

THESIS

EXPLORING THE POTENTIAL UTILITY OF A MINDFULNESS-BASED INTERVENTION
FOR PROMOTING INTUITIVE EATING IN ADOLESCENTS

Submitted by

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ABSTRACT

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Metabolic diseases and other illnesses related to high weight are increasing in prevalence, which is of particular concern in adolescent populations due to the long-term health implications. Intuitive eating (IE), the ability to eat when hungry, stop when satisfied, and consume the foods that one prefers, has been inversely associated with body mass index (BMI; kg/m^2) and, as such, is a construct of interest in the field of adolescent wellness. In theory, adolescent IE would be related to both greater mindfulness and less disordered eating. Yet, relatively few studies have examined IE in adolescents and even fewer studies have explored whether mindfulness-based intervention affect IE in adolescents. In this master's thesis, I explored the effects of a mindfulness-based intervention on increasing dispositional mindfulness and increasing IE in adolescents at risk for excess weight gain using baseline and 3-year follow-up data from a pilot randomized controlled trial of N=54 adolescent girls (55%) and boys 12-17 years old who were experiencing above-average weight or had a family history of experiences with obesity. Youth were randomized to either a mindfulness-based group intervention or health education control group for 6 hours spread over 6 consecutive weeks. Mindfulness and disordered eating were measured on validated self-report instruments at baseline and 3-year follow-up. IE was measured through adolescents' report on the Intuitive Eating Scale-2, measured only at 3-year follow-up. There were no significant differences between groups in mindfulness, disordered eating, or IE at 3-year follow-up. Disordered eating at 3-year follow-up

was negatively correlated with total average IE at 3-year follow-up. These findings are limited based on the small, pilot nature of the study indicating that further research is needed in this area.

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INTRODUCTION

Overview

Metabolic disease and its associated health conditions are of increased research interest as more communities around the globe are affected, at an increasingly early age of onset (Blüher, 2020). According to Alberga et al. (2012), preventative intervention during adolescence is important because excess weight gain and metabolic abnormalities in adolescence are associated with negative psychosocial and metabolic health outcomes in young and later adulthood. Additionally, adolescence is a key period for the establishment of eating behaviors that play a key role in health during the teenage years and throughout the lifespan (Alberga et al., 2012). First-wave intervention methods to prevent metabolic disorders worked to improve metabolic health via weight loss through caloric deficit, often via caloric restriction (e.g., dieting) and increased exercise (Blüher, 2020). Yet, dieting in adolescents, referring to attempts to cut back on how much one is eating to lose weight, actually has been positively associated with *increased* body mass index (BMI; kg/m²) after 10 years (Neumark-Sztainer et al., 2012). In some youth, eating patterns that focus on caloric restriction might have adverse psychological effects, particularly when dieting attempts fail, such as increasing disordered eating behaviors, and paradoxically encouraging continued excess weight gain (Hazzard et al., 2020). A meta-analytic review concluded that overall, extant dietary and/or exercise interventions for treating high weight in adolescence only amount to small reductions in BMI (Al-Khudairy et al., 2017), further highlighting the need to explore alternative approaches.

Preliminary pilot research into mindfulness-based interventions suggests that they may offer an alternative means of improving adolescent's eating behavior and metabolic health

(Shomaker et al., 2019; Bernstein et al., 2020; Shomaker et al., 2017). In line with a number of key aspects of mindfulness-based interventions, intuitive eating (IE) is an approach that includes concepts such as mindful eating, attention to thoughts, and noticing body sensations (Resch & Tribole, 2012). IE has been related to positive mental and physical wellness for adolescents and adults (Warren et al., 2017). The objective of this master's thesis was to explore the effects of a mindfulness-based intervention on mindfulness and IE in adolescents at risk for excess weight gain.

Metabolic Health in Adolescence

Metabolic diseases such as type 2 diabetes (T2D) are serious chronic diseases that impact quality of life, cause major health problems such as cardiovascular disease, stroke, amputations, kidney disease, and blindness, and lead to earlier mortality and a shortened lifespan (Fox et al., 2007). High weight and insulin resistance are risk factors for T2D (Weiss et al., 2004), which is common. It is estimated that 40% of people in the United States will develop T2D at some point in their lifetime (Gregg et al., 2014). Moreover, although T2D used to be a disease limited to older adulthood, T2D now manifests earlier in adulthood and even in adolescence (Mayer-Davis et al., 2017). The incidence of T2D in adolescents and young adulthood is increasing, particularly affecting youth from historically disadvantaged racial/ethnic groups and youth from families living on a low income (Mayer-Davis et al., 2017). Adolescence is a sensitive developmental period for interventions to impact metabolic health, due to physiological changes related to puberty, establishment of health behaviors such as eating patterns, and psychosocial characteristics that affect the course of insulin resistance, risk for obesity, and related co-morbidities like T2D (Alberga et al., 2012).

