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The Effect of Chronic Stress on Body Image, Food Intake, and Food Preferences in Female Undergraduate Students

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Abstract

Among the many negative effects of stress, behavioral changes regarding food intake/preferences are well-established by research. Most individuals tend to choose less healthy foods—often high-fat, calorically dense, palatable "comfort foods"—when they are experiencing stress. Body image can also have an impact on food intake/preferences; for example, body image dissatisfaction often leads to dieting or dietary restraint. However, evidence also suggests that stress may be associated with greater body image dissatisfaction. This study addresses the interaction between all three variables: stress, body image, and food intake/preferences. Measurements were obtained from thirteen female undergraduate students at two different time points during the college semester. The first measurement period occurred near the beginning of the semester and served as the time point associated with lower chronic stress. The second measurement period occurred at the end of the semester during the two weeks before final examinations and served as the time point associated with higher chronic stress. During each time point, the following measures were taken: perceived body image, perceived stress (acute and chronic), 24-hour food intake measures, salivary cortisol, and height and weight. We hypothesized that perceived stress, salivary cortisol, body image dissatisfaction, and consumption of calorically dense foods would be lower during the first (low-stress) time point and higher during the second (high-stress) time point. The results of the study partially supported our hypothesis in that perceived acute stress levels were significantly higher during the high-stress time point ($p<0.05$). We also saw a trend which indicated that salivary cortisol and perceived chronic stress were higher during the high-stress time point compared to the low-stress. However, significant differences were not seen for cortisol levels, caloric intake patterns or perceived body image across the two time points ($p>0.05$).

Introduction

Stress can have many negative impacts on human health—physiologically, psychologically, and behaviorally. Physiologically, stress is associated with the development of numerous diseases and poor immune function (Habhab et al. 2009; Marucha et al. 1998). Psychologically, stress can induce negative emotional states, compromise mental health, and lower self-esteem (Habhab et al. 2009; Murray et al. 2011). These factors may ultimately lead to unhealthy behavioral choices (Wallis and Hetherington 2009; Willenbring et al. 1986).

It is well-established that stress-induced behavioral changes often impact food intake and food preferences (Habhab et al. 2009; Kandiah et al. 2006; Wallis and Hetherington 2009; Willenbring et al. 1986). The effects of stress on food intake behaviors remains unclear; it has been reported to stimulate appetite in some individuals, as well as attenuating appetite in others (Kandiah et al. 2006). Some research also suggests that there is variation in stress-induced food preferences due to factors such as whether individuals regularly restrain their diets (Wallis and Hetherington 2009; Habhab et al. 2009). However, the preponderance of research indicates that most individuals tend to choose high-fat, calorically dense foods when they are experiencing stress (Wallis and Hetherington 2009; Habhab et al. 2009; Kandiah et al. 2006; Willenbring et al. 1986). During periods of stress, people tend to also show a preference for sweet tastes over other tastes (Kandiah et al. 2006; Habhab et al. 2009). Likewise, findings suggest that stress results in a greater consumption of high-fat, palatable, "comfort food" snacks with a decreased consumption of balanced meals (Wallis and Hetherington 2009; Habhab et al. 2009; Kandiah et al. 2006). In summary, stress appears to induce an increase in the intake of high-energy, calorically dense foods over healthier options for most individuals.

Another factor shown to impact food choices is body image (Trindade and Ferreira 2015; Bibiloni et al. 2013). Generally, greater body image dissatisfaction tends to result in dieting and self-imposed eating restrictions, as the majority of individuals who are dissatisfied with their appearance desire a thinner body. A greater cognitive connection to negative body image ideas can enhance this restrictive effect on food choices (Trindade and Ferreira 2015). Body image dissatisfaction is not necessarily associated with body mass index (BMI) for all individuals; indeed, often it is not at all related to BMI (Trindade and Ferreira 2015; Bibiloni et al. 2013). Psychologically, stress is also associated with low self-esteem and poor body image (Murray et al. 2011; Himmelstein et al. 2015; Farhat 2015). Research indicates that a poor body image may induce significant stress on an individual (Himmelstein et al. 2015; Farhat 2015). However, there is also evidence which suggests that chronic life-related stress may result in a worsened body image (Murray et al. 2011). Therefore, the question arises as to how all of these variables—stress, body image, and food intake and preferences—interact in conjunction with one another.

The present study was run using female undergraduate college students as its participants. The rationale for this choice was that this population tends to be at a high risk for body image dissatisfaction, self-imposed dietary restraints/restrictions, and high levels of stress, as a consequence of their academic and extracurricular obligations (Kandiah et al. 2006; Murray et al. 2011). An extensive body of research suggests that there is a connection between different phases of the menstrual cycle and food intake/food preferences (Saad and Stenstrom 2012; McNeil et al. 2013). Keeping this in mind, we only included women who were currently using hormonal birth control in an attempt to control for this. The study measured perceived stress and body image through questionnaires, and food intake/preferences were established by means of a food interview with the participant. We also obtained body weight and height measures in order to calculate BMI (Body Mass Index). Finally, we measured salivary cortisol, which is a physiological indicator of stress (Kirschbaum and Hellhammer 1989). All measurements occurred at two different time points during a college semester—one near the beginning of the semester to be associated with lower chronic stress, and the second at the end of the semester prior to final examinations to be associated with higher chronic stress. We hypothesized that salivary cortisol and perceived stress will be higher for the participants during the high stress measurement period compared to the low stress period. We also hypothesized that the high stress period, compared to the low stress period, will be associated with more body image dissatisfaction and a greater intake of high-fat, calorically dense "comfort" foods.

Methods

After receiving IRB approval for the project, seventeen female undergraduate students were recruited from St. Catherine University for the first time point of the study. Thirteen of the participants returned for the second time point in December. We mainly recruited participants by visiting classes or specific groups of students (i.e. the General Psychology lab instructors), explaining the study, and collecting contact information from those who were interested. We also sent out a mass email to the St. Kate's Honors students. Participants were only included if they were using hormonal birth control at the time of their enrollment in the study.

Measurements were taken at two separate time points during the semester. The first period of measurement (Time Point A; associated with low-stress) occurred between the third week of September and the first week of October. The second period of measurement was held in December during the two weeks prior to final examinations (Time Point B; associated with high-stress). In selecting the time frame for Time Point A, it was rationalized that students may tend to be more stressed at the beginning of the semester. However, once they have settled into their academic routine, but before examinations and mid-terms are upon them, their stress levels may in fact be lower (thereby leading us to collect our data during the third to fifth weeks of the semester). The time frame for Time Point B (two weeks prior to final examinations) was selected based the fact that several other studies examining stress have also used the final examination periods as a time point of higher stress. At each time point, the following measures were collected: perceived body image (survey), perceived acute and chronic stress (survey), food intake/preferences (interview), height, body weight, and salivary cortisol.

For each time point, every participant initially indicated their current level of stress on a Likert scale of 1-10. Salivary cortisol was measured using ELISA immunoassay kits from Salimetrics, Inc. Saliva was collected through the passive drooling method, and it was immediately frozen until the assay was run. Assay analysis was completed using a BioTek ELx800 microplate reader, Gen5 software, and the My Assays program. In order to control for circadian rhythm differences in cortisol levels, saliva was collected at approximately the same time of day for all participants across the two time points. After saliva collection, weight and height were measured in order to calculate BMI. Three questions were asked regarding the participants' use of birth control. These questions addressed the type of birth control, the type of cycle (21 vs 28 day, if applicable), and the current cycle day (if applicable). We used this information to match participants' hormone levels between the two time points, if possible. For example, if participants were currently on active hormones with their birth control during Time Point A, then they were contacted to return for data collection on a day when they would be on active hormones again for Time Point B. Conversely, if the participants were not on active hormones during Time Point A, they were asked to return for data collection during Time Point B on a day that they were not on active hormones.

Perceived body image and perceived stress were both measured using a survey format. The body image questionnaire was based on the Physical Appearance State and Trait Anxiety Scale by Reed, Thompson, Brannick, and Sacco (1991). The questionnaire breaks physical appearance down into several individual traits, and the participants ranked their level of anxiety for each trait from 0-4 (0 associated with no anxiety/dissatisfaction and 4 associated with almost constant anxiety/dissatisfaction). The rank for each trait was then totaled to provide the final body image score, with higher body image scores associated with greater anxiety/dissatisfaction regarding body image. The questionnaire about chronic stress was modified from the Undergraduate Stress Questionnaire by Crandall et al. (1992). The questionnaire consisted of 82 stressful events, and the students placed a checkmark next to any events that occurred in the past two weeks of the semester. A greater number of checkmarks indicated more chronic life-related stress.

