance and body-weight stability: impact of gene–environment interactions. *Br J Nutr.* 2004;92(S1):S63-S66. doi:10.1079/BJN20041144.

78. Ludwig DS, Peterson KE, Gortmaker SL. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet.* 2001;357(9255):505-508. doi:10.1016/S0140-6736(00)04041-1.

79. Bray GA, Popkin BM. Dietary sugar and body weight: have we reached a crisis in the epidemic of obesity and diabetes?: health be damned! Pour on the sugar. *Diabetes care.* 2014;37(4):950-956. doi:10.2337/dc13-2085.

80. Stella SY, Kansagra SM. Associations of sodium intake with obesity, body mass index, waist circumference, and weight. *Am J Prev Med.* 2014;46(6):e53-e55. doi:10.1016/j.amepre.2014.02.005.

81. Nelson MC, Story M, Larson NI, Neumark-Sztainer D, Lytle LA. Emerging adulthood and college-aged youth: an overlooked age for weight-related behavior change. *Obes.* 2008;16(10):2205-2211. doi:10.1038/oby.2008.365.

82. LaCaille LJ, Dauner KN, Krambeer RJ, Pedersen J. Psychosocial and environmental determinants of eating behaviors, physical activity, and weight change among college students: a qualitative analysis. *J Am Coll Health.* 2011;59(6):531-538. doi:10.1080/07448481.2010.523855.

83. Rutters F, Nieuwenhuizen AG, Lemmens SGT, Born JM, Westerterp-Plantenga MS. Acute stress-related changes in eating in the absence of hunger. *Obes.* 2009;17(1):72-77. doi:10.1038/oby.2008.493.

84. Hill JO, Peters JC. Environmental contributions to the obesity epidemic. *Sci.* 1998;280(5368):1371-1374. doi:10.1126/science.280.5368.1371.

85. Courtney AL, Rapuano KM, Sargent JD, Heatherton TF, Kelley WM. Reward system activation in response to alcohol advertisements predicts college drinking. *J Stud Alcohol Drugs.* 2018;79(1):29-38. doi:10.15288/jsad.2018.79.29.

86. Wei Y, Rickard M, Brown C. Effects of consumer weight level and advertising appeals on consumer attitude toward food and advertisements. *J Food Prod Mark.* 2015;21(4):426-441. doi:10.1080/10454446.2013.856056.

87. Herbert BM, Pollatos O. The relevance of interoception for eating behavior and eating disorders. In: Tsakiris M, De Preester H. *The Interoceptive Mind: From Homeostasis to Awareness.*Oxford, UK: Oxford university press; 2019:165-186.

88. Laghi F, Pompili S, Bianchi D, Lonigro A, Baiocco R. Psychological characteristics and eating attitudes in adolescents with drunkorexia behavior: an exploratory study. *Eat Weight Disord.* 2019:1-10. doi:10.1007/s40519-019-00675-y.

89. Cameron OG. Interoception: the inside story—a model for psychosomatic processes. *Psychosom Med.* 2001;63(5):697-710. https://journals.lww.com/psychosomaticmedicine/Abstract/2001/09000/Interoception__The_Inside_Story_A_Model_for.1.aspx. Accessed December 2018.

90. Craig AD. How do you feel? Interoception: the sense of the physiological condition of the body. *Nat Rev Neurosci.* 2002;3(8):655. doi:10.1038/nrn894

91. Lattimore P, Mead BR, Irwin L, Grice L, Carson R, Malinowski P. 'I can't accept that feeling': Relationships between interoceptive awareness, mindfulness and eating disorder symptoms in females with, and at-risk of an eating disorder. *Psychiatry Res.* 2017;247:163-171. doi:10.1016/j.psychres.2016.11.022.

92. Cameron OG, Minoshima S. Regional brain activation due to pharmacologically induced adrenergic interoceptive stimulation in humans. *Psychosom Med.* 2002;64(6):851-861. https://journals.lww.com/psychosomaticmedicine/Abstract/2002/11000/Regional_Brain_Activation_Due_to_Pharmacologically.1.aspx. Accessed December 2018.

93. Critchley HD, Wiens S, Rotshtein P, Öhman A, Dolan RJ. Neural systems supporting interoceptive awareness. *Nat Neurosci.* 2004;7(2):189. doi:10.1038/nn1176.

94. Van Oudenhove L, Demyttenaere K, Tack J, Aziz Q. Central nervous system involvement in functional gastrointestinal disorders. *Best Pract Res Clin Gastroenterol.* 2004;18(4):663-680. doi:10.1016/j.bpg.2004.04.010.

95. Herbert BM, Blechert J, Hautzinger M, Matthias E, Herbert C. Intuitive eating is associated with interoceptive sensitivity. Effects on body mass index. *Appetite.* 2013;70:22-30. doi:10.1016/j.appet.2013.06.082.

96. Merwin RM, Zucker NL, Lacy JL, Elliott CA. Interoceptive awareness in eating disorders: Distinguishing lack of clarity from non-acceptance of internal experience. *Cogn Emot.* 2010;24(5):892-902. doi:10.1080/02699930902985845.

97. Willem C, Gandolphe M, Roussel M, Verkindt H, Pattou F, Nandrino JL. Difficulties in emotion regulation and deficits in interoceptive awareness in moderate and severe obesity. *Eat Weight Disord.* 2019;24(4):633-644. doi:10.1007/s40519-019-00738-0.

98. Willem C, Nandrino JL, Doba K, et al. Interoceptive reliance as a major determinant of emotional eating in adult obesity. *J Health Psychol*. 2020;1359105320903093. doi:10.1177/1359105320903093.

99. Bandini L, Schoeller D, Edwards J, Young V, Oh S, Dietz W. Energy expenditure during carbohydrate overfeeding in obese and nonobese adolescents. *Am J Physiol Endocrinol Metab.* 1989;256(3):E357-E367. doi:10.1152/ajpendo.1989.256.3.E357.

100. Schwartz MW, Woods SC, Porte Jr D, Seeley RJ, Baskin DG. Central nervous system control of food intake. *Nature.* 2000;404(6778):661. doi:10.1038/35007534.

101. Johnson F, Pratt M, Wardle J. Dietary restraint and self-regulation in eating behavior. *Int J Obes.* 2012;36(5):665. doi:10.1038/ijo.2011.156.

102. Tan CC, Holub SC. Children's self-regulation in eating: Associations with inhibitory control and parents' feeding behavior. *J Pediatr Psychol.* 2010;36(3):340-345. doi:10.1093/jpepsy/jsq089.

103. Deliens T, Clarys P, De Bourdeaudhuij I, Deforche B. Determinants of eating behaviour in university students: a qualitative study using focus group discussions. *BMC Public Health.* 2014;14(1):53. doi:10.1186/1471-2458-14-53.

104. Deliens T, Deforche B, De Bourdeaudhuij I, Clarys P. Determinants of physical activity and sedentary behaviour in university students: a qualitative study using focus group discussions. *BMC Public Health.* 2015;15(1):201. doi:10.1186/s12889-015-1553-4.

105. Metzgar CJ, Preston AG, Miller DL, Nickols-Richardson SM. Facilitators and barriers to weight loss and weight loss maintenance: a qualitative exploration. *J Hum Nutr Diet.* 2015;28(6):593-603. doi:10.1111/jhn.12273.

106. Munt AE, Partridge SR, Allman-Farinelli M. The barriers and enablers of healthy eating among young adults: a missing piece of the obesity puzzle: a scoping review. *Obes Rev.* 2017;18(1):1-17. doi:10.1111/obr.12472.