Traditional Approaches to Intervention

According to Bluher (2020), popular intervention approaches for preventing the worsening of metabolic health have almost exclusively focused on reducing high weight. This type of approach can be categorized as weight-normative, meaning the emphasis is on weight loss (Tylka et al., 2014). In the medical system, weight stigma has influenced how adolescent metabolic health concerns are approached. Weight stigma refers to societal prejudice, stereotyping, and mistreatment of people with overweight/obesity because of their body size (Pont et al., 2017). Sadly, the belief that shame will motivate individuals to lose weight is continually perpetuated by healthcare professionals and researchers (Pont et al., 2017). For instance, when measured at both a 2001 and 2013 conference, obesity researchers and healthcare professionals in 2013 were found to have increased explicit anti-fat bias (Tomiyama et al., 2015). Additionally, it has been suggested that foundational research may overestimate the impact of high weight on mortality (Flegal et al., 2004). These factors contribute to the narrowing of interventions for adolescent metabolic health concerns to primarily weight-reduction. Interventions for adolescents with high weight routinely incorporate multiple approaches to weight loss, including dieting (Ells et al., 2018). Dieting, which has multiple definitions, is often defined as caloric/food intake restriction for weight loss in the short-term and weight loss maintenance in the long-term (Brewer et al., 2018). Paradoxically, dieting has been associated with excess weight gain over time (Hazzard et al., 2020). Although this link is not entirely understood, the connection of dieting with excess weight gain is likely because measures of dieting are self-reported and thus, capture behavioral restriction as well as cognitive intent to restrict, such that high endorsement of dieting could represent a range from minimal-to-none actual caloric restriction to excessive restriction that triggers cycles of restriction and overeating.

Pressure to be thin from parents and peers has been associated with greater excess weight gain during adolescence (Suelter et al., 2018).

Dietary restraint, referring specifically to the psychological intent to eat less than desired, is often promoted in weight loss programs, yet has been associated with disordered eating attitudes and behaviors (Schaumberg et al., 2016). The alternative to weight-normative approaches to intervention and prevention is to take a weight-inclusive approach, centering on health behaviors that may be more acceptable, sustainable, and impactful than weight loss (Tylka et al., 2014). Research into weight-inclusive alternatives is gaining traction with options such as mindfulness (Shomaker, Berman, et al., 2019), psychotherapy (Tanofsky-Kraff et al., 2010), and IE (Warren et al., 2017). These interventions focus on addressing psychological factors underlying health behaviors rather than on weight loss.

Intuitive Eating (IE)

First introduced by Tribole and Resch in their 1995 book *Intuitive Eating, A Revolutionary Program That Works*, IE has been conceptualized as an anti-diet approach that puts food decisions back into the eater's control. IE focuses on non-judgment and acceptance, emphasizing eating when hungry, honoring food preference, and recognizing and accepting satiety (Resch & Tribole, 2012). In a meta-analysis of studies examining the relationship between IE and psychological concepts, Linardon et al. (2021) reported inverse associations of IE with eating disorder psychopathology and general psychopathology. Additionally, IE was positively associated with body image and overall wellbeing in this meta-analysis (Linardon et al., 2021). Various explanatory mediating factors between the constructs of body appreciation and IE have been suggested, including interoceptive awareness (referring to recognizing satiety and hunger cues in the body) and interoceptive responsiveness (willingness to respond to satiety

and hunger cues) (Oswald et al., 2017). One study found that social appearance comparison mediated the relationship between body acceptance by others and IE in adolescent girls such that lower social appearance comparison was related to increased body acceptance, and in turn, more IE (Andrew et al., 2015). Studies measuring IE most commonly use the Intuitive Eating Scale (IES), a survey created to measure IE beliefs and behaviors (Warren et al., 2017).

The emerging body of IE research primarily has been conducted in adults (Augustus-Horvath & Tylka, 2011; Janssen et al., 2018; Ruzanska & Warschburger, 2019; Sairanen et al., 2017), but a small number of studies have researched IE in adolescents (Andrew et al., 2015; Dockendorff et al., 2012). One noteworthy longitudinal study of a community-based cohort of adolescents found that baseline and increases in IE over an 8-year period were associated with indices of healthier psychological wellness and reduced disordered eating behavior at 8-year follow-up, when most adolescents were in young adulthood (Hazzard et al., 2020). Among middle school students, IE was positively, cross-sectionally related to more life satisfaction, being less likely to see thin as the ideal, and feeling more satisfied with one's body (Dockendorff et al., 2012). Similarly, in young adults, IE was positively, cross-sectionally associated with increased trust in one's body (Denny et al., 2013). Further, with respect to weight and metabolic health, IE has been associated with healthier glycemic control in adolescents with type 1 diabetes (Wheeler et al., 2016).

Despite the potential psychological and metabolic health benefits of intuitive eating, few studies have examined interventions to promote IE. Three separate, non-randomized controlled studies have tested interventions designed to increase IE, and these interventions all have been in college-age or adult women (Bush et al., 2014; Cole & Horacek, 2010; Wilson et al., 2020). One randomized controlled pilot study of adult military wives with overweight or obesity evaluated

the *My Body Knows When* 10-session group intervention teaching IE relative to an inactive control group and found increased IE in the intervention group post-intervention and at 6-month follow-up (Cole & Horacek, 2010). However, there was no significant difference in BMI at either post-intervention or at 6-months follow-up (Cole & Horacek, 2010). Bush et al. (2014) engaged a sample of female university employees and female spouses of university employees who were in good general health in the *Eat for Life* 10-week group program which combined mindfulness training and IE education. Compared to a waitlist control, the intervention group had reduced problematic eating behaviors as well as higher IE, body appreciation, and mindfulness at post-intervention (Bush et al., 2014). Last, in a randomized controlled trial, female college students in good general health were randomized to attend two classes that presented psychoeducation on healthy eating based on IE as an alternative to unhealthy dieting and unrealistic body ideals, or to a control receiving brochures on body image and the USDA MyPlate guidelines (Wilson et al., 2020). At both post-intervention and one-month follow-up, female college students in the intervention had reduced body image dissatisfaction as well as improved IE and dietary intake compared to the control group (Wilson et al., 2020). There have been few studies, all in adults, testing IE interventions with short-term follow-up but these preliminary studies suggest promise for IE interventions to improve IE.