Food intake/preferences were obtained for the participants through food interviews. The participants were given a piece of paper and a writing utensil, and they were asked to take as much time as they needed to list all the food and beverages they had consumed in the past 24 hours. Following this, the researcher then conducted a 'food interview,' during which the participant was asked for additional details and clarification about all the items that they listed. This was done in order to most accurately quantify the participant's food intake. The data from the food interviews was entered into Food Processor software, which quantified the total calories, fat (g), protein (g), carbohydrates (g), and sugar (g) for the 24-hour period for every participant. Regarding statistical analysis, paired t-tests were run in order to compare variables across the two time points. Regression analyses were also run to examine the relationship between the different variables.

Results

Stress and Salivary Cortisol

Salivary cortisol concentrations determined via ELISA immunoassay were not significantly different between Time Point B (late in the semester prior to final examinations) and Time Point A (near the beginning of the semester) (Figure 1, t-test, $p>0.40$). However, cortisol levels were higher during Time Point B than Time Point A. Scores of immediate stress as determined via Likert scale (from 1-10 with 1 being not stressed at all and 10 being extremely stressed) were significantly higher during Time Point B compared to Time Point A (Figure 2, t-test, $p<0.01$).

Regarding chronic stress scores, these data became complicated due to the fact that some participants filled out only one side of the two-sided survey. Therefore, Figure 3 is separated into three panels for the front side of the survey (A), the back side of the survey (B), and both sides of the survey (C). B and C both have smaller n values of nine instead of thirteen. Neither A, B, nor C show that chronic stress levels were significantly different between Time Point B and Time Point A (Figure 3, t-test, A: $p>0.28$, B: $p>0.08$, C: $p>0.07$). However, chronic stress levels were higher during Time Point B compared to Time Point A for all panels of Figure 3 (A, B, and C), with B and C showing p values less than 0.1. Lastly, the relationship between salivary cortisol concentration and chronic stress was not significant (Figure 4, $R^2 = 0.0408$, $p>0.42$). However, the relationship was weakly positive.

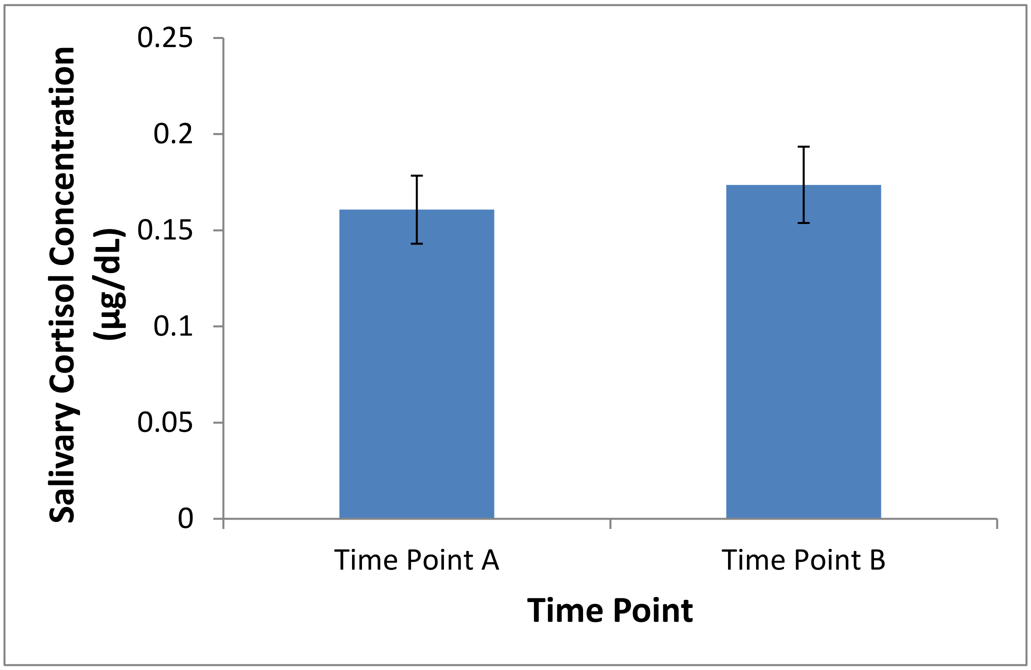

Figure 1: The effect of time point on salivary cortisol concentration (µg/dL). Saliva was collected from thirteen female undergraduate students during two different time points of a college semester. Time Point A occurred near the beginning of the semester, while Time Point B occurred late in the semester prior to final examinations. Salivary cortisol concentrations were determined using an ELISA immunoassay. Each bar represents the average salivary cortisol concentration for the given time point. Error bars represent ±1 standard error. Means were analyzed for significant differences (t-test, $p>0.40$).

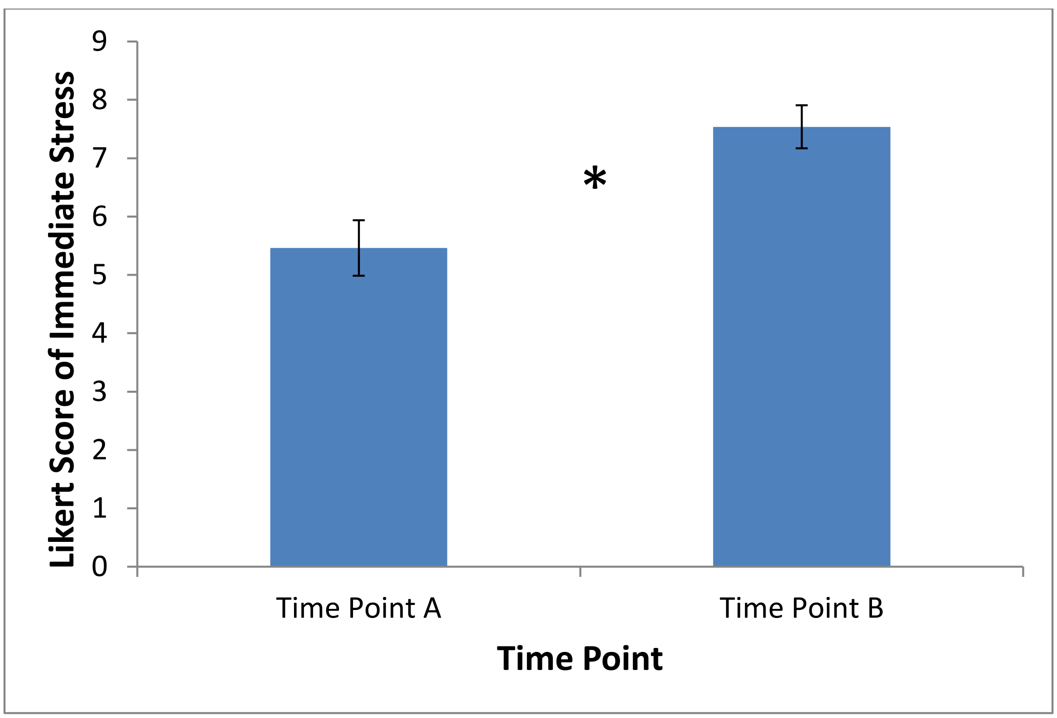

Figure 2: The effect of time point on Likert score of immediate stress. At two different time points of a college semester, thirteen female undergraduate students indicated their immediate level of stress on a Likert scale of 1-10, prior to beginning any other data collection procedures. Time Point A occurred near the beginning of the semester, while Time Point B occurred late in the semester prior to final examinations. Each bar represents the average Likert score of stress for a given time point. Error bars represent ±1 standard error. Asterisk (*) denotes a significant difference between means (t-test, $p<0.01$)

