COVER SHEET

TITLE: Relationship of Mindful Eating with Healthy Lifestyle Factors and Emotion

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The Relationship of Mindful Eating with Healthy Lifestyle Factors and Emotion

There is growing interest in dispositional mindfulness and its impact on health and well-being. Mindful eating may be a component of maintaining healthy lifestyles. 143 college students completed a mindful-eating questionnaire (MEQ), 3-day dietary intake and physical activity recall, and measure of emotions. MEQ scores were higher among participants with a healthy BMI compared to unhealthy BMI. Only the emotional subscore of mindful eating (MEQ-EM) was positively correlated with dietary quality with marginal significance. Higher levels of positive emotion were significantly directly correlated with higher MEQ-EM score, better dietary quality, and higher levels of physical activity. Findings were supportive of the significance of a mindful eating component in healthy lifestyles. An intervention-based study is necessary to determine sequential relationship of these factors.

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May 9, 2014
The Relationship of Mindful Eating with Healthy Lifestyle Factors and Emotion

Senior Honors Thesis

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Introduction

Theoretical Basis of Mindfulness and Mindful Eating

The prospects of therapeutic uses of mindfulness practice in healthcare have been under increased interest in the past 30 years (Ludwig & Kabat-Zinn, 2008). Meta-analyses of previous research reveal successful use of meditation and mindfulness practices in treating a wide range of psychological and physical health conditions, including cardiovascular disease, blood pressure, substance abuse, and obesity (Ospina et al., 2007; Balaji et al., 2012). Cultivating mindfulness is becoming more accessible and prevalent in society, through programs such as mindfulness-based stress reduction, mindfulness-based cognitive therapy, or community mindfulness-meditation groups led by certified instructors. These practices may reduce depression, anxiety, and stress according to a review of current literature (Marchand, 2012).

Mindfulness is a universal human capacity and a way of living moment-to-moment which Ludwig and Kabat-Zinn define as attending to relevant aspects of experience in a nonjudgmental manner (2008). This trait may be exhibited through dispositional mindfulness, the level of awareness during everyday activities, or through state mindfulness, during or subsequent to meditation practices (Cahn & Polich, 2006).

When translating this concept of mindfulness to the context of nutrition, “mindful eating” refers to a nonjudgmental awareness of physical and emotional sensations while eating or in a food-related environment (Framson et al., 2009). An analysis of the constructs of mindful eating leading to the development of a questionnaire-based standardized measurement for mindful eating, focused on five constructs. “Disinhibition” refers to the ability to limit intake of foods, especially when palatable food is in abundance. “Awareness” is noticing and appreciating subtle flavors and textures in food. Mindful eating involves noticing when one is eating due to
"External Cues" other than hunger. Specifically, "Emotional Response" refers to eating behaviors driven by either positive or negative emotions. "Distraction" is the tendency for one’s mind to wander or engage in multitasking while eating.

Demand for Novel Interventions

Mindful eating may offer insight on improving health lifestyles on a population level. Not only are more than two-thirds of the current U.S. adult population overweight or obese, but nearly one in three children also fall into these categories (Flegal et al., 2010). In spite of the growing amount of research supporting the significance of mindfulness in obesity treatment and other health outcomes (Dalen et al., 2010; Kristellar & Hallet, 1999), none of the action initiatives detailed in the May 2010 report from the White House Task Force on Childhood Obesity directly attempt to foster mindful eating practices. A better understanding of the role mindful eating plays in helping individuals achieve and maintain a healthy weight, dietary intake, and state of well-being may reveal another critical component of the plan to address obesity and improve dietary quality of the population.

In addition to obesity, healthy lifestyle habits including physical activity and dietary intake are modifiable risk factors of many age-related diseases, such as cardiovascular disease, certain cancers, and diabetes. 8 of the 10 most common causes of death in the U.S. are at least partially linked to nutrition, as ranked by the 2010 report on deaths from the Center for Disease Control. Associations between mental health and many of the same chronic diseases linked to nutritional factors have been supported by previous literature (Chapman et al., 2005), suggesting emotion may be an important component in interventions for healthy lifestyle behaviors. Preventative care and lifestyle modification have the potential to cut costs to the healthcare
system, as evidenced by a $3.14 median cost-to-benefit ratio of corporate health promotion programs (US. Dept Health and Human Services, 2003).