107. Koball AM, Meers MR, Storfer-Isser A, Domoff SE, Musher-Eizenman DR. Eating when bored: Revision of the Emotional Eating Scale with a focus on boredom. *Health Psychol.* 2012;31(4):521. doi:10.1037/a0025893.

108. Lowe MR, Fisher EB. Emotional reactivity, emotional eating, and obesity: A naturalistic study. *J Behav Med.* 1983;6(2):135-149. https://link.springer.com/content/pdf/10.1007/BF00845377.pdf. Accessed December 2018.

109. Wolff GE, Crosby RD, Roberts JA, Wittrock DA. Differences in daily stress, mood, coping, and eating behavior in binge eating and nonbinge eating college women. *Addict Behav.* 2000;25(2):205-216. doi:10.1016/S0306-4603(99)00049-0.

110. Bekker MHJ, van de Meerendonk C, Mollerus J. Effects of negative mood induction and impulsivity on self-perceived emotional eating. *Int J Eat Disord.* 2004;36(4):461-469. doi:10.1002/eat.20041.

111. Choi J. Impact of Stress Levels on Eating Behaviors among College Students. *Nutrients.* 2020;12(5):1241. doi:10.3390/nu12051241.

112. Bilici S, Ayhan B, Karabudak E, Koksal E. Factors affecting emotional eating and eating palatable food in adults. *Nutr Res Pract.* 2020;14(1):70-75. doi:10.4162/nrp.2020.14.1.70.

113. Keck MM, Vivier H, Cassisi JE, et al. Examining the Role of Anxiety and Depression in Dietary Choices among College Students. *Nutrients.* 2020;12(7):2061. doi:10.3390/nu12072061.

114. Horvath SA, Shorey RC, Racine SE. Emotion dysregulation as a correlate of food and alcohol disturbance in undergraduate students. *Eat Behav.* 2020:101409. doi:10.1016/j.eatbeh.2020.101409.

115. Bu L, Lai Y, Deng Y, et al. Negative Mood Is Associated with Diet and Dietary Antioxidants in University Students During the Menstrual Cycle: A Cross-Sectional Study from Guangzhou, China. *Antioxidants.* 2020;9(1):23. doi:10.3390/antiox9010023.

116. Braden A, Emley E, Watford T, Anderson L, Musher-Eizenman D. Self-reported emotional eating is not related to greater food intake: results from two laboratory studies. *Psychol Health.* 2020;35(4):500-517. doi:10.1080/08870446.2019.1649406.

117. Clarke KL. Multivariate Relationships of Binge Watching-Drinking-Eating With Depression, Anxiety, and Stress in College Students. *Walden Dissertation and Doctoral Studies.* 2019. https://scholarworks.waldenu.edu/dissertations/6883. Accessed January 2019.

118. Lipson SK, Sonneville KR. Eating disorder symptoms among undergraduate and graduate students at 12 US colleges and universities. *Eat Behav.* 2017;24:81-88. doi:10.1016/j.eatbeh.2016.12.003.

119. Lenka, Shriver H, Wollenberg G, Gates GE. Prevalence of disordered eating and its association with emotion regulation in female college athletes. *Int J Sport Nutr Exerc Metab.* 2016;26(3):240-248. doi:10.1123/ijsnem.2015-0166.

120. Polivy J, Herman CP. Distress and eating: why do dieters overeat? *Int J Eat Disord.* 1999;26(2):153-164. doi:10.1002/(SICI)1098-108X(199909)26:2<153::AID-EAT4>3.0.CO;2-R.

121. Birch LL, Fisher JO. Mothers' child-feeding practices influence daughters' eating and weight. *Am J Clin Nutr.* 2000;71(5):1054-1061. doi:10.1093/ajcn/71.5.1054.

122. Birch LL, Fisher JO, Davison KK. Learning to overeat: maternal use of restrictive feeding practices promotes girls' eating in the absence of hunger. *Am J Clin Nutr.* 2003;78(2):215-220. doi:10.1093/ajcn/78.2.215.

123. Tylka TL, Kroon Van Diest AM. The Intuitive Eating Scale–2: Item refinement and psychometric evaluation with college women and men. *J Couns Psychol.* 2013;60(1):137. doi:10.1037/a0030893.

124. Imhoff K, Seher PhD RDN, Ld C, DeBois PhD K. Exploring Intuitive Eating Behaviors and Attitudes among a Sample of College Students. *Williams Honors College, Honors Research Projects*. https://ideaexchange.uakron.edu/honors_research_projects/11812020. Accessed July 2020.

125. Shouse SH, Nilsson J. Self-silencing, emotional awareness, and eating behaviors in college women. *Psychol Women Q.* 2011;35(3):451-457. doi:10.1177/0361684310388785.

126. Gast J, Madanat H, Nielson AC. Are men more intuitive when it comes to eating and physical activity? *Am J Men Health.* 2012;6(2):164-171. doi:10.1177/1557988311428090.

127. Denny KN, Loth K, Eisenberg ME, Neumark-Sztainer D. Intuitive eating in young adults. Who is doing it, and how is it related to disordered eating behaviors? *Appetite.* 2013;60:13-19. doi:10.1016/j.appet.2012.09.029.

128. Borelli J, Pignotti GP, Widaman A. Examining the Relationship Between Intuitive Eating and Diet Quality Among College Students. *Curr Dev Nutr.* 2020;4(Supplement_2):1290-1290. doi:10.1093/cdn/nzaa059_007.

129. Luszczynska A, Schwarzer R. Social cognitive theory. In: Conner M, Norman P, ed. *Predicting Health Behaviour.* New York, NY: University Press; 2005:127-169.

130. Zimmerman BJ. A social cognitive view of self-regulated academic learning. *J Educ Psychol.* 1989;81(3):329. doi:10.1037/0022-0663.81.3.329.

131. Zimmerman BJ. Attaining self-regulation: A social cognitive perspective. In: Boekaerts M, Pintrich PR, Zeidner M, ed. *Handbook of Self-Regulation.* Elsevier; 2000:13-39. doi:10.1016/B978-0-12-109890-2.X5027-6.

132. Armor DA, Taylor SE. Situated optimism: Specific outcome expectancies and self-regulation. In: Zanna MP, ed. *Advances in Experimental Social Psychology.* Elsevier; Vol 30. 1998:309-379. doi:10.1016/S0065-2601(08)60386-X.

133. Wallace LS, Buckworth J, Kirby TE, Sherman WM. Characteristics of exercise behavior among college students: application of social cognitive theory to predicting stage of change. *Prev Med.* 2000;31(5):494-505. doi:10.1006/pmed.2000.0736.

134. Hetherington MM, Wood C, Lyburn SC. Response to energy dilution in the short term: evidence of nutritional wisdom in young children? *Nutr Neurosci.* 2000;3(5):321-329. doi:10.1080/1028415X.2000.11747329.

135. Birch LL, Deysher M. Conditioned and unconditioned caloric compensation: evidence for self-regulation of food intake in young children. *Learn Motiv.* 1985;16(3):341-355. doi:10.1016/0023-9690(85)90020-7.

136. Carnell S, Wardle J. Measuring behavioural susceptibility to obesity: validation of the child eating behaviour questionnaire. *Appetite.* 2007;48(1):104-113. doi:10.1016/j.appet.2006.07.075.

137. Samuel J, Fomon, Filer, Thomas LN, Anderson TA, Nelson SE. Influence of formula concentration on caloric intake and growth of normal infants. *Acta Paediatr.* 1975;64(2):172-181. doi:10.1111/j.1651-2227.1975.tb03818.x.