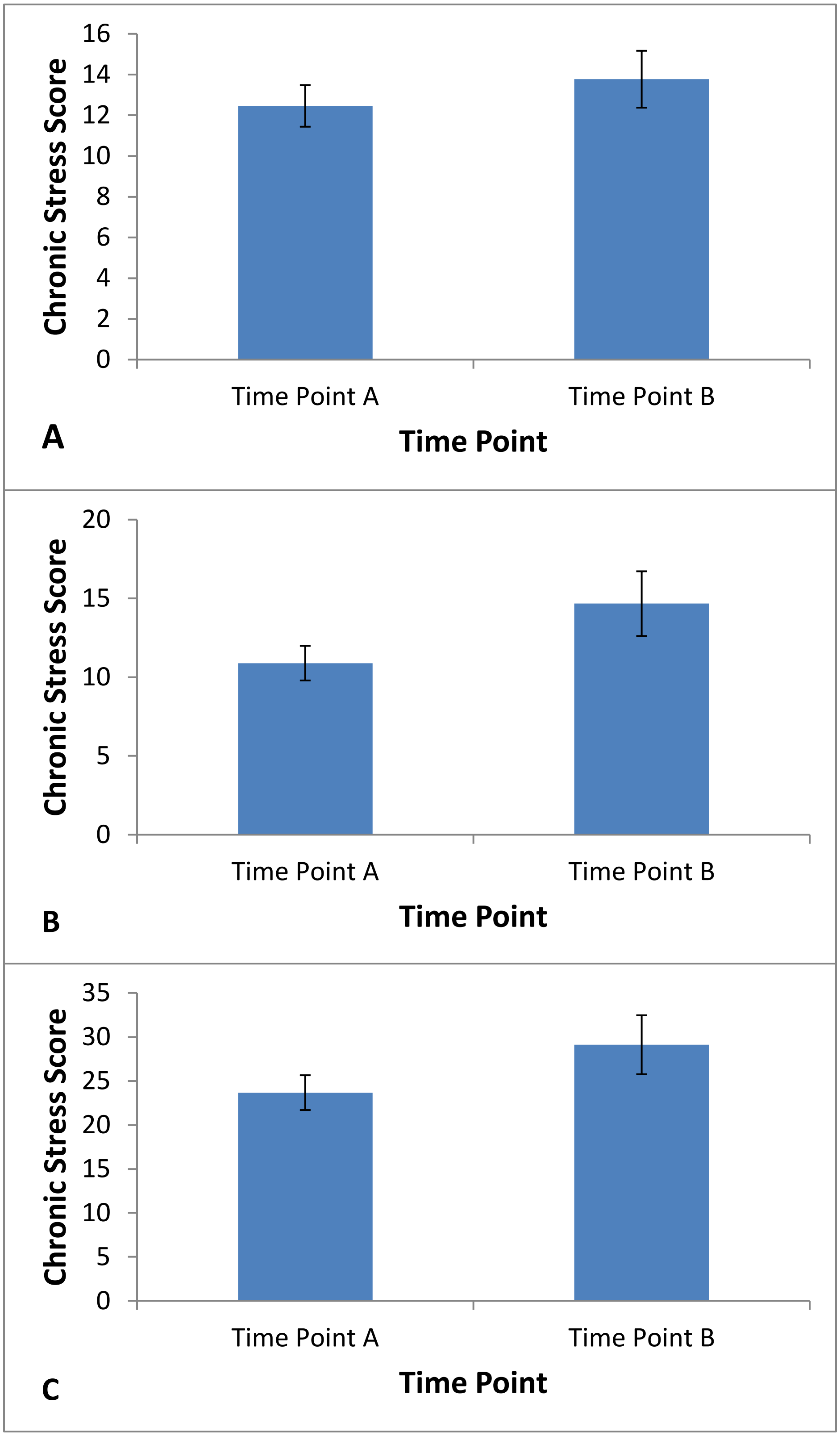

Figure 3: The effect of time point on chronic stress. At two different time points of a college semester, female undergraduate students filled out a survey which assessed their level of chronic stress. A higher score indicates greater chronic stress. Time Point A occurred near the beginning of the semester, while Time Point B occurred late in the semester prior to final examinations. **A** (n=13), **B** (n=9), and **C** (n=9) respectively show the average stress scores for a given time point for only the front side of the chronic stress survey, only the back side of the survey, and both sides of the survey. Error bars represent ±1 standard error. Means were analyzed for significant differences (t-test, A: $p>0.28$, B: $p>0.08$, C: $p>0.07$).

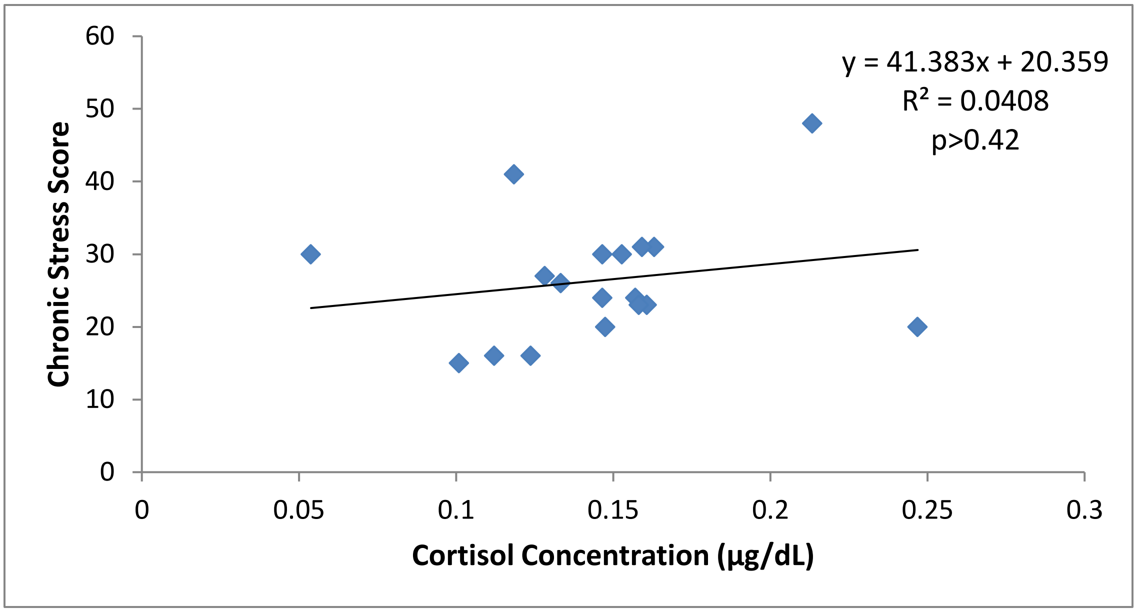

Figure 4: The relationship between salivary cortisol concentration (µg/dL) and chronic stress. At two different time points of a college semester, female undergraduate students filled out a survey which assessed their level of chronic stress. A higher score indicates greater chronic stress. Time Point A occurred near the beginning of the semester, while Time Point B occurred late in the semester prior to final examinations. The chronic stress scores are shown for those participants who filled out both sides of the survey (n=9). Corresponding salivary cortisol concentrations as determined via ELISA immunoassay are also shown. Each point represents an individual participant at either time point. The relationship between salivary cortisol concentration and chronic stress was analyzed using regression ($R^2 = 0.0408$, $p>0.42$).

Body Mass Index (BMI) and Body Image

BMI was not significantly different between Time Point A and Time Point B (Figure 5, t-test, p>0.58), but BMI was higher during Time Point B compared to Time Point A. Body image scores were not significantly different between Time Point A and Time Point B (Figure 6, t-test, p>0.5), but body image scores were slightly higher during Time Point A than Time Point B. There was not a significant relationship between BMI and body image (Figure 7, R^2 = 0.0702, p>0.19), but the relationship was weakly positive.