Etiology of Obesity and Mechanisms of Mindful Eating

A study that analyzed common behaviors and traits of members of the National Weight Control Registry may show how mindful eating may supplement common approaches to healthy lifestyle modification (Wing & Phelan, 2005). This registry includes people who lost an average of 33 kg and maintained the loss for more than five years. Members reported engaging in high levels of physical activity, eating a low-calorie, low-fat diet, eating breakfast regularly, self-monitoring weight, and maintaining a consistent eating pattern across weekdays and weekends. Common traits were having low levels of depression and impulsivity. This may support the role of positive emotion and the mindful-eating construct of disinhibition in long-term weight management.

Impulsivity has been reported as a common trait among obese individuals. A study of both obese and healthy-weight individuals utilized a discount delay task involving a food reward to examine the impact of mindfulness training on impulsive choices for food (Hendrickson & Rasmussen, 2013). High percent body fat individuals had steeper discounting curves, suggesting obese individuals displayed more impulsive choices for food than healthy-weight individuals. Participants who underwent a mindful eating intervention displayed significantly more self-controlled and less risk-adverse discounting patterns than baseline, which suggests mindful eating may specifically address the impulsivity component of obesity etiology.

Chronic stress may also be a causal factor of obesity. Cortisol, a stress hormone, may impact metabolism by fat tissue, resulting in increased upper-body obesity (Holmes et al., 2010).
A study conducted by Ruttle et al. (2013) investigated concurrent and longitudinal levels of diurnal cortisol in relationship to BMI in adolescents. Findings suggested the association between cortisol and BMI is developmentally influenced. Findings of lower levels of pro-inflammatory gene expression in experienced mindfulness-meditators, which correlates with faster physical recovery from a stressful situation, may suggest a biochemical mechanism of mindfulness in reducing obesity (Kaliman et al., 2014).

The relationship between emotion or mood disorder and obesity has been previously studied. Obese women have a 25% greater risk of developing depression in their lifetimes than the general population, and this association was stronger in women than men (Simon et al., 2006). Increased risk in both genders also existed for bipolar disorder, panic disorder, and agoraphobia. Overeating may involve using food as a relief or distraction from painful emotions (Wiser & Telch, 1999). Kumar et al. (2008) examined mindfulness-based cognitive therapy as an intervention that resulted improvements in emotion regulation.

Several proposed constructs of mindful eating could improve dietary quality as well as decrease obesity rates. Mindfulness may cultivate the ability to notice when internal satiety signals cue the ceasing of food intake. A study by Wansik et al. (2004) suggested that mindfulness while eating could inform an individual’s awareness of having eaten enough. Also, mindful awareness allows for a sense of presence in a given experience. A study that correlated listening to music while eating with increased food intake suggested distractions or mindlessness at meal times may be a factor of food intake amounts (Stroebele & de Castro, 2006).

Mental imagery has also been demonstrated to have a significant effect on food intake. A study by Morewedge, et al. (2010) had participants imagine eating a large amount of candy, which subsequently reduced the amount of candy actually consumed in comparison to
participants who only imagined eating a small amount of candy. This suggests that habituation to a food resulting in less desire for consumption can be induced by top-down mental processes, such as imagery, without pre-ingestive sensory stimulation. Therefore, cognitive processes are likely to play a significant role in controlling appetite. Furthermore, this may rationalize a possible mechanism for a link between mindful eating and healthy diet. Mindful eating training may improve conscious volitional control over food intake. For example, one may determine a goal such as “I want to eat for better health,” and realize this through conscious choices of consuming more fruits and vegetables. Being mindful focuses attention on automatic thoughts and emotions and promotes development of new, more adaptable responses (Greensonne, 2009).

Current Research on Applications of Mindful Eating

Recently, mindful eating interventions have become prevalent in treatment of eating disorders. Previous studies have targeted binge eating. Mindfulness-Based Eating Awareness Training is a nine-week program that incorporates hunger and satiety meditations, as well as meditations on forgiveness and connecting with our inner wisdom. Following the training, participants reported reduction in frequency and severity of binge-eating episodes (Kristeller, 2010). Given that 30% of obese individuals in treatment programs reported binge-eating behaviors (Spitzer et al, 1993), mindfulness-eating interventions may hold great promise for decreasing obesity rates. Further investigation is necessary to determine whether mindful eating practices are related to success in weight loss or weight management in those with subclinical levels of unhealthy eating behaviors.