Theoretical Understanding of IE.

In seeking to understand why IE may be beneficial for improving psychological well-being, research on dietary restraint offers one lens. Dietary restraint is correlated with increased risk for eating-related problems including disordered eating behaviors in adolescent females (Liechty & Lee, 2013). A possible explanatory mechanism for this relationship is the initiation of a compensatory spiral (Schaumberg et al., 2016). The Spiral Model of Chronic Dieting, put forth

by Polivy and Heatherton (2017), proposes that chronic dietary restraint attempts can initiate a cycle of restraint and compensatory binge or uncontrolled eating episodes, or eating past satiation following a period of dietary restriction, which lowers self-esteem. This reduction in self-esteem then leads to increased dietary restraint attempts, with increasingly lower self-efficacy and a resulting, greater propensity to engage in binge or uncontrolled eating, often leaving individuals feeling frustrated with themselves and with the excess weight gain that can occur as a consequence of binge or uncontrolled eating (Polivy & Heatherton, 2017). In theory, IE disrupts this Spiral Model of Chronic Dieting cycle by reducing both dietary restraint and compensatory binge eating and through fueling reliance on the body's hunger and satiety cues by increasing interoception, non-judgmental awareness of binge eating, and unconditional permission to eat regardless of recent uncontrolled eating episodes, by increasing acceptance and self-compassion (Resch & Tribole, 2012).

Another compelling theoretical explanation for IE's therapeutic mechanisms of action is described in the Acceptance Model of IE. This model suggests that the degree to which others accept one's body is positively associated with IE in that increased body acceptance by others decreases one's focus on how other person see one's body and increases IE (Augustus-Horvath & Tylka, 2011; Avalos & Tylka, 2006). This model is supported by cross-sectional data in large samples of emerging, early, and middle adult women (Augustus-Horvath & Tylka, 2011). Additional constructs that have been found to explain the relationship between body acceptance and IE include lower social appearance comparison and less self-objectification (Andrew et al., 2015).

While the extant literature offers some suggestion that IE interventions may be beneficial, there have been no published tests of interventions on IE in adolescents, to our knowledge, and

only one randomized controlled trial evaluating intervention effects on IE in adults (Wilson et al., 2020). Therefore, it is of use to examine whether general mindfulness-based interventions may improve IE.

Mindfulness Training & Outcomes of Interest

Dispositional Mindfulness

Mindfulness is intentionally focusing attention on the present moment while refraining from judgement (Kabat-Zinn, 1990). Its practice has found its way into the Western world and with it has brought a surge of interest from the research community. The literature differentiates between dispositional or trait mindfulness and mindfulness training. Dispositional or trait mindfulness is one's general propensity toward mindful attention and awareness in daily life (Brown & Ryan, 2003). Mindfulness training seeks to increase dispositional mindfulness by engaging participants in experiential activities to practice mindfulness such as meditation and encouraging home practice (Broderick & Frank, 2014; Kabat-Zinn, 1990).

A 2019 meta-analysis concluded that mindfulness-based interventions have positive effects immediately post-intervention on adolescent mental health and cognition when compared to controls and a 2016 meta-analysis found that mindfulness training did increase dispositional mindfulness in adults (Dunning et al., 2019; Quaglia et al., 2016). In a systematic review, dispositional mindfulness was positively associated with less negative cognitive thinking and emotion regulation while inversely associated with depressive symptoms (Tomlinson, 2017).

Eating Behaviors

Disordered Eating Symptomology. Disordered eating symptomology is generally considered to include extreme restriction and/or binge behaviors in an attempt to control body size (Fairburn & Beglin, 1994). In our group, a general mindfulness training intervention has been shown to reduce eating in response to stress and improve food reinforcement in adolescents at risk for excess weight, relative to a didactic health education control, at 6-month follow-up (Shomaker, Berman, et al., 2019) and the effects for eating in response to stress were sustained at 18-month follow-up (Bernstein et al., 2021). Brewer et al. (2018) posit that improved eating behaviors occur through three steps in mindfulness training: awareness of eating behaviors, recognizing outcomes of behaviors, and empowering intuitive food choice. Warren et al. (2017) posits that, consistent with these hypothesized mechanisms, fMRI research in adults may indicate that practicing mindfulness increases activity in areas of the brain that are important for interoception.

There is limited research on the effects of mindfulness training on eating disorder symptomology. A preliminary, cross-sectional, observational study of college freshman found that certain aspects of mindfulness, particularly nonjudgement and awareness, were associated with reduced eating disorder symptomology (Prowse et al., 2013). Dispositional mindfulness has been correlated with less frequent binge and emotional eating behaviors in adolescents at risk for T2D (Pivarunas et al., 2015). Mindfulness training was found to increase behavioral flexibility in healthy adults when compared to an educational cooking class, which has been hypothesized to be central to decreasing compulsive eating behaviors (Janssen et al., 2018).