138. Louis-Sylvestre J, Tournier A, Verger P, Chabert M, Delorme B, Hossenlopp J. Learned caloric adjustment of human intake. *Appetite.* 1989;12(2):95-103. doi:10.1016/0195-6663(89)90099-8.

139. Faith MS, Pietrobelli A, Heo M, et al. A twin study of self-regulatory eating in early childhood: Estimates of genetic and environmental influence, and measurement considerations. *Int J Obes.* 2012;36(7):931-937. doi:10.1038/ijo.2011.258.

140. Kral TVE, Moore RH, Chittams J, et al. Caloric compensation and appetite control in children of different weight status and predisposition to obesity. *Appetite.* 2020:104701. doi:10.1016/j.appet.2020.104701.

141. Hughes SO, Power TG, Beck A, et al. Short-Term Effects of an Obesity Prevention Program Among Low-Income Hispanic Families With Preschoolers. *J Nutr Educ Behav.* 2020;52(3):224-239. doi:10.1016/j.jneb.2019.12.001.

142. Brugaillères P, Issanchou S, Nicklaus S, Chabanet C, Schwartz C. Caloric compensation in infants: developmental changes around the age of 1 year and associations with anthropometric measurements up to 2 years. *Am J Clin Nutr.* 2019;109(5):1344-1352. doi:10.1093/ajcn/nqy357.

143. Foltin RW, Fischman MW, Emurian CS, Rachlinski JJ. Compensation for caloric dilution in humans given unrestricted access to food in a residential laboratory. *Appetite.* 1988;10(1):13-24. doi:10.1016/S0195-6663(88)80029-1.

144. Hill JO, Wyatt HR, Reed GW, Peters JC. Obesity and the environment: where do we go from here? *Sci.* 2003;299(5608):853-855. doi:10.1126/science.1079857.

145. Van Der Horst K, Oenema A, Ferreira I, et al. A systematic review of environmental correlates of obesity-related dietary behaviors in youth. *Health Educ Res.* 2006;22(2):203-226. doi:10.1093/her/cyl069.

146. Trost SG, Kerr LM, Ward DS, Pate RR. Physical activity and determinants of physical activity in obese and non-obese children. *Int J Obes.* 2001;25(6):822. doi:10.1038/sj.ijo.0801621.

147. Barrett LF, Quigley KS, Bliss-Moreau E, Aronson KR. Interoceptive sensitivity and self-reports of emotional experience. *J Pers Soc Psychol.* 2004;87(5):684. doi:10.1037/0022-3514.87.5.684.

148. Kral TVE, Allison DB, Birch LL, Stallings VA, Moore RH, Faith MS. Caloric compensation and eating in the absence of hunger in 5-to 12-y-old weight-discordant siblings. *Am J Clin Nutr.* 2012;96(3):574-583. doi:10.3945/ajcn.112.037952.

149. Tripicchio GL, Keller KL, Johnson C, Pietrobelli A, Heo M, Faith MS. Differential maternal feeding practices, eating self-regulation, and adiposity in young twins. *Pediatr.* 2014;134(5):e1399. doi:10.1542/peds.2013-3828.

150. Louis TA, Lavori PW, Bailar JC, Polansky M. Crossover and self-controlled designs in clinical research. In: Bailar LC, Mosteller F, ed. *Medical uses of statistics,* Boston, MA: New England Medical Journal Publications. 1992:83-104.

151. Duflo E, Glennerster R, Kremer M. Using randomization in development economics research: A toolkit. In: Schultz P, Strauss J, ed. *Handbook of development economics.* Elsevier; 2007;4:3895-3962. doi:10.1016/S1573-4471(07)04061-2.

152. Rooney B, Benson C, Hennessy E. The apparent reality of movies and emotional arousal: A study using physiological and self-report measures. *Poetics.* 2012;40(5):405-422. doi:10.1016/j.poetic.2012.07.004.

153. Cohen B, Waugh G, Place K. At the movies: An unobtrusive study of arousal-attraction. *J Soc Psychol.* 1989;129(5):691-693. doi:10.1080/00224545.1989.9713786.

154. Codispoti M, Surcinelli P, Baldaro B. Watching emotional movies: Affective reactions and gender differences. *Int J Psychophysiol.* 2008;69(2):90-95. doi:10.1016/j.ijpsycho.2008.03.004.

155. Jalilifard A, Pizzolato EB, Islam MK. Emotion classification using single-channel scalp-EEG recording. In *2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*(pp. 845-849). IEEE. doi:10.1109/EMBC.2016.7590833.

156. Christie IC, Friedman BH. Autonomic specificity of discrete emotion and dimensions of affective space: A multivariate approach. *Int J Psychophysiol.* 2004;51(2):143-153. doi:10.1016/j.ijpsycho.2003.08.002.

157. Levenson RW, Ekman P, Heider K, Friesen WV. Emotion and autonomic nervous system activity in the Minangkabau of West Sumatra. *J Pers Soc Psychol.* 1992;62(6):972. doi:10.1037/0022-3514.62.6.972.

158. Yeomans MR, Coughlan E. Mood-induced eating. Interactive effects of restraint and tendency to overeat. *Appetite.* 2009;52(2):290-298. doi:10.1016/j.appet.2008.10.006.

159. Jampour L, Jafarirad S, Cheraghian B, Behrouzian F. Effects of Mood Induction Using Movie Watching on Food Intake and Hormone Levels. *Nutr Today.* 2019;54(2):88-94. doi:10.1097/NT.0000000000000329.

160. He J, Votruba S, Pomeroy J, Bonfiglio S, Krakoff J. Measurement of ad libitum food intake, physical activity, and sedentary time in response to overfeeding. *PLoS One.* 2012;7(5):e36225. doi:10.1371/journal.pone.0036225.

161. Venti CA, Votruba SB, Franks PW, Krakoff J, Salbe AD. Reproducibility of ad libitum energy intake with the use of a computerized vending machine system. *Am J Clin Nutr.* 2009;91(2):343-348. doi:10.3945/ajcn.2009.28315.

162. Adams MA, Pelletier RL, Zive MM, Sallis JF. Salad bars and fruit and vegetable consumption in elementary schools: a plate waste study. *J Am Diet Assoc.* 2005;105(11):1789-1792. doi:10.1016/j.jada.2005.08.013.

163. Williams P, Walton K. Plate waste in hospitals and strategies for change. *E Spen Eur E J Clin Nutr Metab.* 2011;6(6):e235-e241. doi:10.1016/j.eclnm.2011.09.006.

164. Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. *J Psychosom Res.* 1985;29(1):71-83. https://wp.ufpel.edu.br/renataabib/files/2018/07/Three-factor-eating-original.pdf. Accessed January 2019.

165. Karlsson J, Persson L-O, Sjöström L, Sullivan M. Psychometric properties and factor structure of the Three-Factor Eating Questionnaire (TFEQ) in obese men and women. Results from the Swedish Obese Subjects (SOS) study. *Int J Obes.* 2000;24(12):1715. doi:10.1038/sj.ijo.0801442.

166. Anglé S, Engblom J, Eriksson T, et al. Three factor eating questionnaire-R18 as a measure of cognitive restraint, uncontrolled eating and emotional eating in a sample of young Finnish females. *Int J Behav Nutr Phys Act.* 2009;6(1):41. doi:10.1186/1479-5868-6-41

167. De Lauzon B, Romon M, Deschamps V, et al. the Fleurbaix Laventie Ville Sante (FLVS) Study Group: The Three-Factor Eating Questionnaire-R18 Is Able to Distinguish among Different Eating Patterns in a General Population. *J Nutr.* 2004;2380(134):2372-2004. doi:10.1093/jn/134.9.2372.