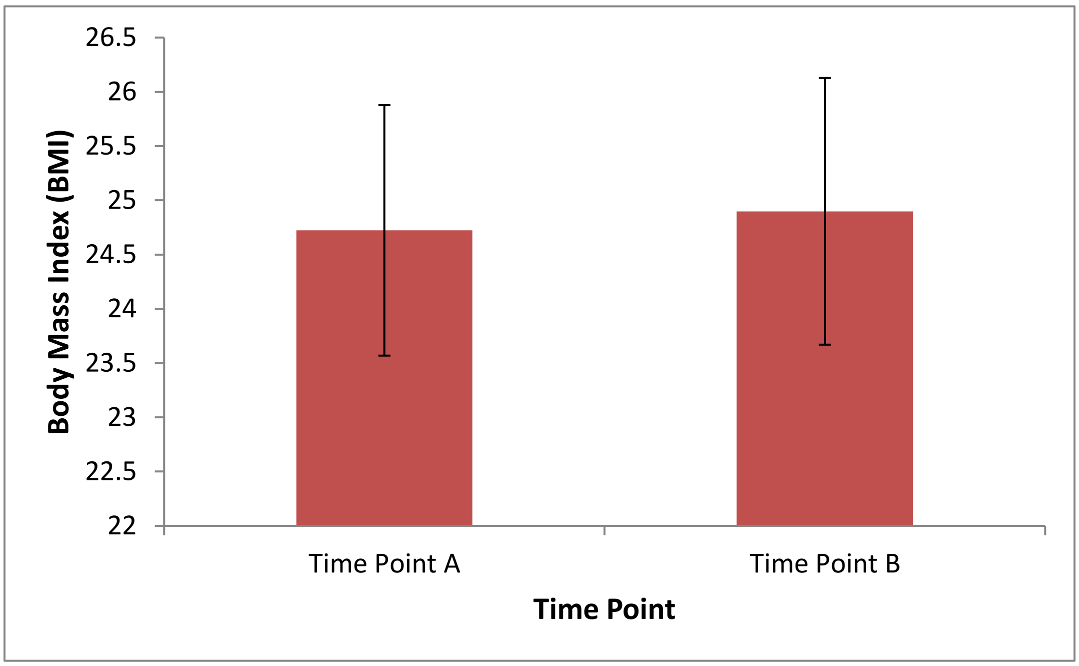

Figure 5: The effect of time point on body mass index (BMI). At two different time points of a college semester, weight and height measurements were obtained for thirteen female undergraduate students. Time Point A occurred near the beginning of the semester, while Time Point B occurred later in the semester prior to final examinations. BMI was subsequently calculated from weight and height, and each bar represents the average BMI for a given time point. Error bars represent ±1 standard error. Means were analyzed for significant differences (t-test, p>0.58).

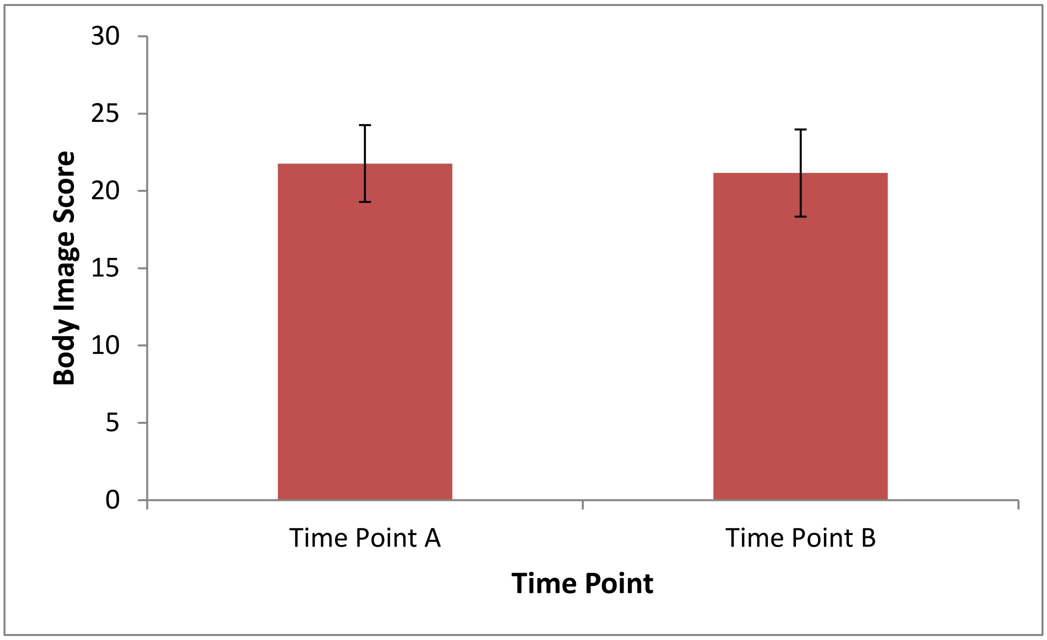

Figure 6: The effect of time point on body image score. During two different time points of a college semester, body image was determined for thirteen female undergraduate students using a survey. Time Point A occurred near the beginning of the semester, while Time Point B occurred later in the semester prior to final examinations. A higher body image score indicates greater anxiety and dissatisfaction regarding body image. Each bar represents the average body image score for a given time point. Error bars represent ±1 standard error. Means were analyzed for significant differences (t-test, p>0.5).

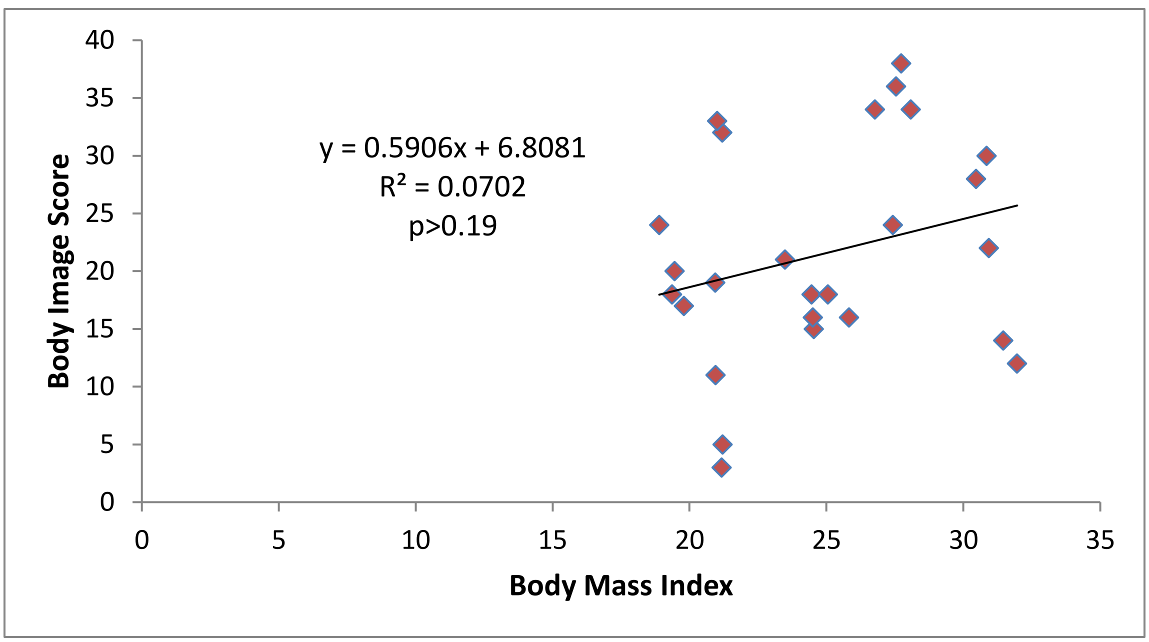

Figure 7: The relationship between body mass index (BMI) and body image. During two different time points of a college semester, weight and height were obtained from thirteen female undergraduate students, and BMI was calculated from these measurements. Body image scores were also obtained at two different time points of the semester via survey, with higher body image scores indicating greater anxiety/dissatisfaction regarding body image. Each point represents an individual participant at either time point. The relationship between BMI and body image was analyzed using regression ($R^2 = 0.0702$, p>0.19).

Food Intake and Food Preferences

For both time points of the semester, food intake and food preferences were determined via food interviews. The total calories consumed over the 24-hour period were not significantly different between Time Point A and Time Point B (Figure 8, t-test, $p>0.35$), but the total calories consumed were greater during Time Point A than Time Point B. Fat (g) consumed over the 24-hour period was not significantly different between Time Point A and Time Point B (Figure 9, t-test, $p>0.20$), but more fat was consumed during Time Point A than Time Point B. Protein (g) consumed over the 24-hour period was also not significantly different between Time Point A and Time Point B (Figure 10, t-test, $p>0.09$), but more protein was consumed during Time Point A compared to Time Point B. Carbohydrates (g) consumed over the 24-hour period did not differ significantly between Time Point A and Time Point B (Figure 11, t-test, $p>0.97$), and were in fact very similar between the time points. Lastly, sugar (g) consumed over the 24-hour period was not significantly different between the two time points (Figure 12, t-test, $p>0.64$), but more sugar was consumed during Time Point B than Time Point A.