Little research exists on the role of mindful eating in obesity prevention and overall health in a general population. A study published by Murphy et al. in 2012 indicated that higher
levels of mindfulness among college-aged women were related to healthier eating practices and better overall physical health, and mindfulness predicted physical health status above and beyond the contribution of healthy eating or sleep quality. Mindful eating fully mediated the negative association between everyday mindfulness and serving size of energy dense foods, which shows mindful eating may have greater impact on weight management than a general state of mindfulness (Beshara et al., 2013).

Another study that analyzed mindful eating in a general population looked at the relationship with serving size of energy-dense foods. Self-report measures on dispositional mindfulness, mindful eating using the MEQ, and serving size estimates showed that greater levels of both mindfulness and mindful eating were related to significantly smaller serving sizes, and mindful eating mediated the negative association between everyday mindfulness and serving size (Beshara et al., 2013). Specifically, emotion and disinhibition subscales of mindful eating were most strongly related to serving size. This supports the application of mindful eating skills in the prevention of obesity, and suggests the specific role of emotion in regulating eating behaviors needs to be investigated.

We aim to further understand this link between mindfulness and healthy lifestyle factors of dietary intake, exercise, and body mass index (BMI). Our methods aim to reveal if mindful eating and its constructs correlate with one’s likeliness to improve his/her dietary intake of nutrients. We also aim to determine the strength of various predictors of body mass index, useful for treatment approaches of obesity. This study used survey responses to score individuals on measures of mindful eating, body mass index, nutrient intakes, and physical activity levels. A measurement of levels of positive and negative emotion addresses the overall goal that both
mindful eating and maintaining a healthy weight range will lead to an improved sense of well-being.

Methods

Data Collection

162 undergraduate students at University of Wisconsin-Madison voluntarily participated in the study, and 143 of these students completed the study. Average age was 19 (SD = 1.7) and ranged from 18 to 35. 83 were female and 59 were male, 1 student did not designate gender. Upon enrollment in an introductory psychology course, students were given access to the survey website to access university-based psychology studies. Enrollment for the study was open for 45 days, from late March until early May of 2013. No active recruitment or advertisements were used; participants were only aware of the study as it appeared in the list of available study opportunities on the website.

Participation in these studies is not a course requirement, and extra credit points are awarded by a consistent rate per estimated time for each study. Subjects viewed the mindful eating questionnaire (MEQ) and demographics survey as one study. Estimated time of completion was 20 minutes, and 1 extra credit point was awarded. The 3-day dietary recall, physical activity log, and I-PANAS-SF appeared as another study. Upon completion of the first study, the second study was available to them in the list of participation opportunities on the website. Estimated time of completion was a half hour to complete the surveys each day, and 6 extra credit points were awarded if the participant completed all required activities. No points were awarded for partial completion. This study design was developed in attempt to prevent biased responses.
Survey Measures

Demographics

The demographics questionnaire was composed expressly for the purpose of this study. Participants reported height, weight, age, and two most common resources they use for food (dining hall, fast food, pre-prepared/frozen meals, cook for themselves, parents’ home, or other). To improve reliability of self-reported height/weight, participants reported both current height/weight and as listed on their driver’s license, as well as the issue date of their license.

Mindful Eating Questionnaire (MEQ)

The MEQ is a validated, 28-item questionnaire that assessed how well participants incorporate the five domains of mindful eating (disinhibition, external cues, awareness, emotional response, and distraction) into their dietary and eating habits (Framson et al., 2009). Five domain subscales were averaged for the total score, which ranged from 1 to 4. Participants were asked to identify with statements such as “I stop eating when I’m full, even when eating something I love,” or “I notice when there are subtle flavors in the foods I eat.” Higher scores suggested more mindful eating behaviors. MEQ total score showed weak internal consistency (α = .62). Only disinhibition (α = .76) and emotional response (α = .72) subscores of MEQ had reliable internal consistency.

Dietary Recall

The United States Department of Agriculture (USDA) SuperTracker website (USDA, 2013) allows participants to report their complete dietary intake and physical activity at the end of two separate weekdays (Monday-Thursday) and one weekend day (Friday-Sunday). After
selecting foods consumed from a list of common food items and specifying the amount, the system uses a nutrient database to calculate the nutrient and calorie intake. The average consumption of nutrients across each food group was used for the evaluation of his/her HEI score.