Intuitive Eating. Mindfulness training processes and IE have many factors in common (Warren et al., 2017). In the previously discussed *Eat for Life* non-randomized worksite

intervention study, for participants who completed at least 60% of the program dispositional mindfulness at baseline was found to partially explain between-group differences in IE (Bush et al., 2014). IE can be viewed as an enactment of mindfulness toward eating, hunger, and satiety. Indeed, consistent with this perspective, the IES measure includes three components: unconditional permission to eat, eating for physical rather than emotional reasons, and reliance on internal hunger/satiety cues (Dockendorff et al., 2012; Tylka, 2006). Due to IE's relative novelty in the literature, research on IE is limited (Kerin et al., 2019). In the following sections, it is proposed that these elements of IE are related to three variables central to mindfulness training: interoception, acceptance, and self-compassion.

Interoception

Interoception is the process of neurologically sensing internal body signals and cues such as hunger and satiety (Khalsa et al., 2018). IE-based interventions may increase interoception (Cole & Horacek, 2010). Cross-sectional research in young adult and college women indicates that interoceptive awareness and responsiveness are partial mediators of the association between BMI and all IE domains, as measured with the IES (Herbert et al., 2013; Oswald et al., 2017). Further, in college women, the IE dimension of higher unconditional permission to eat was associated with increased interoceptive awareness (Dockendorff et al., 2012). Based on this research, it could be anticipated that interventions that serve to increase interoception would improve IE. In connecting interoception to mindfulness, Warren et al. (2017) propose that extant research on mindfulness and the brain suggests that practicing mindfulness may increase interoception.

Acceptance

Acceptance, or the ability to fully experience something without avoiding or changing the experience, is associated with initial increased intensity of negative emotions, but followed by subsequent decreased intensity on re-exposure (Campbell-Sills et al., 2006; Uusberg et al., 2016). Applied to eating, these findings may suggest the ability of acceptance to increase an individual's ability to eat for physical rather than emotional reasons, because the intensity of emotional eating may decrease over time with both re-exposure and increased acceptance. Additionally, body acceptance, referring to acceptance with reference to one's body specifically, has been positively associated with IE (Wilson et al., 2020). In a non-randomized pilot trial of an adolescent mindfulness-based intervention, Learning to BREATHE (L2B), which provides general mindfulness training, adolescents in the intervention had significantly increased acceptance of self at post-treatment, as compared to an inactive control group (Broderick, 2009). Together, extant theoretical and preliminary empirical evidence suggests that greater acceptance would be associated with the IE components of reliance on internal hunger/satiety cues and eating for physical rather than emotional reasons. If an individual is able to accept their hunger/satiety cues as they arise, they may be more likely to trust those cues and utilize them to inform eating decisions.

Self-compassion

Self-compassion is defined as the ability to approach difficult emotions or personal failure with kindness and understanding and differs from acceptance in that it is targeted toward emotional and life experiences unique to the individual (Dvořáková et al., 2017). Self-compassion is thought to partially mediate the relationship between internalized weight stigma and IE (Webb & Hardin, 2016) and self-compassion has been positively associated with IE in