168. De Lauzon-Guillain B, Romon M, Musher-Eizenman D, et al. Cognitive restraint, uncontrolled eating and emotional eating: correlations between parent and adolescent. *Matern Child Nutr.* 2009;5(2):171-178. doi:10.1111/j.1740-8709.2008.00164.x.

169. Allison DB, Kalinsky LB, Gorman BS. A comparison of the psychometric properties of three measures of dietary restraint. *Psychol Assess.* 1992;4(3):391. doi:10.1037/1040-3590.4.3.391.

170. Van Strien T, Frijters JER, Bergers GPA, Defares PB. The Dutch Eating Behavior Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. *Int J Eat Disord.* 1986;5(2):295-315. doi:10.1002/1098-108X(198602)5:2<295::AID-EAT2260050209>3.0.CO;2-T.

171. Nolan LJ, Geliebter A. Night eating is associated with emotional and external eating in college students. *Eat Behav.* 2012;13(3):202-206. doi:10.1016/j.eatbeh.2012.02.002.

172. Tylka TL, Wood-Barcalow NL. The Body Appreciation Scale-2: item refinement and psychometric evaluation. *Body Image.* 2015;12:53-67. doi:10.1016/j.bodyim.2014.09.006.

173. Camilleri GM, Méjean C, Bellisle F, et al. Cross-cultural validity of the Intuitive Eating Scale-2. Psychometric evaluation in a sample of the general French population. *Appetite.* 2015;84:34-42. doi:10.1016/j.appet.2014.09.009.

174. Carbonneau E, Carbonneau N, Lamarche B, et al. Validation of a French-Canadian adaptation of the Intuitive Eating Scale-2 for the adult population. *Appetite.* 2016;105:37-45. doi:10.1016/j.appet.2016.05.001.

175. Mayer JD, Gaschke YN. The experience and meta-experience of mood. *J Pers Soc Psychol.* 1988;55(1):102. doi:10.1037/0022-3514.55.1.102.

176. Kokkonen M, Pulkkinen L. Examination of the paths between personality, current mood, its evaluation, and emotion regulation. *Eur J Pers.* 2001;15(2):83-104. doi:10.1002/per.397.

177. Halberstadt JB, Niedenthal PM, Kushner J. Resolution of lexical ambiguity by emotional state. *Psychol Sci.* 1995;6(5):278-282. doi:10.1111/j.1467-9280.1995.tb00511.x.

178. Hall M, Baum A. Intrusive Thoughts as Determinants of Distress in Parents of Children With Cancer. *J Appl Soc Psychol.* 1995;25(14):1215-1230. doi:10.1111/j.1559-1816.1995.tb02615.x.

179. Mayer JD, Allen JP, Beauregard K. Mood inductions for four specific moods: a procedure employing guided imagery vignettes with music. *J Ment Imagery.* 1995. https://psycnet.apa.org/record/1996-10385-001. Accessed February 2019.

180. Mayer JD, Gaschke YN. The Brief Mood Introspection Scale (BMIS). *University of New Hampshire website.* https://scholars.unh.edu/cgi/viewcontent.cgi?article=1011&context=personality_lab. Published 1988. Accessed January 2019.

181. Shields SA, Mallory ME, Simon A. The body awareness questionnaire: reliability and validity. *J Pers Assess.* 1989;53(4):802-815. doi:10.1207/s15327752jpa5304_16.

182. Daubenmier JJ. The relationship of yoga, body awareness, and body responsiveness to self-objectification and disordered eating. *Psychol Women Q.* 2005;29(2):207-219. doi:10.1111/j.1471-6402.2005.00183.x.

183. Stensland SH, Margolis S. Simplifying the calculation of body mass index for quick reference. *J Am Diet Assoc.* 1990;90(6). https://www.cabdirect.org/cabdirect/abstract/19911436585. Accessed November 2018.

184. Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav Res Methods.* 2008;40(3):879-891. doi:10.3758/BRM.40.3.879.

185. Shapiro SS, Wilk MB. An analysis of variance test for normality (complete samples). *Biometrika.* 1965;52(3/4):591-611. https://www.jstor.org/stable/2333709?casa_token=7oFXCc0P9m0AAAAA%3ArYEzxK5L8N9kKsIHRI-jR5FH9Dp4COdNEZaVEVmQVGK_2t60Ftztl9HsQKOiy-Zbpq9v5eEIP5jcC1iBo5xk5i8yaeUEYfcbFzUL_CTCucr1hVnR3n6m&seq=1#metadata_info_tab_contents. Accessed June 2020.

186. Razali NM, Wah YB. Power comparisons of shapiro-wilk, kolmogorov-smirnov, lilliefors and anderson-darling tests. *J Stat Model Anal.* 2011;2(1):21-33. https://www.researchgate.net/profile/Bee_Yap/publication/267205556_Power_Comparisons_of_Shapiro-Wilk_Kolmogorov-Smirnov_Lilliefors_and_Anderson-Darling_Tests/links/5477245b0cf29afed61446e1/Power-Comparisons-of-Shapiro-Wilk-Kolmogorov-Smirnov-Lilliefors-and-Anderson-Darling-Tests.pdf. Accessed June 2020.

187. Armstrong RA. When to use the B onferroni correction. *Ophthalmic Physiol Opt.* 2014;34(5):502-508. doi:10.1111/opo.12131.

188. Sira N, Pawlak R. Prevalence of overweight and obesity, and dieting attitudes among Caucasian and African American college students in Eastern North carolina: A cross-sectional survey. *Nutr Res Pract.* 2010;4(1):36-42. doi:10.4162/nrp.2010.4.1.36.

189. Huang TTK, Harris KJ, Lee RE, Nazir N, Born W, Kaur H. Assessing overweight, obesity, diet, and physical activity in college students. *J Am Coll Health.* 2003;52(2):83-86. doi:10.1080/07448480309595728

190. van Herpen E, van der Lans I. A picture says it all? The validity of photograph coding to assess household food waste. *Food Qual Prefer.* 2019;75:71-77. doi:10.1016/j.foodqual.2019.02.006.

191. Lillegaard ITL, Øverby NC, Andersen LF. Can children and adolescents use photographs of food to estimate portion sizes? *Eur J Clin Nutr.* 2005;59(4):611-617. doi:10.1038/sj.ejcn.1602119.

192. Wardle J, Haase AM, Steptoe A, Nillapun M, Jonwutiwes K, Bellisie F. Gender differences in food choice: the contribution of health beliefs and dieting. *Ann Behav Med.* 2004;27(2):107-116. doi:10.1207/s15324796abm2702_5.

193. Cloete A. *Self–regulation, psychopathology and gender in a group of university students.* North West University; 2010. http://hdl.handle.net/10394/4639. Accessed July 2020.

194. Cecil JE, Palmer CNA, Wrieden W, et al. Energy intakes of children after preloads: adjustment, not compensation–. *Am J Clin Nutr.* 2005;82(2):302-308. doi:10.1093/ajcn/82.2.302.

195. Ruzanska UA, Warschburger P. Intuitive eating mediates the relationship between self-regulation and BMI-Results from a cross-sectional study in a community sample. *Eat Behav.* 2019;33:23-29. doi:10.1016/j.eatbeh.2019.02.004.

196. Kitsantas A. The role of self-regulation strategies and self-efficacy perceptions in successful weight loss maintenance. *Psychol Health.* 2000;15(6):811-820. doi:10.1080/08870440008405583.