*Healthy Eating Index (HEI)*

The HEI is a density-based measure of diet quality developed by the USDA that assessed conformance to federal dietary guidelines across 12 components: total fruit, whole fruit, total vegetables, beans and greens, whole grains, dairy, total protein foods, seafood and plant proteins, fatty acids, refined grains, sodium, and empty calories (Guenther et al., 2007). The HEI has two categories of adequacy (sum of the first nine components), and moderation (sum of the last three components).

*Physical Activity and Moderate Intensity Exercise (MIE) Minutes*

Participants used SuperTracker to record 3 days of physical activity by selecting from an extensive list of activities and indicating duration. Supertracker database ranked each activity as light, moderate, or intense and estimated calories burned. Physical activity was summarized by a moderate intensity equivalent (MIE) minute total.

*International Positive and Negative Affect Schedule – Short Form (I-PANAS-SF)*

The I-PANAS-SF measured participants’ state of well-being as reported after completion of each of three dietary recall days. Negative emotion was measured as afraid, ashamed, hostile, nervous, and upset, and positive emotion was measured as active, alert, attentive, determined,
and inspired. Participants used a 5-point Likert-type scale to rank the extent to which they generally feel these terms apply to his/her self (Thompson, 2007). A higher score suggests greater frequency of positive or negative emotion. Both positive ($\alpha = .75$) and negative emotion ($\alpha = .77$) showed good internal consistency.

Data Analysis

Data was compiled and analyzed using SPSS predictive analytics software. A two-tailed Pearson’s correlation analysis was used to assess the relation between mindful eating and healthy lifestyle variables. A multiple hierarchical regression examined predictors of positive emotion as well as mediation models. Independent sample t-test compared BMI categories to determine the predictive strength of these variables on a healthy weight range. The Baron & Kenny (1986) test of mediation was used for examining the relationships among healthy eating, mindful eating, and positive emotion.

Results

Descriptive Statistics of Variable Measures

Mean values for MEQ and I-PANAS-SF fell within standard deviation of values reported in previous literature (Framson et al., 2009; Thompson, 2007). HEI score ($M = 57.4$, $SD = 15.2$) was higher than average among US population sample of those 2-years or older (Guenther et al., 2013). BMI ($M = 22.9$ kg/m$^2$, $SD = 3.3$) was lower than national average. Average daily calorie intake ($M = 1578$ calories, $SD = 545$) was lower than expected energy requirement for adults, according to the Dietary Guidelines for Americans (2010). Self-report of current BMI ($M = 22.9$ kg/m$^2$, $SD = 3.4$) was significantly higher than self-report of BMI using height and weight as
listed on most recent identification card ($M = 22.2$ kg/m$^2$, $SD = 3.1$, $t(129) = -6.95, p < .001$).

Self report of current BMI was used in subsequent data analyses.

**Correlations of Mindful Eating Questionnaire Scores (MEQ) and Healthy Lifestyle Factors**

There were no significant correlations between MEQ total score and HEI total score or subscores. The correlation of MEQ total score and HEI moderation score was marginally significant ($r = .156, p = .064$). MEQ total score was inversely correlated with negative emotion ($r = -.171, p < .05$), but was not correlated with positive emotion. MEQ did not correlate with BMI or physical activity as linear variables.

MEQ emotional subscale (MEQ-EM) showed multiple significant correlations with HEI scores and emotions. Higher MEQ-EM score positively correlated with higher score on the empty calorie category, signifying a lower intake of empty calories in proportion to total calories ($r = .16, p < .05$). However, higher MEQ-EM score was positively correlated with a higher total calorie intake ($r = .18, p < .05$). Higher MEQ-EM score was negatively correlated with higher level of negative emotions ($r =-.028, p<.001$) and positively correlated with higher level of positive emotions ($r = .17, p < .05$). Higher MEQ-EM score was directly correlated with marginal significance to higher HEI score ($r = .16, p = .057$). See Table 2.

**Comparison of Healthy and Unhealthy Body Mass Index Ranges**

When participants were grouped by healthy ($\geq 18.5$ and $<25$) and unhealthy ($<18.5$ or $\geq 25$) BMI ranges, those in the healthy category ($M = 2.71$, $SD = .26$) had significantly higher MEQ scores than those in the unhealthy category ($M = 2.60$, $SD = .25$, $t(141) = 2.11, p < .05$). This difference was marginally significant when the 5 underweight participants were excluded.
from the unhealthy BMI category, the mean MEQ scores remained relatively the same (healthy BMI MEQ score $M = 2.71$, $SD = .26$; unhealthy BMI MEQ score $M = 2.60$, $SD = .25$, $t(135) = 1.93$, $p = .055$).