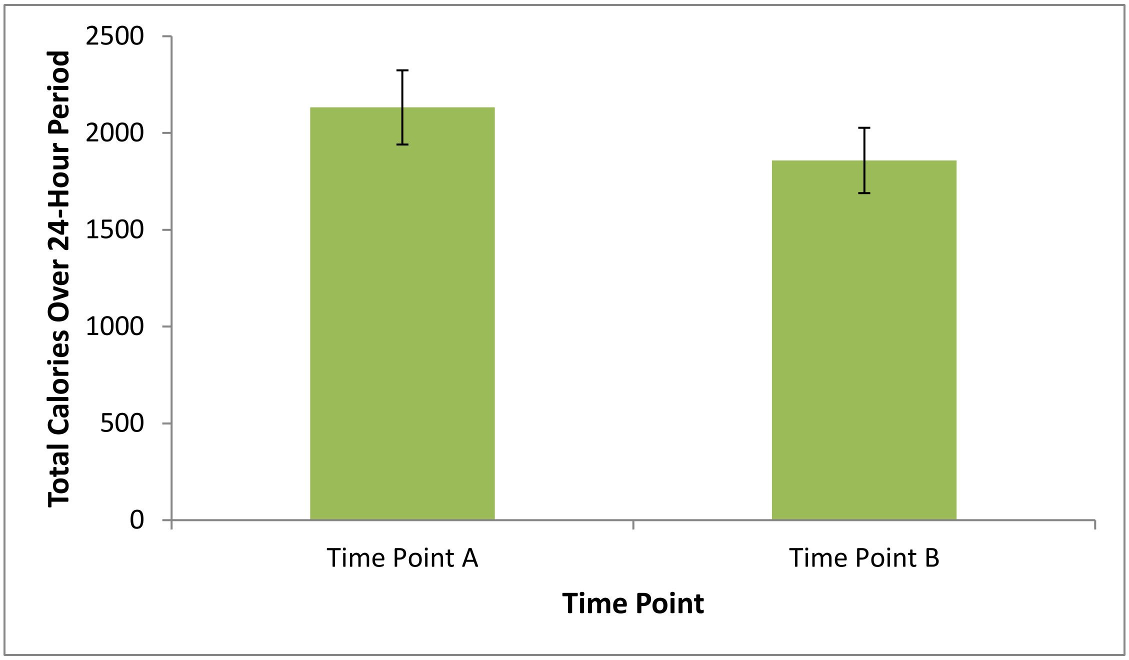

Figure 8: The effect of time point on total calories consumed over a 24-hour period. During two different time points of a college semester, food interviews were conducted with thirteen female undergraduate students in order to determine all food and beverages that were consumed over the past 24-hour period. Time Point A occurred near the beginning of the semester, while Time Point B occurred later in the semester prior to final examinations. All food and beverage items were analyzed using Food Processor software, which quantified the total number of calories consumed for the 24-hour period. Each bar represents the average calories consumed for a given time point. Error bars represent ±1 standard error. Means were analyzed for significant differences (t-test, $p>0.35$).

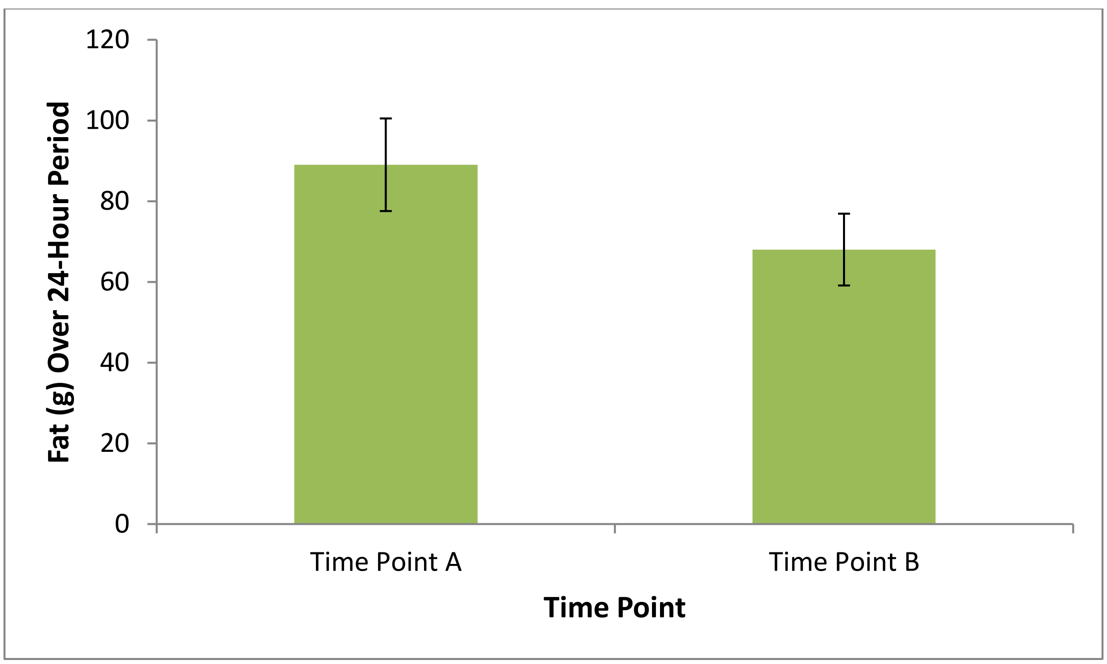

Figure 9: The effect of time point on fat (g) consumed over a 24-hour period. During two different time points of a college semester, a food interview was conducted with thirteen female undergraduate students in order to determine all food and beverages that were consumed over the past 24-hour period. Time Point A occurred near the beginning of the semester, while Time Point B occurred later in the semester prior to final examinations. All food and beverage items were analyzed using Food Processor software, which quantified the total amount of fat (g) for the 24-hour period. Each bar represents the average fat (g) consumed for a given time point. Error bars represent ±1 standard error. Means were analyzed for significant differences (t-test, $p>0.20$).

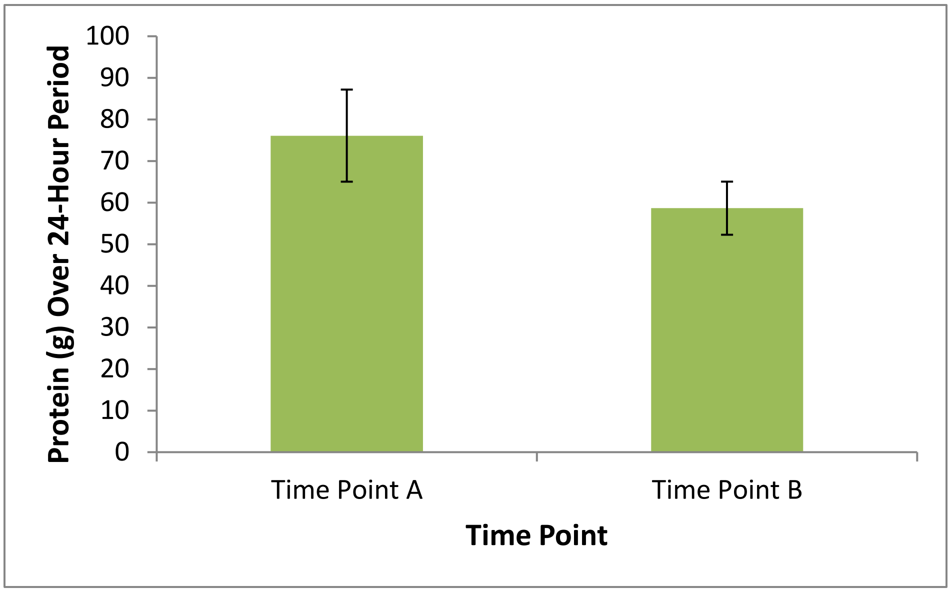

Figure 10: The effect of time point on protein (g) consumed over a 24-hour period. During two different time points of a college semester, a food interview was conducted with thirteen female undergraduate students in order to determine all food and beverages that were consumed over the past 24-hour period. Time Point A occurred near the beginning of the semester, while Time Point B occurred later in the semester prior to final examinations. All food and beverage items were analyzed using Food Processor software, which quantified the total amount of protein (g) for the 24-hour period. Each bar represents the average protein (g) consumed for a given time point. Error bars represent ±1 standard error. Means were analyzed for significant differences (t-test, $p>0.09$).