197. Campos-Uscanga Y, Gutiérrez-Ospina G, Morales-Romero J, Romo-González T. Self-regulation of eating and physical activity is lower in obese female college students as compared to their normal weight counterparts. *Eat Weight Disord* 2017;22(2):311-319. doi:10.1007/s40519-016-0338-9.

198. Balani R, Herrington H, Bryant E, Lucas C, Kim SC. Nutrition knowledge, attitudes, and self-regulation as predictors of overweight and obesity. *J Am Assoc Nurse Pract.* 2019;31(9):502-510. doi:10.1097/JXX.0000000000000169.

199. Martin E, Dourish CT, Rotshtein P, Spetter MS, Higgs S. Interoception and disordered eating: A systematic review. *Neurosci Biobehav Rev.* 2019;107:166-191. doi:10.1016/j.neubiorev.2019.08.020.

200. Blasczyk-Schiep S, Adamczewska K, Sokoła KF. Subclinical eating disorder symptoms and positive vs. negative affect in high school students: the mediating role of self-regulation. *Personality Psychol.* 2019;7(2):120-131. doi:10.5114/cipp.2019.83125.

201. Leon GR, Fulkerson JA, Perry CL, Early-Zald MB. Prospective analysis of personality and behavioral vulnerabilities and gender influences in the later development of disordered eating. *J Abnorm Psychol.* 1995;104(1):140. doi:10.1037/0021-843X.104.1.140.

202. Grabauskaitė A, Baranauskas M, Griškova-Bulanova I. Interoception and gender: What aspects should we pay attention to? *Conscious Cogn.* 2017;48:129-137. doi:10.1016/j.concog.2016.11.002.

203. Dakanalis A, Zanetti MA, Clerici M, Madeddu F, Riva G, Caccialanza R. Italian version of the Dutch Eating Behavior Questionnaire. Psychometric proprieties and measurement invariance across sex, BMI-status and age. *Appetite.* 2013;71:187-195. doi:10.1016/j.appet.2013.08.010.

204. Anglé S, Engblom J, Eriksson T, et al. Three factor eating questionnaire-R18 as a measure of cognitive restraint, uncontrolled eating and emotional eating in a sample of young Finnish females. *Int J Behav Nutr Phys Act.* 2009;6(1):41. doi:10.1186/1479-5868-6-41.

205. Lazarevich I, Irigoyen-Camacho ME, del Consuelo Velázquez-Alva M, Salinas-Ávila J. Psychometric characteristics of the Eating and Appraisal Due to Emotions and Stress Questionnaire and obesity in Mexican university students. *Nutr Hosp.* 2015;31(6):2437-2444. https://www.redalyc.org/pdf/3092/309238516013.pdf. Accessed August 2020.

206. Carbonneau N, Carbonneau E, Cantin M, Gagnon-Girouard M-P. Examining women's perceptions of their mother's and romantic partner's interpersonal styles for a better understanding of their eating regulation and intuitive eating. *Appetite.* 2015;92:156-166. doi:10.1016/j.appet.2015.05.020.

207. Filkowski MM, Olsen RM, Duda B, Wanger TJ, Sabatinelli D. Sex differences in emotional perception: meta analysis of divergent activation. *Neuroimage.* 2017;147:925-933. doi:10.1016/j.neuroimage.2016.12.016.

208. Economos CD, Hildebrandt ML, Hyatt RR. College freshman stress and weight change: differences by gender. *Am J Health Behav.* 2008;32(1):16-25. doi:10.5993/AJHB.32.1.2.

209. Lafrance Robinson A, Kosmerly S, Mansfield-Green S, Lafrance G. Disordered eating behaviours in an undergraduate sample: Associations among gender, body mass index, and difficulties in emotion regulation. *Can J Behav Sci/Revue canadienne des sciences du comportement.* 2014;46(3):320. doi:10.1037/a0031123.

210. Geliebter A, Aversa A. Emotional eating in overweight, normal weight, and underweight individuals. *Eat Behav.* 2003;3(4):341-347. doi:10.1016/S1471-0153(02)00100-9.

211. Slochower J, Kaplan SP, Mann L. The effects of life stress and weight on mood and eating. *Appetite.* 1981;2(2):115-125. doi:10.1016/S0195-6663(81)80005-0.

212. van Strien T, Gibson EL, Baños R, Cebolla A, Winkens LHH. Is comfort food actually comforting for emotional eaters? A (moderated) mediation analysis. *Physiol Behav.* 2019;211:112671. doi:10.1016/j.physbeh.2019.112671.

213. van Strien T, Cebolla A, Etchemendy E, et al. Emotional eating and food intake after sadness and joy. *Appetite.* 2013;66:20-25. doi:10.1016/j.appet.2013.02.016.

214. Eneli IU, Tylka TL, Hummel J, et al. Rationale and design of the Feeding Dynamic Intervention (FDI) study for self-regulation of energy intake in preschoolers. *Contemp Clin Trials.* 2015;41:325-334. doi:10.1016/j.cct.2015.01.006.

215. Martin CK, Han H, Coulon SM, Allen HR, Champagne CM, Anton SD. A novel method to remotely measure food intake of free-living individuals in real time: the remote food photography method. *Br J Nutr.* 2008;101(3):446-456. doi:10.1017/S0007114508027438.

216. Florida International University. Florida Shines. https://courses.flvc.org/College/Florida-International. Accessed August 2020.

217. Stroebele N, De Castro JM. Effect of ambience on food intake and food choice. *Nutr.* 2004;20(9):821-838. doi:10.1016/j.nut.2004.05.012.

APPENDICES

Appendix 1.

Recruitment Flyer

Appendix 2.

Consent Form

ADULT CONSENT TO PARTICIPATE IN A RESEARCH STUDY
THE EFFECT OF EMOTIONAL STATE, INTEROCEPTION, INTUITIVE EATING, AND SELF-REGULATION ON THE ENERGY INTAKE OF COLLEGE STUDENTS

SUMMARY INFORMATION

Things you should know about this study:

- **Purpose:** The purpose of the study is to determine the effect of current emotions/mood, and internal bodily signals including intuitive eating, and interoception, on self-regulation in food intake in college students.
- **Procedures**: If you choose to participate, you will be asked to visit two times one week apart to fill out some questionnaires, watch a movie, drink a cup of juice and be served with lunch (buffet style). Your height, weight, body fat percentage, and muscle mass will be measured as well.
- **Duration:** This will take about 6-8 hours total.
- **Risks**: The main risk or discomfort from this research is being uncomfortable to eat in front of the other participants.
- **Benefits:** Participants will receive a snack and lunch each time they participate in the study. No other direct benefits will be provided.
- **Alternatives:** There are no known alternatives available to you other than not taking part in this study.
- **Participation:** Taking part in this research project is voluntary.

Please carefully read the entire document before agreeing to participate.

PURPOSE OF THE STUDY

The purpose of the study is to determine the effect of current emotions/mood, and internal bodily signals including intuitive eating, and interoception, on self-regulation in food intake in college students.

NUMBER OF STUDY PARTICIPANTS

If you decide to be in this study, you will be one of 60 people in this research study.

DURATION OF THE STUDY

Your participation will involve two visits during two weeks in a row. Each visit will take 3-4 hours.