Differences also existed between BMI groups in MEQ subscores of disinhibition and distraction. As reported in Table 3, participants with a healthy BMI had a higher average MEQ-disinhibition score and higher MEQ-distraction score compared to those with an unhealthy BMI.

Correlations of Positive and Negative Emotion and Healthy Lifestyle Factor

Correlations between positive emotion, but not negative emotion, and dietary intake showed significant relationships. Higher level of positive emotions was directly related to higher HEI total score. Higher level of positive emotions was directly related to higher HEI score of adequacy, or how well they incorporated higher levels of healthy foods like fruit, whole grains, seafood, and protein ($r = .27$, $p < .001$), rather than moderation of unhealthy foods. There was a significant direct correlation between higher level of positive emotions and physical activity ($r = .207$, $p < .05$). There were no significant associations between BMI and emotion. See Table 2.

Healthy Eating as Mediator between Mindful Eating and Positive Emotion

Using Baron & Kenny’s 4-step model (1986), mediation analyses were tested by regression analysis for various mediation models using Mindful Eating-Emotion, healthy eating, and positive emotion. Because the linear regression between Mindful Eating-Emotion (MEQ-EM) and HEI score was marginally significant ($r = .16$, $p = .057$), and between HEI and frequency of positive emotion was significant ($r = .23$, $p < .01$), mediation analyses were tested.
The relationship between MEQ-EM and positive emotion \( (r = .169, p < .05) \) decreased and was no longer significant when healthy eating was added to the model \( (r' = .12, p = .10) \). Similarly, average intake of fruits and vegetables caused the relationship between MEQ-EM and positive emotion to decrease and become insignificant \( (r' = .10, p = .04) \). The significance of mediation effect was not supported by Sobel’s test, but the latter model was marginally significant \( (S = 1.56, p = .12 \) and \( S = 1.89, p = .059, \) respectively). Percent mediation as defined by the strength of the indirect effect was 18% for HEI as the mediator, and 22% for average fruit and vegetable intake as the mediator (See Figures 1 and 2).

Predictors of Positive Emotion

A multiple hierarchical regression was used to examine what healthy lifestyle factors were predictors of a higher frequency of positive emotion. In block 1 of the analysis, MEQ-EM was independently predictive of higher levels of positive emotion \( (\beta = .17, p < .05) \) \( F(4.05) = 4.15, p < .05, R^2 = .028 \). In block 2, adding HEI scores to the model showed healthy eating was a significant predictor, but mindful eating was no longer a significant predictor of positive emotion \( (F(5.22) = 5.22, p < .05, R^2 = .071) \). Physical activity was added in the block 3, demonstrating HEI \( (\beta = .19, p < .05) \) and physical activity \( (\beta = .16, p < .05) \) were predictive of positive emotion, but mindful eating remained an insignificant predictor of positive emotion \( (F(4.83) = 4.83, p < .05, R^2 = .096) \). See Table 4.

Gender Differences

Differences by gender of variables used in above analyses were examined using an independent samples t-test. All variables were independent of gender effects other than BMI and
MEQ-EM. Males had a higher BMI ($M = 24.0, SD = 3.6$) than females ($M = 22.2, SD = 3.0$, $t(128) = -3.33, p < .001$). Males were also less likely to eat in response to emotions and reported a higher MEQ-EM score ($M = 2.69, SD = .24$) than MEQ-EM score for females ($M = 2.68, SD = .65$, $t(140) = -4.06, p < .001$). Negative emotion was marginally significant, with males reporting lower levels of negative emotion ($M = 1.96, SD = .52$) than females ($M = 2.14, SD = .53$, $t(137) = 1.94, p = .054$). Correlations reported above did not lose significance when gender effects in negative emotion and MEQ-EM were controlled for. See Table 5.

Discussion

Importance of Mindful Eating in Healthy Lifestyles

We conclude that emotion is an important component of healthy lifestyle habits. This is supported by the significant correlation of healthy eating with eating behaviors linked to emotional cues. In addition, those who reported a healthy BMI scored significantly better on the mindful eating questionnaire. This suggests that mindful eating behaviors may indeed be an important component in managing a healthy weight, which in turn is known to reduce chronic disease risk.