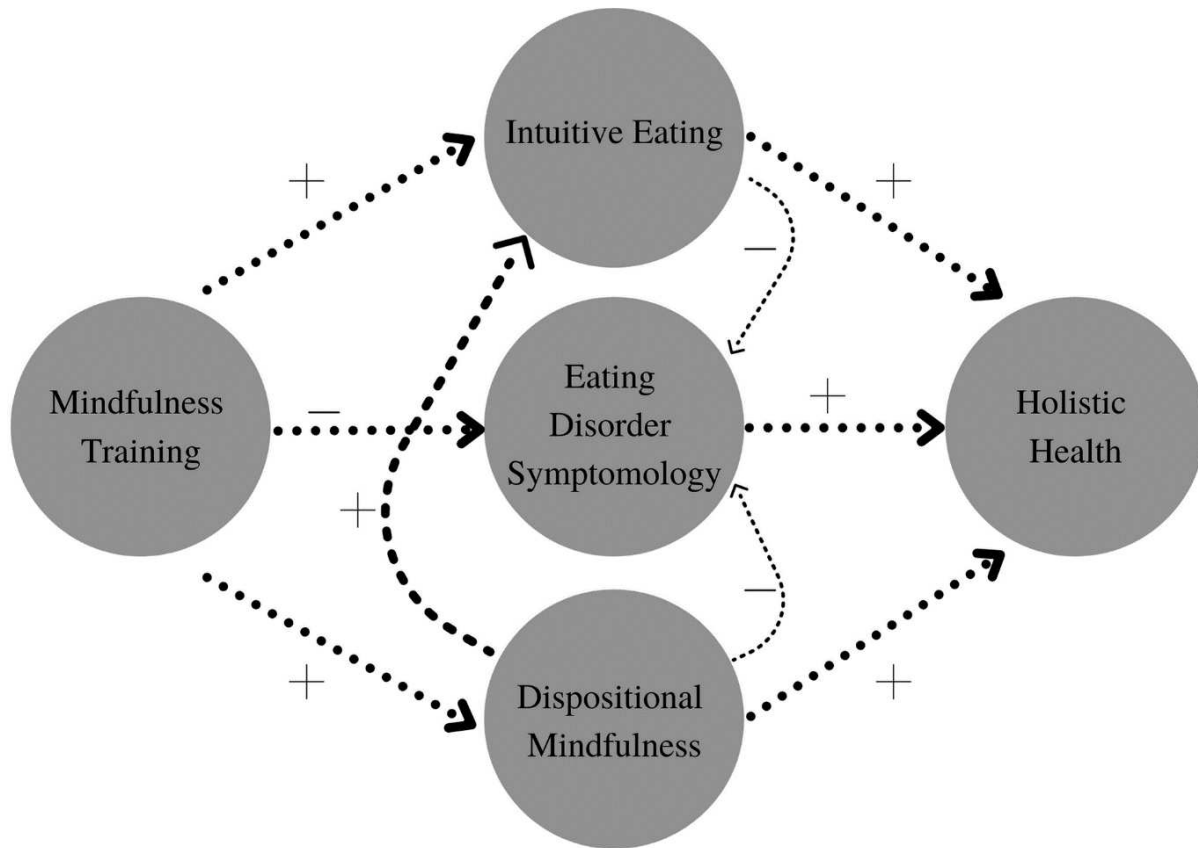


Figure 1. Conceptual model

college students (Schoenefeld & Webb, 2013). However, the L2B mindfulness intervention has shown mixed results related to self-compassion, finding no effect of the intervention in college students but positive effects in adolescents (Bluth et al., 2015; Broderick & Frank, 2014; Dvořáková et al., 2017). Mindfulness training could be anticipated to increase IE in adolescents, in part because of mindfulness' association with self-compassion.

Theoretical Model

The overall conceptual model for this thesis (Figure 1) proposes that mindfulness training would be associated with improved holistic health through the three explanatory and inter-related mechanisms, including IE, eating disorder symptomology, and dispositional mindfulness. Theoretically, mindfulness training would increase IE which in turn would both

decrease eating disorder symptomology and increase holistic health. Additionally, mindfulness training may directly decrease eating disorder symptomology, reducing the negative impact of these symptoms on holistic health. Finally, mindfulness training may increase dispositional mindfulness which may successively increase IE, decreasing eating disorder symptomology, and increase overall holistic health.

Current Study

The focus of the current study was to explore whether an adolescent mindfulness-based intervention, L2B, shows a signal for sustained benefits to IE, dispositional mindfulness, and eating disorder symptomology in adolescents by analyzing 3-year follow-up data from a randomized controlled pilot study of adolescents at risk for excess weight gain who received either L2B or a health education didactic control (Shomaker, Berman, et al., 2019). The primary outcomes were feasibility/acceptability, which have been reported (Shomaker, Berman, et al., 2019). In an attempt to decrease the impact of anti-fat bias and weight stigma in the current project, discussions of and outcomes related solely to weight will not be included. Instead, eating behaviors and mindfulness, more holistic measures of health, will be considered. In the initial report of this pilot study, L2B was related to decreased food reward sensitivity at six-months, when compared to a control group (Shomaker, Berman, et al., 2019). Preliminary data also indicated that stress-eating measured in the laboratory was reduced in the mindfulness versus health education group at six-months and 18-months follow-up (Bernstein et al., 2021; Shomaker, Berman, et al., 2019).

In adolescent populations, L2B has been found to be acceptable to participants (Broderick & Frank, 2014; Metz et al., 2013; Shomaker, Berman, et al., 2019), and shown signals in preliminary studies for improving emotion regulation (Metz et al., 2013) and reducing

depression and insulin resistance (Shomaker et al., 2017). In first-year college students, L2B reduced anxiety and depression symptoms and increased students' life satisfaction immediately post-intervention compared to a waitlist control group (Dvořáková et al., 2017).

The primary hypothesis was that when compared to a health education control group, mindfulness training would be related to higher IE at 3-year follow-up among adolescents at risk for excess weight gain. As previously discussed, mindfulness and IE share many factors (Warren et al., 2017) and IE can be viewed as an enactment of mindfulness toward eating, hunger, and satiety. Extant research has demonstrated that mindfulness interventions are beneficial and acceptable for adolescents and are associated with improved eating behaviors in adolescents (Dunning et al., 2019; Metz et al., 2013; Shomaker, Berman, et al., 2019). Although mindfulness training has been associated with dispositional mindfulness (Quaglia et al., 2016), research has not yet addressed whether mindfulness training affects IE in adolescents. Exploring this question in adolescents at risk for excess weight gain is particularly important despite the exclusion of weight-based outcomes. For example, an observational study of adult women with T2D found that more IE was associated with better glycemic control (Pieres Soares et al., 2020). Understanding how IE is associated with mindfulness training may increase the ability to effectively prevent metabolic disease in this population.

METHOD

Participants and Procedures

Using convenience sampling, adolescents at risk for overweight/obesity were recruited for participation in this study (NCT03085160). Methods for recruitment included: flyers posted in medical clinics, community centers, and schools; emails; radio and newspaper announcements, letters to families, and events such as health fairs. To be included in the study, participants were required to either have a BMI \geq 70th percentile for age and sex or because both biological parents had a BMI \geq 30 kg/m² (overweight/obesity). Adolescents who met at least one of these selection criteria were considered at risk for excess weight gain and adult obesity. Additionally, adolescents were between ages 12-17 and in good general health. Exclusion criteria included major medical problems (e.g., T2D) or psychological problems that the investigators felt would interfere with compliance. Those taking medications that could affect mood or body weight were excluded. Female participants were excluded if pregnant. The final sample included N = 54 adolescents age 12-17. Participants were randomized into either the mindfulness-based intervention (n = 29) or HE (n = 25) group, stratified based on sex, race/ethnicity, age, and BMI status.