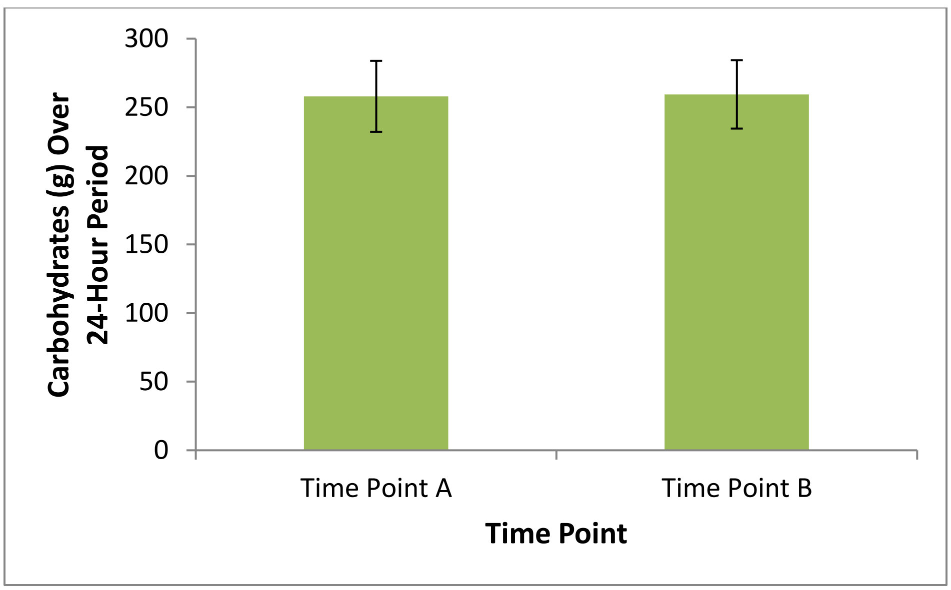

Figure 11: The effect of time point on carbohydrates (g) consumed over a 24-hour period. During two different time points of a college semester, a food interview was conducted with thirteen female undergraduate students in order to determine all food and beverages that were consumed over the past 24-hour period. Time Point A occurred near the beginning of the semester, while Time Point B occurred later in the semester prior to final examinations. All food and beverage items were analyzed using Food Processor software, which quantified the total amount of carbohydrates (g) for the 24-hour period. Each bar represents the average carbohydrates (g) consumed for a given time point. Error bars represent ±1 standard error. Means were analyzed for significant differences (t-test, $p>0.97$).

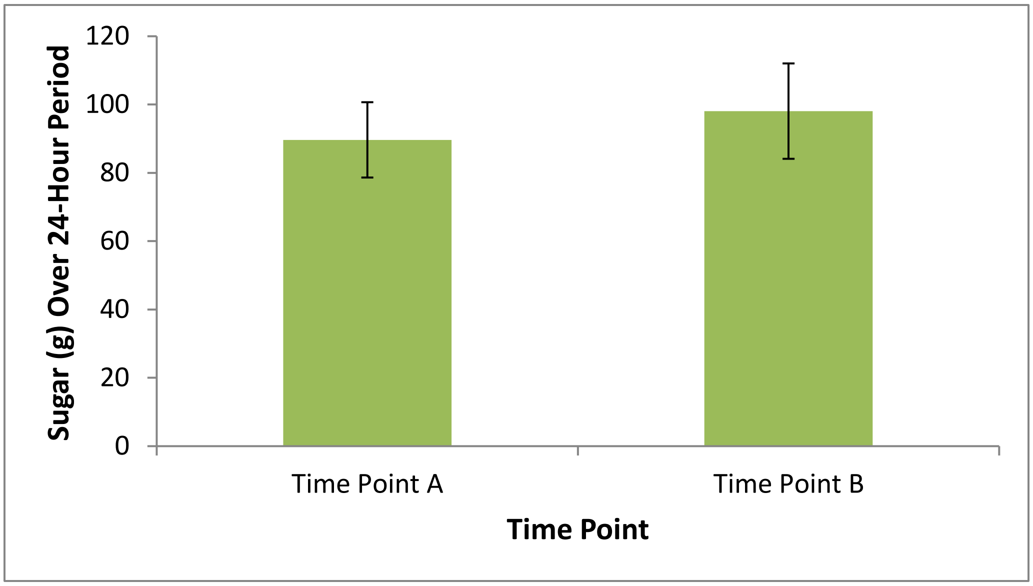

Figure 12: The effect of time point on sugar (g) consumed over a 24-hour period. During two different time points of a college semester, a food interview was conducted with thirteen female undergraduate students in order to determine all food and beverages that were consumed over the past 24-hour period. Time Point A occurred near the beginning of the semester, while Time Point B occurred later in the semester prior to final examinations. All food and beverage items were analyzed using Food Processor software, which quantified the total amount of sugar (g) for the 24-hour period. Each bar represents the average sugar (g) consumed for a given time point. Error bars represent ±1 standard error. Means were analyzed for significant differences (t-test, $p>0.64$).

Interactions Between Stress, Body Image, and Food Intake or Preferences

There was a significant positive relationship between salivary cortisol concentration (µg/dL) and body image score (Figure 13, $R^2 = 0.2006$, $p<0.05$). In contrast, the relationship between chronic stress score and body image score was negative but statistically insignificant (Figure 14, $R^2 = 0.0708$, $p>0.28$). The relationship between chronic stress and total calories consumed over a 24-hour period was not significant (Figure 15, $R^2 = 0.0016$, $p>0.87$). However, the relationship was very weakly positive. Lastly, the relationship between salivary cortisol concentration (µg/dL) and total calories consumed over a 24-hour period was not significant and very weakly negative (Figure 16, $R^2 = 0.003$, $p>0.78$).

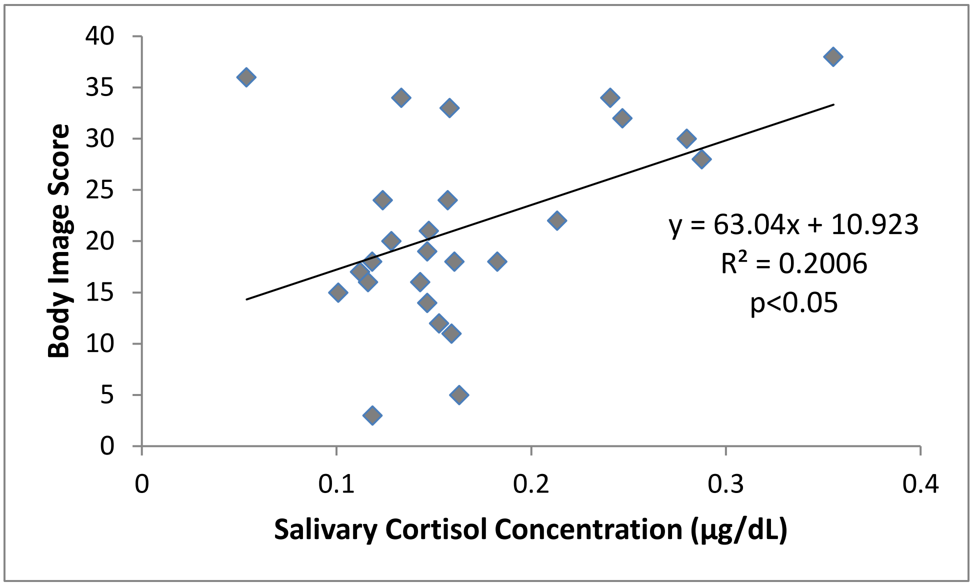

Figure 13: The relationship between salivary cortisol concentration (µg/dL) and body image. Saliva was collected from thirteen female undergraduate students during two different time points of a college semester. Time Point A occurred near the beginning of the semester, while Time Point B occurred late in the semester prior to final examinations. Salivary cortisol concentrations were determined using an ELISA immunoassay. Body image scores were also obtained at two different time points of the semester via survey, with higher body image scores indicating greater anxiety/dissatisfaction regarding body image. Each point represents an individual participant at either time point. The relationship between salivary cortisol concentration and body image was analyzed using regression ($R^2 = 0.2006$, $p<0.05$).