Positive emotion is also a factor of well-being that is known to affect physical health, immunity, and biophysical pathways (Savez, 2013, Kok et al, 2013, & Chapman et al, 2005). Independently, healthy dietary intake and mindful eating behaviors in response to emotion were linked to more frequent positive emotions. The mechanism by which mindful eating may influence positive emotion is unknown, and prediction modeling with healthy eating and physical activity suggests the relationship is complex.
This study does not provide insight into the mechanisms by which this occurs, but a bidirectional association would be a plausible hypothesis. Positive emotions could mean individuals are more motivated to make positive decisions about long-term health, or healthy food choices may affect positive mood, due to more gradual changes in blood sugar and taking time to eat to maintain energy and focus. Another possible contributing factor may be an average age 19 for participants, an age at which participants may not have fully developed emotion regulation skills. (Blakemore & Choudhury, 2006). Since the study took place between spring break and the final week of the semester, the time of the semester may have also affected mood.

Several different mediation models were investigated given multiple variables that had correlations with healthy eating and positive emotion. The role of healthy eating as a mediator between mindful eating in response to emotion and positive emotion had the strongest statistical support. Specifically using the average fruit and vegetable consumption as the mediator had marginal significance of mediation. This may suggest that mindful eating helps individuals to be conscious of maintaining a nutritionally adequate diet, which in turn helps them feel positive emotions about their healthful choices.

Differences in healthy versus unhealthy BMI groups suggests which specific constructs of mindful eating may be most prevalent to weight loss or weight management. Disinhibition and distraction categories showed significant differences, in addition to a difference in MEQ total score. In these categories, a higher mean score suggesting more mindful eating was observed in the healthy BMI group. Disinhibition may relate to the importance of ability to inhibit the desire for more food based on satiety signals. Distraction may relate to the
importance of eating without multitasking to allow for increased awareness to satiety signals, rather than awareness of external activities.

These correlations remained significant when controlling for gender effects in BMI, MEQ-EM, and negative emotion frequency. The higher BMI in males is supportive of common weight patterns by gender. Considering how individual characteristics play a role in what types of treatments are most effective, a higher MEQ-EM score suggesting males had more mindful eating behaviors in response to emotion and less frequent occurrence of negative emotions could indicate females may benefit more from training in mindful eating skills. Males may be gender biased to be less expressive of emotions, which may have impacted their responses on the MEQ.

Limitations

A college undergraduate sample from a single university limited this study. Most are relatively young, active adults with a lower BMI than the national average. A relatively small standard deviation (3.15 kg/m²) in BMI scores may have masked the ability to see a relation between mindful eating or emotion and BMI as reported by another study (Murphy et al., 2012). College students may have personal control over eating habits and routines but are also limited to food access at a dining hall or convenience stores within walking distance of their residence.

Reliability of measurements likely affected the ability to see trends as reported in previous literature. The MEQ had only two subscales that showed good internal consistency; MEQ-EM was one that was reliable and thus supported the use of this variable in data analyses in addition to MEQ total score. Physical activity measured by MIE minutes did not support many well-known relationships with physical activity, in particular with BMI. Given the large standard deviation in MIE minutes, the conversion of physical activities reported to this
measurement was not reliable. Future studies could be improved by a different method of recording physical activity.

Alternate methods of dietary quality assessment may also lend certain advantages over the dietary recall method using the Supertracker website. Average daily intake of calories reported was 1578 calories. This is well below the RDA for adults at 2000 calories/day, indicating likelihood many participants either neglected or forgot to report certain items consumed. This may have skewed the HEI scores to be higher than average, especially if items such as alcoholic beverages were not reported. Having participants keep a food log throughout the day which they would then turn in and be entered into the database by researchers may have been a more consistent and reliable method of collecting data on dietary intake.

Bias of which students selected to participate in this study may have hindered the ability to obtain a representative sample. Although students would only see each study listed in the survey website as an acronym such as “MEQ” for mindful eating questionnaire or “DHQ” for dietary history questionnaire, they could find out more about the content of the study by reading the consent document upon following the study link. If a student knew they had poor eating habits, this may have deterred them from continuing with the study due to not wanting to focus on this personal quality. This may have led to a higher than average HEI score as well.