PROCEDURES

If you agree to be in the study, we will ask you to do the following things:

- During the first visit:
    - You will receive a snack 3 hours prior to the trial.
    - You will complete a set of questionnaires
    - Your weight, height, body fat percentage, and muscle mass will be measured.
    - You will be asked to watch a movie.
    - You will drink a cup of juice after the movie, 30 minutes before lunch.
    - You will be asked to answer one of the questionnaires again.
    - You will be served with a buffet style lunch where you can eat as much as you want.
- During the second visit:
    - You will receive a snack 3 hours prior to the trial.
    - You will complete one questionnaire
    - You will be asked to watch a movie.
    - You will drink a cup of juice after the movie, 30 minutes before lunch.
    - You will be asked to answer the same questionnaire again.
    - You will be served with a buffet style lunch where you can eat as much as you want.

RISKS AND/OR DISCOMFORTS

The study has the following possible risks to you: You might not feel comfortable eating in front of other people.

BENEFITS

Participants will receive a snack and lunch each time they participate in the study. No other direct benefits will be provided.

ALTERNATIVES

There are no known alternatives available to you other than not taking part in this study. Any significant new findings developed during the course of the research which may relate to your willingness to continue participation will be provided to you.

CONFIDENTIALITY

The records of this study will be kept private and will be protected to the fullest extent provided by law. In any sort of report we might publish, we will not include any information that will make it possible to identify you. Research records will be stored securely, and only the researcher team will have access to the records. However, your records may be inspected by authorized University or other agents who will also keep the information confidential.

USE OF YOUR INFORMATION

Identifiers about you might be removed from the identifiable private information and that, after such removal, the information could be used for future research studies or distributed to another investigator for future research studies without additional informed consent from you or your legally authorized representative.

COMPENSATION & COSTS

You will receive a 5 points extra credit if participating through Sona-system. You will receive a $15 FIU gift card if you complete both trials.

RIGHT TO DECLINE OR WITHDRAW

Your participation in this study is voluntary. You are free to participate in the study or withdraw your consent at any time during the study. You will not lose any benefits if you decide not to participate or if you quit the study early. The investigator reserves the right to remove you without your consent at such time that he/she feels it is in the best interest.

RESEARCHER CONTACT INFORMATION

If you have any questions about the purpose, procedures, or any other issues relating to this research study you may contact Padideh Lovan at FIU, AHC-5, Dietetics and Nutrition department, 786-260-2168, phadd001@fiu.edu.

IRB CONTACT INFORMATION

If you would like to talk with someone about your rights of being a subject in this research study or about ethical issues with this research study, you may contact the FIU Office of Research Integrity by phone at 305-348-2494 or by email at ori@fiu.edu.

PARTICIPANT AGREEMENT

I have read the information in this consent form and agree to participate in this study. I have had a chance to ask any questions I have about this study, and they have been answered for me. I understand that I will be given a copy of this form for my records.

_____	_____
Signature of Participant	Date
_____	
Printed Name of Participant	
_____	_____
Signature of Person Obtaining Consent	Date

Appendix 3.

IRB-Florida International University

FIU | FLORIDA INTERNATIONAL UNIVERSITY

Office of Research Integrity
Research Compliance, MARC 414

MEMORANDUM

To:	Dr. Catherine Coccia
CC:	Padideh Lovan
From:	Elizabeth Juhasz, Ph.D., IRB Coordinator
Date:	September 5, 2019
Protocol Title:	"THE EFFECT OF EMOTIONAL STATE, INTEROCEPTION, INTUITIVE EATING, AND SELF-REGULATION ON THE ENERGY INTAKE OF COLLEGE STUDENTS"

The Social and Behavioral Institutional Review Board of Florida International University has approved your study for the use of human subjects via the **Expedited Review** process. Your study was found to be in compliance with this institution's Federal Wide Assurance (00000060).

IRB Protocol Approval #:	IRB-19-0315	**IRB Approval Date:**	09/05/19
TOPAZ Reference #:	107782	**IRB Expiration Date:**	09/05/22

As a requirement of IRB Approval you are required to:

1) Submit an IRB Amendment Form for all proposed additions or changes in the procedures involving human subjects. All additions and changes must be reviewed and approved by the IRB prior to implementation.
2) Promptly submit an IRB Event Report Form for every serious or unusual or unanticipated adverse event, problems with the rights or welfare of the human subjects, and/or deviations from the approved protocol.
3) Utilize copies of the date stamped consent document(s) for obtaining consent from subjects (unless waived by the IRB). Signed consent documents must be retained for at least three years after the completion of the study.
4) **Receive annual review and re-approval of your study prior to your IRB expiration date.** Submit the IRB Renewal Form at least 30 days in advance of the study's expiration date.
5) Submit an IRB Project Completion Report Form when the study is finished or discontinued.

HIPAA Privacy Rule: **N/A**

Special Conditions: **N/A**

For further information, you may visit the IRB website at http://research.fiu.edu/irb.

Appendix 4.

IRB Amendment-Florida International University

FIU | FLORIDA INTERNATIONAL UNIVERSITY

Office of Research Integrity
Research Compliance, MARC 414

MEMORANDUM

To:	Dr. Catherine Coccia
CC:	Padideh Lovan
From:	Maria Melendez-Vargas, MIBA, Coordinator
Date:	October 22, 2019
Proposal Title:	"THE EFFECT OF EMOTIONAL STATE, INTEROCEPTION, INTUITIVE EATING, AND SELF-REGULATION ON THE ENERGY INTAKE OF COLLEGE STUDENTS"
	Approval # IRB-19-0315-AM01
	Reference # 107782

The Social and Behavioral Institutional Review Board has approved the following modification(s):

- Expanded recruitment plan by posting flyers around the FIU campus in publicly visible posting areas and distributing the flyers directly to interested students and attendees of select undergraduate class sections and student organizations to inform a larger number of students about the study and participation opportunity. Post the flyer directly on social media outlets that FIU students use.
- Add a $15 monetary incentive for each participant (including those who have already completed the trials) in the form of FIU gift card, provided to each participant to encourage participation, following the protocol, and completing the trials. Participants who completed the trials will be contacted via email and text message to schedule an appointment to pick up their gift card.

There are no additional requirements in regards to your study. However, if there are further changes in the protocol after you commence your study, then you are required to resubmit your proposal for review. As a reminder, you are still require to receive continuing review and re-approval prior to your expiration date of **September 5, 2022.** For further information, you may visit the FIU IRB website at http://research.fiu.edu/irb.

HIPAA Privacy Rule: N/A

Special Conditions: N/A

For further information, you may visit the IRB website at http://research.fiu.edu/irb.

MMV/em

Appendix 5.

Screening Form

1. **Are you an FIU student?**
    a. No
    b. Yes
2. **Which program are you enrolled in?**
    a. Undergraduate
    b. Graduate
3. **Are you between 18-24 years of age?**
    a. No
    b. Yes
4. **Are you an FIU athlete?**
    a. No
    b. Yes
5. **Are you vegan?**
    a. No
    b. Yes
6. **Do you have any food allergies?**
    a. No
    b. Yes
        i. If yes, be specific …….
7. **Which of the following movies have you watched before?**
    a. The boy in the striped pajamas
    b. Hachi, a dog tale
    c. Finding neverland
    d. Never let me go
    e. Marley and me
    f. The fault in our stars
    g. Me before you
    h. None of them
8. **You will be attending 2 trials for this study. Each trial takes approximately 3-4 hours (starting at 10:00 a.m.). What is your best availability?**
    a. Wednesday
    b. Thursday
    c. Friday
    d. Saturday
    e. Sunday
9. **People who are pregnant, have been diagnosed with any health related conditions such as diabetes, have recently been diagnosed with an eating disorder, or are taking medications are not eligible for this study. Do you have any of these conditions?**
    a. No
    b. Yes

i. Comments (if needed):.....