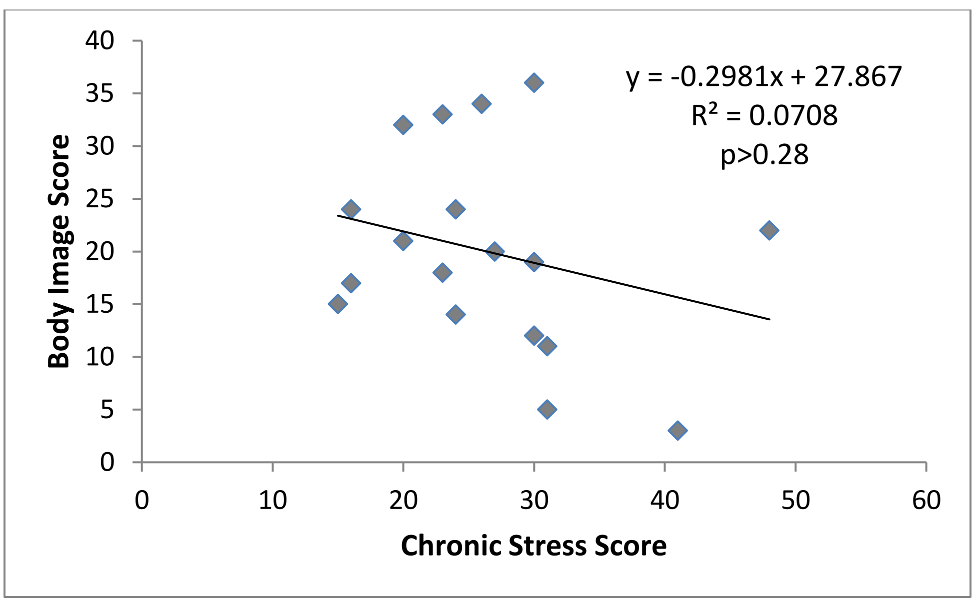

Figure 14: The relationship between chronic stress and body image. At two different time points of a college semester, female undergraduate students filled out a survey which assessed their level of chronic stress. A higher score indicates greater chronic stress. Time Point A occurred near the beginning of the semester, while Time Point B occurred late in the semester prior to final examinations. The chronic stress scores are shown for those participants who filled out both sides of the survey (n=9). Corresponding body image scores as determined via survey are also shown, with higher body image scores indicating greater anxiety/dissatisfaction regarding body image. Each point represents an individual participant at either time point. The relationship between chronic stress and body image was analyzed using regression ($R^2 = 0.0708$, $p>0.28$).

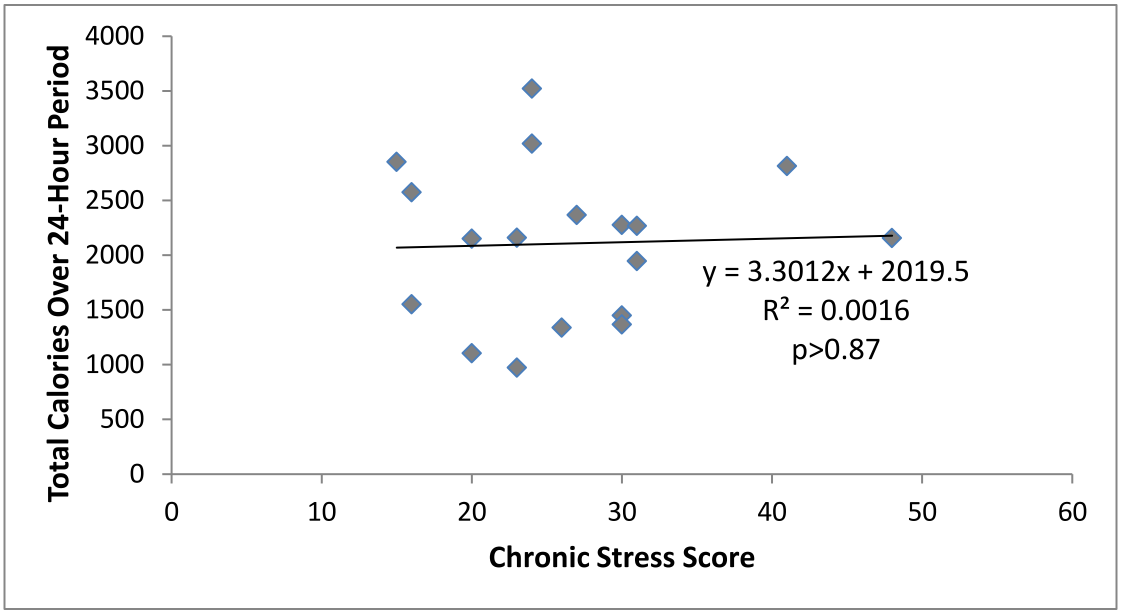

Figure 15: The relationship between chronic stress and total calories consumed over a 24-hour period. At two different time points of a college semester, female undergraduate students filled out a survey which assessed their level of chronic stress. A higher score indicates greater chronic stress. Time Point A occurred near the beginning of the semester, while Time Point B occurred late in the semester prior to final examinations. The chronic stress scores are shown for those participants who filled out both sides of the survey (n=9). Corresponding values for the total number of calories consumed over a 24-hour period (as determined via food interviews and Food Processor software) are also shown. Each point represents an individual participant at either time point. The relationship between chronic stress and total calories consumed over a 24-hour period was analyzed using regression ($R^2 = 0.0016$, $p>0.87$).

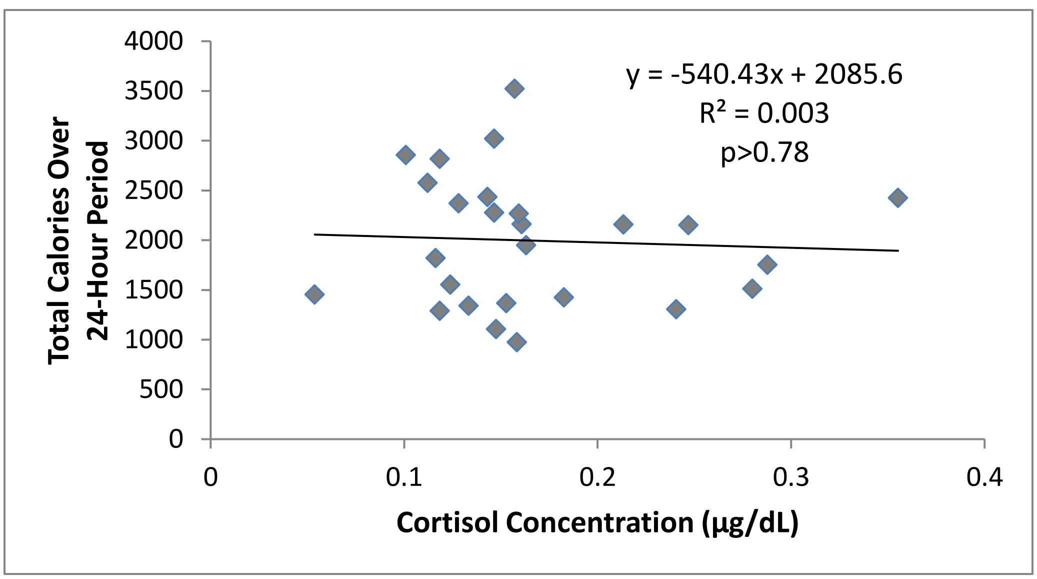

Figure 16: The relationship between salivary cortisol concentration (μg/dL) and total calories consumed over a 24-hour period. Saliva was collected from thirteen female undergraduate students during two different time points of a college semester. Time Point A occurred near the beginning of the semester, while Time Point B occurred late in the semester prior to final examinations. Salivary cortisol concentrations were determined using an ELISA immunoassay. Food interviews were conducted in order to determine all food and beverages that were consumed over the past 24-hour period. All food and beverage items were analyzed using Food Processor software, which quantified the total number of calories consumed for the 24-hour period. Each point represents an individual participant at either time point. The relationship between salivary cortisol concentration (μg/dL) and total calories consumed over a 24-hour period was analyzed using regression ($R^2 = 0.003$, $p>0.78$).