Participants and their parent or guardian provided assent and consent, respectively, during their initial visit to the lab, after which baseline data were collected. Following the initial visit, the adolescents participated in 6 weekly 1-hour sessions of either L2B or HE, facilitated by trained graduate students and supervised by a licensed clinical psychologist. Following the intervention, data were collected immediately at 6-weeks follow-up, 6-months after group start, 18-months after group start, and 3 years after group start. This thesis will be the

first report of 3-year data. Three-year follow-ups occurred from November 2017 to December 2020, and 16 follow-up visits (28%) overlapped with the COVID-19 pandemic. Procedures were adjusted by having participants complete surveys remotely and by having them come into the lab at a later date for physiological measurements. COVID-19 restrictions resulted in greater than anticipated attrition related to delays and some participants being less inclined to come in to the lab. Despite delays in data collection, all 3-year follow-ups were completed as of December 2020.

Measures

Intuitive Eating

At 3-year follow-up only, IE was measured using the Intuitive Eating Scale-2 (IES-2). The IES-2 contains 23 items such as *I stop eating when I feel full (not overstuffed)* and *I find myself eating when I am bored, even when I'm not physically hungry*, separated into four subscales and using a Likert-type (Tylka & Kroon Van Diest, 2013). Seven items are reverse scored, subscale and total score are summed and averaged, and higher scores indicate higher IE (more positive valence) (Tylka & Kroon Van Diest, 2013). The IES-2 has demonstrated very good internal reliability in adult populations (Tylka & Kroon Van Diest, 2013). While reliability of the IES-2 in adolescent populations has yet to be reported, literature suggests concurrent validity of the original IES in adolescent populations (Dockendorff et al., 2012). The IES-2 has been inversely related in college women and men to disordered eating symptomology, BMI, and while positively associated with interoceptive awareness, self-esteem, body appreciation, and life satisfaction (Tylka & Kroon Van Diest, 2013).

Dispositional Mindfulness

At baseline and 3-year follow-up, dispositional mindfulness was measured using the Mindful Attention Awareness Scale, developed by Brown and Ryan (2003). The MAAS contains 15 items endorsed using a Likert-type scale and is scored using the mean, resulting in a score of 1-6 with lower scores indicating lower dispositional mindfulness and higher scores greater (more positive valence) mindfulness. Higher MAAS scores have been associated with increased length of mindfulness practice experience and may be suitable for detecting long-term effects of mindfulness training (Brown & Ryan, 2003). In young adult and adult populations, the MAAS was found to be both reliable and valid (Brown & Ryan, 2003).

Eating Disorder Symptomology

At baseline and 3-year follow-up, eating disorder symptomology was measured using both the Eating Disorder Examination (EDE), a structured interview, and the Eating Disorder Examination-Questionnaire (Fairburn & Beglin, 1994; Luce & Crowther, 1999). Both the EDE and EDE-Q are reliable and valid measures of eating disorder symptomology in young adult women (Cooper et al., 1989; Fairburn & Beglin, 1994; Luce & Crowther, 1999; Terence Wilson & Smith, 1989). The EDE is reliable, valid, and has good psychometric properties in adolescent populations (Glasofer et al., 2007). EDE-Q variable of interest will be total disordered eating.

Analytic Plan

Descriptive information was generated for baseline and 3-year follow-up characteristics, by condition (L2B vs. HealthEd). Unadjusted differences between conditions were described with independent samples t-test and chi-square. T-tests and chi-square also were used to evaluate any patterns in missing data/attrition at 3-year follow-up. Correlations were used to describe associations among 3-year disordered symptomology, dispositional mindfulness, and

3-year IE. Linear mixed models were run to look at the prediction of mindfulness and global disordered eating and the model included group, time (baseline screenings, 3-year follow-up), age, and group by time interaction (interval). As there was no baseline measure of IE, I explored to what extent condition related to 3-year IE.

RESULTS

Descriptive Information: Baseline Characteristics and Retention

Baseline characteristics of study participants are included in Table 1. Overall retention to 3-year follow-up was 74.1%. A chi-square test was performed and found no significant difference in retention by group condition, $X^2(1, 54) = 2.39, p = 0.12$ or sex, $X^2(1, 54) = .02, p = 0.89$. Using an independent samples t-test, no significant difference in baseline mindfulness was found for those who dropped out ($M = 3.97, SD = 1.09$) and those who remained until 3-year follow-up ($M = 4.09, SD = 1.09$); $t(50) = -.33, p = .74$. Likewise, an independent samples t-test found no significant difference by baseline global eating disorder symptomology for those who dropped out ($M = 1.77, SD = 0.91$) and those who remained until 3-year follow-up ($M = 1.55, SD = 1.08$); $t(52) = 0.69, p = .49$.