10. Your contact information to provide you with more details about the time and the dates of the trials:

Name:.....

Email address:.....

Phone number:.....

Appendix 6.

Demographics Questionnaire

1. **Gender**
    a. Male
    b. Female

2. **Age**
    a. 18
    b. 19
    c. 20
    d. 21
    e. 22
    f. 23
    g. 24

3. **Race (Please select the one that best describes you)**
    a. White
    b. Black or African American
    c. Asian
    d. American Indian

4. **Ethnicity**
    a. Non-Hispanic
    b. Hispanic or Latino

5. **Class standing**
    a. Freshman
    b. Sophomore
    c. Junior
    d. Senior

6. **Marital status**
    a. Married
    b. Single
    c. Divorced
    d. Separated
    e. Widowed

7. **Which of these describes your personal income last year?**
    a. Less than $25,000
    b. $25,000 to $34,999
    c. $35,000 to $49,999
    d. $50,000 to $74,999

e. More than $75,000

8. **Physical activity level**
    a. Inactive (no activity beyond daily life)
    b. Low (activity beyond daily life but fewer than 150 minutes a week)
    c. Medium (150 minutes to 300 minutes a week)
    d. High (more than 300 minutes a week)

9. **Which of the following best describes your living arrangement?**
    a. On-campus dorms
    b. Off-campus dorms
    c. Apartment building, condo, house

10. **Which of the following best describes your living arrangement?**
    a. By myself
    b. With parents
    c. With roommate/s
    d. With my partner

Appendix 7.

Dutch Eating Behavior Questionnaire (DEBQ)

For each item, please circle the answer that best characterizes your attitudes or behaviors.

1. **If you have put on weight, do you eat less than you usually do?**
   1 2 3 4 5
   Never Very often
2. **Do you try to eat less at mealtimes than you would like to eat?**
   1 2 3 4 5
   Never Very often
3. **How often do you refuse food or drink offered because you are concerned about your weight?**
   1 2 3 4 5
   Never Very often
4. **Do you watch exactly what you eat?**
   1 2 3 4 5
   Never Very often
5. **Do you deliberately eat foods that are slimming?**
   1 2 3 4 5
   Never Very often
6. **When you have eaten too much, do you eat less than usual the following days?**
   1 2 3 4 5
   Never Very often
7. **Do you deliberately eat less in order not to become heavier?**
   1 2 3 4 5
   Never Very often
8. **How often do you try not to eat between meals because you are watching your weight?**
   1 2 3 4 5
   Never Very often
9. **How often in the evening do you try not to eat because you are watching your weight?**
   1 2 3 4 5
   Never Very often
10. **Do you take into account your weight with what you eat?**
    1 2 3 4 5
    Never Very often
11. **Do you have the desire to eat when you are irritated?**
    1 2 3 4 5
    Never Very often

12. Do you have a desire to eat when you have nothing to do?

1 2 3 4 5

Never Very often

13. Do you have a desire to eat when you are depressed or discouraged?

1 2 3 4 5

Never Very often

14. Do you have a desire to eat when you are feeling lonely?

1 2 3 4 5

Never Very often

15. Do you have a desire to eat when somebody lets you down?

1 2 3 4 5

Never Very often

16. Do you have a desire to eat when you are cross?

1 2 3 4 5

Never Very often

17. Do you have a desire to eat when you are approaching something unpleasant to happen?

1 2 3 4 5

Never Very often

18. Do you get the desire to eat when you are anxious, worries, or tense?

1 2 3 4 5

Never Very often

19. Do have a desire to eat when things are going against you or when things have gone wrong?

1 2 3 4 5

Never Very often

20. Do you have a desire to eat when you are frightened?

1 2 3 4 5

Never Very often

21. Do you have a desire to eat when you are disappointed?

1 2 3 4 5

Never Very often

22. Do you have a desire to eat when you are emotionally upset?

1 2 3 4 5

Never Very often

23. Do you have a desire to eat when you are bored or restless?

1 2 3 4 5

Never Very often

24. If food tastes good to you, do you eat more than usual?

1 2 3 4 5

Never Very often

25. If food smells and looks good, do you eat more than usual?

1 2 3 4 5

Never Very often

26. If you see or smell something delicious, do you have a desire to eat it?

1	2	3	4	5
Never				Very often

27. If you have something delicious to eat, do you eat it straight away?

1	2	3	4	5
Never				Very often

28. If you walk past the baker, do you have the desire to buy something delicious?

1	2	3	4	5
Never				Very often

29. If you walk past a snack bar or a cafe, do you have the desire to buy something delicious?

1	2	3	4	5
Never				Very often

30. If you see others eating, do you also have the desire to eat?

1	2	3	4	5
Never				Very often

31. Can you resist eating delicious foods?

1	2	3	4	5
Never				Very often

32. Do you eat more than usual, when you see others eating?

1	2	3	4	5
Never				Very often

33. When preparing a meal, are you inclined to eat something?

1	2	3	4	5
Never				Very often

Appendix 8.

Three Factor Eating Questionnaire Revised-18 (TFEQ-R18):

From scale 1-4 (4 the highest) indicate how frequent is a certain behavior, or how true a statement is for you?

1. When I smell delicious food, I find it very difficult to keep from eating, even if I have When I smell a sizzling steak or juicy piece of meat, I find it very difficult to keep from eating, even if I have just finished a meal.

4	*3*	*2*	*1*
Definitely true	*mostly true*	*mostly false*	*definitely false*

2. I deliberately take small helpings as a means of controlling my weight.

4	*3*	*2*	*1*
Definitely true	*mostly true*	*mostly false*	*definitely false*

3. When I feel anxious, I find myself eating.

4	*3*	*2*	*1*
Definitely true	*mostly true*	*mostly false*	*definitely false*

4. Sometimes when I start eating, I just can't seem to stop.

4	*3*	*2*	*1*
Definitely true	*mostly true*	*mostly false*	*definitely false*

5. Being with someone who is eating often makes me hungry enough to eat also.

4	*3*	*2*	*1*
Definitely true	*mostly true*	*mostly false*	*definitely false*

6. When I feel blue, I often overeat.

4	*3*	*2*	*1*
Definitely true	*mostly true*	*mostly false*	*definitely false*

7. When I see a real delicacy, I often get so hungry that I have to eat right away.

4	*3*	*2*	*1*
Definitely true	*mostly true*	*mostly false*	*definitely false*

8. I get so hungry that my stomach often seems like a bottomless pit.

4	*3*	*2*	*1*
Definitely true	*mostly true*	*mostly false*	*definitely false*

9. I am always hungry so it is hard for me to stop eating before I finish the food on my plate.

4	*3*	*2*	*1*
Definitely true	*mostly true*	*mostly false*	*definitely false*

10. When I feel lonely, I console myself by eating.

4	*3*	*2*	*1*
Definitely true	*mostly true*	*mostly false*	*definitely false*

11. I consciously hold back at meals in order not to weight gain.

4	*3*	*2*	*1*
Definitely true	*mostly true*	*mostly false*	*definitely false*

12. I do not eat some foods because they make me fat.

4	*3*	*2*	*1*
Definitely true	*mostly true*	*mostly false*	*definitely false*

13. I am always hungry enough to eat at any time.

4	*3*	*2*	*1*
Definitely true	*mostly true*	*mostly false*	*definitely false*

14. How often do you feel hungry?

1	*2*	*3*	*4*
Only at mealtimes	*sometimes between meals*	*often between meals*	*almost always*

15. How frequently do you avoid "stocking up" on tempting foods?

1	*2*	*3*	*4*
Almost never	*seldom*	*usually*	*almost always*

16. How likely are you to consciously eat less than you want?

1	*2*	*3*	*4*
Unlikely	*slightly likely*	*moderately likely*	*very likely*

17. Do you go on eating binges though you are not hungry?

1	*2*	*3*	*4*
Never	*rarely*	*sometimes*	*at least once a week*

18. On a scale of 1 to 8, where 1 means no restraint in eating (eating whatever you want, whenever you want it) and 8 means total restraint (constantly limiting food intake and never "giving in"), what number would you give yourself?