The BMI measurement may have also been biased, due to self-report of this data. There was a significant difference in the BMI from current estimate of height and weight, versus that listed on most recent identification card. Although, the mean BMI for current estimate was higher, indicating individuals may have been willing to report an increase in their BMI since the measurement reported for their identification card. Regardless, either measure is at best an
estimate, and more reliable results may have been obtained by requiring participants to come in to the lab in order for researchers to take a consistent measurement.

Future Directions

Given the associations with emotion observed in this study, future studies may investigate how emotion regulation and levels of positive emotion may improve healthy lifestyle activities among a population. Future studies may wish to track emotion levels before and after recorded daily food intakes and physical activity to determine sequential order of these variables.

Neurobiological changes of meditation and mindfulness training have reported noticeable changes in even novice meditators after relatively brief periods of training (Davidson et al., 2003). This suggests even brief interventions in mindful eating could have the potential to create changes in brain patterns that relate to likelihood of engagement in healthy lifestyle behaviors, and such intervention-based study is warranted. Investigating longitudinal effects of mindful eating instruction beginning in childhood may help determine whether mindful eating could be useful for preventing obesity through instructing healthy eating behaviors before unhealthy eating patterns ensue.

Further actions to make mindfulness instruction more accessible to individuals on a larger scale may result from supporting research. College students in particular are a population that are susceptible to the stress of major lifestyle changes, heavy workload, and adjusting to challenges in eating routines and food access. College health facilities should consider implementing programs that instruct mindful eating skills, particularly for students who may struggle with developing or maintaining healthy eating behaviors.
Although this study only examined data reported by college students, it is possible many of these findings on the relationships of mindful eating to other healthy lifestyle factors could be observed in a more general population. Continued research on mindful eating in the field of eating disorders and obesity as well as neurobiological effects of mindfulness practices in relation to awareness of appetite will add to our depth of knowledge on how to most successfully promote healthy dietary behaviors, decrease prevalence of chronic disease, and increase emotional well-being.

Appendix

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Descriptive Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable</strong></td>
<td><strong>Mean</strong></td>
</tr>
<tr>
<td>Mindful Eating</td>
<td>2.68 (±.30)</td>
</tr>
<tr>
<td>MEQ Emotion</td>
<td>2.85 (±.60)</td>
</tr>
<tr>
<td>Healthy Eating Index</td>
<td>57.4 (±15.2)</td>
</tr>
<tr>
<td>Positive Emotion</td>
<td>3.59 (±.50)</td>
</tr>
<tr>
<td>Negative Emotion</td>
<td>2.06 (±.50)</td>
</tr>
<tr>
<td>MIE Minutes</td>
<td>253 (±280)</td>
</tr>
<tr>
<td>Body Mass Index</td>
<td>22.9 (±3.3)</td>
</tr>
<tr>
<td>Calorie Intake</td>
<td>1578 (±545)</td>
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<tr>
<td>Fruit &amp; Veg Servings</td>
<td>2.2 (±1.3)</td>
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<table>
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<tr>
<th>Table 2</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1 Positive Emotion</td>
<td>–</td>
</tr>
<tr>
<td>2 Negative Emotion</td>
<td>–</td>
</tr>
<tr>
<td>3 Mindful Eating</td>
<td>–</td>
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<tr>
<td>4 MEQ Emotion</td>
<td>–</td>
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<tr>
<td>5 Healthy Eating</td>
<td>–</td>
</tr>
<tr>
<td>6 Body Mass Index</td>
<td>–</td>
</tr>
<tr>
<td>7 Physical Activity</td>
<td>–</td>
</tr>
</tbody>
</table>

(*) p < .10. *p < .05. **p < .01.
Table 3  
*Comparison of Healthy Body Mass Index (BMI) and Unhealthy BMI*