Discussion

The purpose of this study was to examine the relationship between chronic stress, body image, and dietary choices in undergraduate women. We hypothesized that salivary cortisol and perceived stress would be higher during the high stress time point (Time Point B) compared to the low stress time point (Time Point A). We also hypothesized that the high stress time point, compared to the low stress time point, would be associated with more body image dissatisfaction and a greater intake of high-fat, calorically dense "comfort" foods.

The results indicate that salivary cortisol and chronic stress levels were higher during Time Point B compared to Time Point A, but not significantly (Figures 1 and 3, t-test, $p>0.40$, A: $p>0.28$, B: $p>0.08$, C: $p>0.07$). The trend of higher levels of salivary cortisol and chronic stress during Time Point B than Time Point A was also nearing statistical significance in panels B and C of Figure 3. Lastly, Likert scores of immediate stress were significantly higher during Time Point B compared to Time Point A (Figure 2, t-test, $p<0.01$). These results are overall somewhat supportive of our hypothesis that Time Point B, which occurred in later in the semester (December) prior to final examinations, would serve as a period of higher stress compared to Time Point A.

Although the results are somewhat supportive of the hypothesis, the lack of statistical significance for salivary cortisol and chronic stress allows for dispute. It is quite possible that the chronic stress survey was not sufficient to capture the main differences in chronic stress that were expected between Time Point A and B. Mainly, the differences in chronic stress would most likely be within the academic domain for undergraduate students. Although the survey did include items related to academics, it did not include a way to indicate gradation of chronic stress within the academic domain. If the survey had been modified to include this, it may have more accurately captured chronic stress differences for undergraduate students over a semester. The validity of the stress measurements is also related to the relationship between chronic stress and salivary cortisol, which was positive but not statistically significant (Figure 4, $R^2 = 0.0408$, $p>0.42$). The positive relationship was expected, but we would likely expect it to be stronger. Much research supports the accuracy and validity of salivary cortisol as a biological indicator of stress (Vining et al. 1983). Therefore, one can either conclude that the stress the students underwent was not substantial enough to affect their cortisol or that there were issues with saliva collection or completion of the assay.

Neither BMI nor body image were significantly different between Time Point A and Time Point B, although BMI was greater during Time Point B compared to Time Point A (Figure 5, t-test, $p>0.58$). In contrast, body image scores were very slightly higher during Time Point A (Figure 6, t-test, $p>0.5$). The greater body image scores indicate more dissatisfaction/anxiety regarding body image. These results do not support the hypothesis that body image dissatisfaction would be greater with more stress. Body image seemed to be even less affected by time point than chronic stress or immediate stress (as determined via Likert scale), which indicates that body image may not be as greatly influenced by stress in this study. In contrast, other studies have shown that stress has a very notable impact on body image (Murray et al. 2011). Lastly, the relationship between body image and BMI was positive but not significant (Figure 7, $R^2 = 0.0702$, $p>0.19$). This fits with the results of other studies, which have shown that BMI and body image are not much related (Trindade and Ferreira 2015; Bibiloni et al. 2013). However, it is interesting that a positive relationship between BMI and body image was shown at all in this study, perhaps indicating that female undergraduate students' body image is more dependent on BMI.

Regarding food intake and food preferences, the total calories consumed over a 24-hour period were not significantly different between Time Point A and Time Point B (Figure 8, t-test, $p>0.35$). On average, though, more calories were consumed over the 24-hour period during Time Point A than Time Point B. Although not all stress measurements demonstrated significantly higher stress for Time Point B compared to Time Point A, there was overall a trend of greater stress during Time Point B. Therefore, this indicates that female undergraduate students in this study were likely consuming fewer calories on average when they were experiencing more stress.

Fat (g) consumed over the 24-hour period was not significantly different between Time Point A and Time Point B, but more fat was consumed during Time Point A (Figure 9, t-test, $p>0.20$). Also, more protein (g) was consumed over the 24-hour period during Time Point A, and this difference was somewhat nearing statistical significance (Figure 10, t-test, $p>0.09$). In contrast, carbohydrates (g) consumed over the 24-hour period showed very little difference between Time Point A and B (Figure 11, t-test, $p>0.97$). Lastly, sugar (g) consumed over the 24-hour period was not significantly different between Time Point A and Time Point B, but more sugar was consumed during Time Point B (Figure 12, t-test, $p>0.64$). As a whole, these results show that the undergraduate students' diets were somewhat affected by chronic stress. Less fat but more sugar was consumed with more stress, and less protein was also consumed with more stress. As a general trend, these results somewhat support the original hypothesis. We would have expected fat and sugar consumption to be significantly greater with more stress, but stress itself was not significantly greater during Time Point B for all stress measurements. We also would have expected protein consumption to be greater with less stress, which is somewhat supported by our results.

The relationship between salivary cortisol concentration (μg/dL) and body image score was positive and significant (Figure 13, $R^2 = 0.2006$, $p<0.05$). In contrast, the relationship between chronic stress score and body image score was negative and not significant (Figure 14, $R^2 = 0.0708$, $p>0.28$). As a higher body image score is indicative of more body image dissatisfaction, the significant positive relationship between salivary cortisol and body image score supports our hypothesis, while the negative and non-significant relationship between chronic stress score and body image score does not. Lastly, the relationships of chronic stress score and salivary cortisol concentration to the total calories consumed over a 24-hour period were both non-significant with high p values (Figures 15 and 16, $R^2 = 0.0016$ and $R^2 = 0.003$, $p>0.87$ and $p>0.78$). This indicates that stress was not significantly associated with the total calories consumed, which is not supportive of our original hypothesis.

In examining the interaction between chronic stress, body image, and dietary choices, we find that female undergraduate students were not as susceptible to stress differences between the two time points as expected. However, the overall trend with stress measurements did support that the students experienced more stress during Time Point B. Body image dissatisfaction was not affected by time point, which does not support our hypothesis that more stress would lead to more body image dissatisfaction. The relationship between salivary cortisol and body image dissatisfaction was significant and positive, however, which supports the hypothesis. Regarding dietary choices, none of the results were significant. However, summarizing the data demonstrates that the students ate fewer total calories, less fat, less protein, very similar carbohydrates, and more sugar during Time Point B, the time point of higher stress. From a broad perspective, the results are mostly not supportive of the original hypothesis. We hypothesized that stress would be greater during Time Point B compared to Time Point A, which was only somewhat supported. We hypothesized that body image dissatisfaction would be significantly greater for Time Point B compared to Time Point A, which was not supported. Lastly, we hypothesized that students would consume more calorically-dense and high fat foods during Time Point B, which would have been supported if they had consumed more calories, more fat, more sugar, and less protein during Time Point B. The results only partially support this.

In terms of limitations to our study, one of the most important considerations is related to seasonal differences in food intake. Research has found that people tend to consume more calories during autumn or colder seasons (de Castro 1991), and we were not able to control for seasonal changes in this study. It is very possible that this may have affected the food-related measurements. Also, the method of quantifying food intake for this study was very likely to be flawed. The participants were self-reporting their food and beverage consumption over a 24-hour period, which always leaves the possibility of inaccurate memory or false reporting. The process of quantifying the food items was also susceptible to inaccuracy, as most participants could only provide an estimation of quantity. Converting the participants' quantity estimates into Food Processor software was also estimated and imperfect, which acts as another level of potential error. Overall, a more accurate record of food intake and food preferences would be a long-term food journal. Further research into the interaction of chronic stress, body image, and food intake/preferences ought to utilize a long-term food journal, control for seasonal changes, and include gradations in chronic stress within the academic domain if the study is being conducted with undergraduate students. Careful control for menstrual hormones is also important for female participants, though the validity of this study's control attempts in this area could not be analyzed.

From a broader perspective, continuing this research of chronic stress, body image, and food choices in female undergraduate students is very important, as, arguably, this population is quite vulnerable in these areas. College is a stressful environment, and many students struggle with stress management. In light of this, it is very easy to develop poor dietary habits. Body image is also a point of struggle for many young women, and it is very important to highlight the potential connection between chronic stress and body image. In this high-stress environment, female college students may be more vulnerable to making unhealthy food choices and developing low self-esteem and poor body image. It is possible that these factors could continue to play off of each other in order to worsen a student's health. Therefore, it is very important to understand these issues so that appropriate resources can be available for students in order to support health improvement, stress management, and strong self-esteem.

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