Table 1

Sample Characteristics

| Baseline characteristic | L2B | HealthEd |
|--|------------|----------|
| <i>Sex, n (%)</i> | | |
| Female | 16 (55.2%) | 14 (56%) |
| Male | 13 (44.8%) | 11 (44%) |
| <i>Race/ethnicity, n (%)</i> | | |
| Non-Hispanic White | 19 (65.5%) | 18 (72%) |
| Hispanic/Latino | 8 (27.6%) | 7 (28%) |
| American Indian or Alaska Native/Native American | 1 (3.4%) | 0 (0%) |
| Asian | 1 (3.4%) | 0 (0%) |

| | | |
|--|--------------|-------------|
| Baseline Age, years, <i>M (SD)</i> | 13.51 (1.48) | 13.9 (1.59) |
| Baseline Mindfulness, <i>M (SD)</i> | 4.07 (1.12) | 4.03 (1.06) |
| 3-year Mindfulness, <i>M (SD)</i> | 4.37 (1.00) | 4.29 (1.21) |
| Baseline Global Disordered Eating, <i>M (SD)</i> | 1.5 (1.05) | 1.72 (1.03) |
| 3-year Global Disordered Eating, <i>M (SD)</i> | 1.75 (0.99) | 1.28 (1.22) |
| 3-year Intuitive Eating, <i>M (SD)</i> | 3.59 (0.44) | 3.49 (0.71) |
| Unconditional Permission to Eat | 3.66 (0.59) | 3.43 (0.95) |
| Eating for Physical v. Emotional Reasons | 3.79 (0.58) | 3.77 (0.82) |
| Reliance on Hunger and Satiety Cues | 3.47 (0.68) | 3.10 (1.05) |
| Eating for Body-Food Choice Congruence | 3.16 (0.67) | 3.62 (1.02) |

Note: Mindfulness: Average Score on the Mindful Attention Awareness Scale (MAAS); Global Disordered Eating: Average Score on the Eating Disorder Examination Questionnaire (EDE-Q); Intuitive Eating: Average Score on the Intuitive Eating Scale-2 (IES-2) and each respective subscale.

Unadjusted Group Condition Comparisons at 3-Year Follow-up

Independent t-tests were performed to explore differences between group conditions at 3-year follow-up. There was no significant difference at 3-year follow-up for mindfulness, $t(36) = -.21$, $p = .83$, between L2B ($M = 4.37$, $SD = 1.00$) and HealthEd ($M = 4.29$, $SD = 1.21$). No significant difference at 3-year follow-up in global eating disorder symptomology was observed, $t(36) = -1.29$, $p = .20$, between L2B ($M = 1.75$, $SD = 0.99$) and HealthEd ($M = 1.28$, $SD = 1.22$). Finally, no significant difference at 3-year follow-up was observed in either total IE, $t(21) = -.38$, $p = .71$, between L2B ($M = 3.59$, $SD = .44$) and HealthEd ($M = 3.49$, $SD = .71$), nor in any IE subscale (p -values > 0.20).

Correlations Among Key Variables

Correlations at 3-year follow-up among all variables of interest were examined for the total sample (Table 2). Mindfulness had a moderate, negative correlation with global eating disorder symptomology, $r(36) = -.44, p < .01$ and a moderate, positive correlation with the IES subscale of eating for physical rather than emotional reasons, $r(21) = .54, p < .01$. Eating disorder symptomology was strongly negatively correlated with overall IE, $r(21) = -.63, p = .001$. The IES subscale of eating for physical rather than emotional reasons had a moderate, positive correlation with the IES subscale of eating for body-food choice congruence, $r(21) = .53, p < .01$.

Table 2

Correlations among Variables of Interest

| Variable | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---------------------------------|------|------|--------|--------|-------|-------|-------|-------|
| 1. Age | .03 | -.24 | -.06 | .34 | .36 | .22 | .32 | -.03 |
| 2. Sex | 1.00 | -.18 | .21 | -.25 | .03 | -.32 | -.12 | -.49* |
| 3. Mindfulness | | 1.00 | -.44** | .26 | -.23 | .54** | .17 | .25 |
| 4. Disordered Eating | | | 1.00 | -.63** | -.50* | -.43* | -.44* | -.50* |
| 5. Intuitive Eating | | | | 1.00 | .68** | .78** | .82** | .61** |
| 6. Unconditional Permission | | | | | 1.00 | .21 | .50* | .24 |
| 7. Physical v. Emotional Eating | | | | | | 1.00 | .46* | .53** |
| 8. Reliance Hunger/Satiety | | | | | | | 1.00 | .27 |
| 9. Body-food Choice | | | | | | | | 1.00 |

Note: Mindfulness: Average Score on the Mindful Attention Awareness Scale (MAAS); Global Disordered Eating: Average Score on the Eating Disorder Examination Questionnaire (EDE-Q); Intuitive Eating: Average Score on the Intuitive Eating Scale-2 (IES-2) and each respective subscale.

*Correlation is significant at the $p < .05$ level

** Correlation is significant at the $p < .01$ level

Linear Mixed Modeling

In the linear mixed modeling analyses, evaluating the group by time effect on adolescent mindfulness there was no group by time interaction ($t = 0.25, p = .80$), meaning that there was no difference in mindfulness over time by group. On average, mindfulness increased from baseline to 3-year follow-up in both L2B (baseline: $M = 3.91, SE = 0.20$ vs. follow-up: $M = 4.50, SE = 0.26$) and HE (baseline: $M = 3.96, SE = 0.22$ vs. follow-up: $M = 4.43, SE = 0.26$); $f = 4.61, p < .05$. The linear mixed modeling analysis predicting global disordered eating symptoms indicated a non-significant group by time interaction as well ($t = .51, p = 0.61$). In this case, there was no change in either group over time, either in L2B (baseline: $M = 1.53, SE = 0.21$ vs. follow-up: $M = 1.71, SE = 0.26$) or HE (baseline: $M = 1.74, SE = 0.22$ vs. follow-up: $M = 1.40, SE = 0.26$); $f = 0.12, p > 0.7$.