1 2 3 4 5 6 7 8

Appendix 9.

Body Responsiveness Scale (BRS)

For each item, on a scale of 1 to 7, please circle the number that best describes your answer.

1. **I am confident that my body will let me know what is good for me.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

2. **My bodily desires lead me to do things that I end up regretting.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

3. **My mind and my body often want to do different things.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

4. **I suppress my bodily feelings and sensations.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

5. **I 'listen' to my body to advise me about what to do.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

6. **It is important for me to know how my body is feeling throughout the day.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

7. **I enjoy becoming aware of how my body feels.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

Appendix 10.

Body Awareness Questionnaire (BAQ)

For each item, on a scale of 1 to 7, please circle the number that best describes your answer.

1. **I notice differences in the way my body reacts to various foods.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

2. **I can always tell when I bumped myself whether or not it will become a bruise.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

3. **I always know when I've exerted myself to the point where I'll be sore the next day.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

4. **I am always aware of changes in my energy level when I eat certain foods.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

5. **I know in advance when I'm getting the flu.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

6. **I know I'm running a fever without taking my temperature.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

7. **I can distinguish between tiredness because of hunger and tiredness because of lack of sleep.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

8. **I can accurately predict what time of day lack of sleep will catch up with me.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

9. **I am aware of a cycle in my activity level throughout the day.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

10. **I *don't* notice seasonal rhythms and cycles in the way my body functions.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

11. **As soon as I wake up in the morning, I know how much energy I'll have during the day.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

12. **I can tell when I go to bed, how well I will sleep that night.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

13. **I notice distinct body reactions when I am fatigued.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

14. **I notice specific body responses to change in the weather.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

15. **I can predict how much sleep I will need at night in order to wake up refreshed.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

16. **When my exercise habits change, I can predict very accurately how that will affect my energy level.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

17. **There seems to be a "best" time for me to go to sleep at night.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

18. **I notice specific bodily reactions to being over hungry.**

1 2 3 4 5 6 7

Not at all true about me Very true about me

Appendix 11.

Intuitive Eating Scale-2 (IES-2)

For each item, please circle the answer that best characterizes your attitudes or behaviors.

1. **I try to avoid certain foods high in fat, carbohydrates, or calories.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

2. **I have forbidden foods that I don't allow myself to eat.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

3. **I get mad at myself for eating something unhealthy.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

4. **If I am craving a certain food, I allow myself to have it.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

5. **I allow myself to eat what food I desire at the moment.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

6. **I do NOT follow eating rules or dieting plans that dictate what, when, and/or how much to eat.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

7. **I find myself eating when I'm feeling emotional (e.g., anxious, depressed, sad), even when I'm not physically hungry.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

8. **I find myself eating when I am lonely, even when I'm not physically hungry.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

9. **I use food to help me soothe my negative emotions.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

10. **I find myself eating when I am stressed out, even when I'm not physically hungry.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

11. **I am able to cope with my negative emotions (e.g., anxiety, sadness) without turning to food for comfort.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

12. **When I am bored, I do NOT eat just for something to do.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

13. **When I am lonely, I do NOT turn to food for comfort.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

14. **I find other ways to cope with stress and anxiety than by eating.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

15. **I trust my body to tell me when to eat.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

16. **I trust my body to tell me what to eat.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

17. **I trust my body to tell me how much to eat.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

18. **I rely on my hunger signals to tell me when to eat.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

19. **I rely on my fullness (satiety) signals to tell me when to stop eating.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

20. **I trust my body to tell me when to stop eating.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

21. **Most of the time, I desire to eat nutritious foods.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

22. **I mostly eat foods that make my body perform efficiently (well).**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

23. **I mostly eat foods that give my body energy and stamina.**

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Appendix 12.

Brief Mood Introspection Scale (BMIS)

Circle the response on the scale below that indicates how well each adjective or phrase describes your present mood.

(definitely do not feel) (do not feel) (slightly feel) (definitely feel)

XX X V VV

Lively XX X V VV
Happy XX X V VV
Sad XX X V VV
Tired XX X V VV
Caring XX X V VV
Content XX X V VV
Gloomy XX X V VV
Jittery XX X V VV

Drowsy XX X V VV
Grouchy XX X V VV
Peppy XX X V VV
Nervous XX X V VV
Calm XX X V VV
Loving XX X V VV
Fed up XX X V VV
Active XX X V VV

Overall, my mood is:

Very Unpleasant Very Pleasant

-10 –9 –8 –7 –6 –5 –4 –3 –2 –1 0 1 2 3 4 5 6 7 8 9 10

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PRESENTATIONS AND PUBLICATIONS

Haddadian, P. Rashidi, A. Intestinal Microflora, Probiotics and Diabetes Mellitus Prevention Is There a Linkage? *American Society for Nutrition Middle East Conference, Dubai, Emirates, 2013.*

Haddadian, P. Rashidi, A. Gut Microflora and Weight: Application of Probiotics in Human Weight Management. *American Society for Nutrition Middle East Conference, Dubai, Emirates, 2014.*

Haddadian, P. Huwaikem, M. Vaccaro, J. Zarini, G. Huffman, F. Physical activity, sedentary behavior, and obesity in U.S. children age 6-12. *The FASEB J.* 2017;31(1_supplement):642-645.

Graziano PA, Coto J, Garcia A, Matthysse A, Haddadian P, Dick A, Coccia C. Self-regulation of food intake in young children with and without Attention-Deficit/Hyperactivity Disorder. *Society of Pediatric Psychology Annual Conference. New Orleans, LA, USA, 2019.*

Coto J, Garcia A, Matthysse A, Haddadian P, Coccia C, Graziano PA. Predicting child weight outcomes within a behavioral health intervention: The role of parental feeding practices. *Society of Pediatric Psychology Annual Conference. New Orleans, LA, USA, 2019.*

Haddadian P, Coccia C. Does Body Mass Index Influence Social Media Use? An Exploration of Social Media Use in College Students (P04-009-19). In: Oxford University Press; 2019.

Macchi A, Coccia C, Lovan P, et al. A New Strategy to Assess Self-Regulation of Food Intake among Elementary School Children. *J Acad Nutr Diet.* 2019;119(9): A27.

Lovan, P., & Coccia, C. Mood and Eating Behaviors in College Students. *J Nutr Educ Behav*. 2020; *52*(7), S67.

Jeune SC, Aguado M, Lovan P, Dick A, Graziano P, Coccia C. Compensation Indices (COMPX) Scores and Their Relationship to Average Daily Consumption in Elementary School Children. Poster accepted at: Food and Nutrition Conference and Expo. Meeting location: Indianapolis, IN, 10/20.

Coccia C, Lovan P, Macchi A, Coto J, Dick A, Graziano P. How Much and What: Using a Buffet to Determine Self-regulation of Food Intake Among Young School-Age Children. Manuscript submitted for publication: *Appl Physiol Nutr Meta.*