<table>
<thead>
<tr>
<th>Variable</th>
<th>M (SD)</th>
<th>t</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Mindful Eating Total Score</td>
<td>2.11</td>
<td>2.11</td>
<td>0.033</td>
</tr>
<tr>
<td>BMI Unhealthy (N=35)</td>
<td>2.60 (±.25)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI Healthy (N=95)</td>
<td>2.71 (±.26)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEQ-Disinhibition</td>
<td>1.94</td>
<td>0.19</td>
<td>0.056</td>
</tr>
<tr>
<td>BMI Unhealthy (N=35)</td>
<td>2.40 (±.57)</td>
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<tr>
<td>BMI Healthy (N=95)</td>
<td>2.60 (±.56)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEQ-Distraction</td>
<td>2.01</td>
<td>0.049</td>
<td></td>
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<tr>
<td>BMI Unhealthy (N=35)</td>
<td>2.74 (±.52)</td>
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<tr>
<td>BMI Healthy (N=95)</td>
<td>2.92 (±.42)</td>
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</tbody>
</table>

*Note:* Healthy BMI ≥18.5 and <25 kg/m². Unhealthy BMI <18.5 or ≥25 kg/m²

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**Figure 1.** Partial mediation effect of healthy eating on the relationship between mindful eating-emotion and level of positive emotion. β is standardized beta coefficient without healthy eating in the model. (β̂) is standardized beta coefficient with healthy eating in the model.
Figure 2. Partial mediation effect of average fruit & vegetable servings on the relationship between mindful eating-emotion and level of positive emotion. $\beta$ is standardized beta coefficient without fruit & vegetable servings in the model. $(\beta)$ is standardized beta coefficient with fruit & vegetable servings in the model.

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$</th>
<th>SE $\beta$</th>
<th>F</th>
<th>$R^2$</th>
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<tr>
<td>Model 1</td>
<td></td>
<td></td>
<td>4.05*</td>
<td>0.028</td>
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<tr>
<td>Mindful eating - emotion</td>
<td>0.17*</td>
<td>0.07</td>
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<td>Model 2</td>
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<td>5.22*</td>
<td>0.071</td>
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<tr>
<td>Mindful eating - emotion</td>
<td>0.14*</td>
<td>0.07</td>
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<tr>
<td>Healthy eating</td>
<td>0.21*</td>
<td>0.003</td>
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<td>Model 3</td>
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<td>4.83*</td>
<td>0.096</td>
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<tr>
<td>Mindful eating - emotion</td>
<td>0.11</td>
<td>0.07</td>
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<tr>
<td>Healthy eating</td>
<td>0.19*</td>
<td>0.003</td>
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<tr>
<td>Physical Activity</td>
<td>0.16*</td>
<td>&lt;0.0001</td>
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*p < .05
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<th>M (SD)</th>
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<tr>
<td>Negative Emotion</td>
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<tr>
<td>Male</td>
<td>1.96 (±.52)</td>
<td>1.94(*)</td>
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<tr>
<td>Female</td>
<td>2.14 (±.53)</td>
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<tr>
<td>Positive Emotion</td>
<td></td>
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</tr>
<tr>
<td>Male</td>
<td>3.66 (±.56)</td>
<td>-1.36</td>
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<tr>
<td>Female</td>
<td>3.53 (±.52)</td>
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<td>Mindful Eating Questionnaire</td>
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<tr>
<td>Male</td>
<td>2.69 (±.24)</td>
<td>-0.482</td>
</tr>
<tr>
<td>Female</td>
<td>2.67 (±.28)</td>
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<tr>
<td>Mindful Eating Emotion</td>
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<tr>
<td>Male</td>
<td>3.09 (±.55)</td>
<td>-4.06**</td>
</tr>
<tr>
<td>Female</td>
<td>2.68 (±.65)</td>
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<tr>
<td>Healthy Eating Index</td>
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<tr>
<td>Male</td>
<td>55.3 (±14.5)</td>
<td>1.46</td>
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<tr>
<td>Female</td>
<td>59 (±15.6)</td>
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<tr>
<td>Body Mass Index</td>
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<tr>
<td>Male</td>
<td>24.0 (±3.6)</td>
<td>-3.33**</td>
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<tr>
<td>Female</td>
<td>22.2 (±3.0)</td>
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<tr>
<td>Physical Activity (MIE Minutes)</td>
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<tr>
<td>Male</td>
<td>292.3 (±231.1)</td>
<td>-1.48</td>
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<tr>
<td>Female</td>
<td>225.3 (±310.0)</td>
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</tr>
</tbody>
</table>

*Note: Males N = 59, Females N = 83

(*)p < .05, *p < .01, **p < .001
References:


Washington D.C.


White House Task Force on Childhood Obesity Report to the President. (2010). *Solving the problem of childhood obesity within a generation.* Executive Office of the President of the United States.