DISCUSSION

Within this exploratory pilot study of long-term follow-up, there were no significant differences between adolescents at risk for excess weight gain who participated in a mindfulness-based intervention group versus a health education control group in dispositional mindfulness, global disordered eating, or IE at 3-year follow-up. Previous research has supported the potential utility of mindfulness training for increasing mindfulness in adults (Quaglia et al., 2016) and for improving eating behaviors in adolescents at post-intervention and shorter-term follow-ups (Prowse et al., 2013), and previous analyses of the current pilot study indicated benefits of mindfulness-training to stress-eating at 6-month follow-up and 1.5-year follow-up (Shomaker/Bernstein Appetite papers). Yet, to my knowledge, this is the first study to explore IE as an outcome of mindfulness training in adolescents.

In this study, mindfulness increased over time for all participants regardless of condition. This pattern is consistent with a past, longitudinal study which found a positive association between mindfulness and age (Calvete et al., 2019). In this way, it would be expected that adolescents' mindfulness may increase overtime with growth. This may be due to increased executive functioning in adolescence that provides a foundation for self-regulation and other cognitive and emotional process that are foundational for mindfulness (Huizinga et al., 2006; Lyvers et al., 2014).

Overall, this sample showed no differences in global disordered eating with no change from baseline to 3-year follow-up. This could be attributed to sample characteristics, as global disordered eating sample scores were below clinically significant at both baseline and 3-year follow-up, indicating that the sample may not have had disordered eating to reduce.

Although there were no condition effects, it is interesting to note that disordered eating was negatively correlated with IE at 3-year follow-up. This association is expected based on the published, primarily observational research on IE and disordered eating, showing that IE is inversely associated with eating pathology cross-sectionally as well as predicts less eating pathology over time (Hazzard et al., 2020; Linardon et al., 2021). While unable to determine a causal relationship with this study design, this finding is in line with the conceptual model in that higher IE is related to lower disordered eating. In adolescents, this association may suggest the potential to decrease disordered eating through IE.

Additionally, adolescents' dispositional mindfulness was positively correlated with the IES subscale of eating for physical rather than emotional reasons. This too is in line with the conceptual model as dispositional mindfulness is thought to be associated with increases in IE, of which this subscale is a component. This particular scale may have been impacted due to the previously discussed findings suggesting that acceptance, a part of mindfulness, may decrease emotional eating over time due to decreased intensity of emotion after re-exposure (Campbell-Sills et al., 2006; Uusberg et al., 2016).

Finally, at 3-year follow-up, mindfulness was inversely associated with disordered eating which is in line with the conceptual model. Previous data suggests that mindfulness is associated with variance in disordered eating (Lavender et al., 2011) which is in line with my findings.

This exploratory pilot study contributes to the literature in several ways. First, the results support the feasibility of longitudinal studies of mindfulness training in adolescents. To our knowledge, no studies have yet examined the efficacy of mindfulness trainings after 3 years, which may necessitate booster trainings or even changes to the intervention to promote maximum, long-term benefit. Additionally, this is the first study to explore associations between

a mindfulness training and IE. The increased inclusion of this variable in research broadens the discussion of health beyond size, weight, and BMI, placing importance instead on holistic health which includes eating behaviors such as IE. Limitations within the study design such as having a small sample size likely contributed to insignificant findings. Additionally, a six-hour intervention over six-weeks may not be strong enough to show effects after 3 years.

Additionally, generalizability is limited to adolescents with high weight and/or a family history of obesity. Considering the baseline data, generalizability would be additionally limited to those with higher mindfulness and lower global disordered eating. In another study of adolescents using the MAAS, the average score was 3.54 (Brown et al., 2011), lower than this sample's baseline of 4.07. Future studies might consider targeting particular sample characteristics. For example, replicating this study in adolescents with lower initial mindfulness may provide better opportunity for observing increased mindfulness. Similarly, a sample higher in global disordered eating may allow stronger conclusions on the impact of this intervention for affecting disordered eating. Finally, future studies should measure IE at baseline and could seek a sample low in IE at baseline to measure intervention effect on IE.

This study design does offer strengths such as being a randomized control trial with a long-term follow-up. Additionally, this thesis adds to previously published reports on this study (Shomaker et al., 2019; Bernstein et al., 2020) by reporting on 3-year follow-up data. Exploring the potential long-term effects of mindfulness interventions is important in the development of effective programs and policy for the public.

This thesis develops a foundation for examining the relationship between mindfulness training and holistic health outcomes in adolescents. While there were no significant differences at 3-year follow-up in mindfulness, global disordered eating, or IE between groups, this thesis

provides a grounds for further exploring these variables. Future studies should consider larger, adequately powered samples and explore targeting certain population characteristics such as adolescents low in mindfulness, high in global disordered eating, or low in IE to further investigate impact. Continued research is important to continue developing the scientific understanding of adolescent health outside of a weight-based approach.

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