Exploring the Effects of Mindfulness-Based Programs on Weight Management and Eating Behaviours

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Abstract

Over the past decade, mindfulness-based interventions have gained popularity as a tool for managing obesity and its related comorbidities. Namely, mindfulness-based programs have been theorized as an effective tool for addressing problematic eating behaviours that are associated with obesity. The purpose of my dissertation is to further examine the effects of mindfulness-based programs for obesity management.

The first manuscript in my dissertation provides a comprehensive effect-size analysis to evaluate the efficacy of mindfulness-based interventions on weight loss and obesity-related eating behaviours. Results of the meta-analysis showed that mindfulness-based interventions are moderately effective for weight loss and largely effective for reducing problematic eating behaviours in individuals with overweight and obesity. The meta-analysis additionally highlighted a diversity in study design and outcomes, as well as a variability in how mindfulness is taught. Notably, there was a distinction between the use of formal and informal strategies to cultivate mindfulness. Decoupling the independent effects of both strategies on weight loss and disordered eating behaviours is necessary to examine their differentiating effects on various health behaviours.

Although my meta-analysis demonstrated the effectiveness of mindfulness-based interventions in improving certain obesity-related outcomes, existing programs involve lengthy group sessions, require extensively trained staff and are not widely accessible to the greater community. The integration of community-based mindfulness programs for obesity management continues to be a challenge. One way to address this challenge is to develop a manualized program that can be easily implemented into the greater community. The aim of my second manuscript was therefore to develop and evaluate a brief mindful eating program for reducing

overeating in individuals with overweight and obesity. Results from my pilot project suggest that a brief mindful eating intervention may be an effective and affordable solution to addressing problematic overeating in the greater public. However, it was difficult to elucidate the independent effects of various mindful eating processes on study outcomes. This difficulty was the result of several psychometric limitations from former mindful eating questionnaires. Notably, existing questionnaires emphasized the attentional domains of eating-specific mindfulness such as present-moment attention to homeostatic cues of hunger and satiety, while omitting other important facets such as a non-judgmental curiosity and decentering. This disregard of certain key features of mindfulness is challenging when trying to investigate mechanisms of change.

My third and final manuscript thus addressed the psychometric limitations of former mindful eating scales. Notably, my manuscript describes the development and validation of a comprehensive measure of mindful eating across a series of three studies. The Four Facet Mindful Eating Scale (FFaMES) consists of 29 items with 4 factors that assess both the attention and attitude components of eating-specific mindfulness. The results of my manuscript provide evidence for the scale's reliability and construct validity. Using this newly developed scale, future research should continue to investigate the differential effects of various aspects of eating-specific mindfulness in the prevention and treatment of obesity and its comorbidities.

In sum, my dissertation provides a detailed examination of the effects of mindfulness-based training on obesity management. The findings of my three studies provide further evidence for the differential effects of various mindfulness processes on weight and eating-related outcomes. Future research must continue to examine these processes to better understanding how and why mindfulness training effects behaviour change for obesity management.

Resumé

Au cours de la dernière décennie, les interventions fondées sur la pleine conscience ont gagné en popularité en tant qu'outil de gestion de l'obésité et de ses comorbidités connexes. À savoir, les programmes basés sur la pleine conscience ont été théorisés comme un outil efficace pour traiter les comportements alimentaires problématiques qui sont associés à l'obésité. Le but de ma thèse est d'examiner plus en détail les effets des programmes basés sur la pleine conscience pour la gestion de l'obésité.

Le premier manuscrit de ma thèse fournit une analyse complète de la taille de l'effet pour évaluer l'efficacité des interventions basées sur la pleine conscience sur la perte de poids et les comportements alimentaires liés à l'obésité. Les résultats de la méta-analyse ont montré que les interventions basées sur la pleine conscience sont modérément efficaces pour la perte de poids et grandement efficaces pour réduire les comportements alimentaires problématiques chez les personnes ayant des problèmes de surpoids et d'obésité. La méta-analyse a en outre mis en évidence une diversité dans la conception de ces interventions et leurs résultats, ainsi qu'une variabilité dans la façon dont la pleine conscience est enseignée. Il y avait notamment une distinction entre l'utilisation de stratégies formelles et informelles pour cultiver la pleine conscience. Découpler les effets indépendants de ces deux stratégies sur la perte de poids et les comportements alimentaires malsains est nécessaire afin d'examiner leurs effets différenciateurs sur divers comportements de santé.

Bien que ma méta-analyse ait démontré l'efficacité des interventions fondées sur la pleine conscience dans l'amélioration de certains résultats liés à l'obésité, les programmes existants comportent de longues séances de groupe, nécessitent un personnel hautement qualifié et ne sont pas largement accessibles à l'ensemble de la collectivité. L'intégration de programmes

communautaires de pleine conscience pour la gestion de l'obésité continue d'être un défi. Une façon de relever ce défi est d'élaborer un programme avec manuel qui pourrait être facilement accessible à l'ensemble de la collectivité.

L'objectif de mon deuxième manuscrit était donc d'élaborer et d'évaluer un bref programme d'alimentation consciente pour réduire la surconsommation chez les personnes en surpoids et obèses. Les résultats de mon projet pilote donnent à penser qu'une brève intervention consciente en matière d'alimentation pourrait être une solution efficace et abordable pour remédier à la surconsommation problématique dans le grand public. Cependant, il a été difficile d'élucider les effets indépendants de divers processus alimentaires conscients sur les résultats de l'étude. Cette difficulté est le résultat de plusieurs limitations psychométriques provenant d'anciens questionnaires sur l'alimentation consciente. Notamment, les questionnaires existants mettent l'accent sur les domaines attentionnels de la pleine conscience spécifique à l'alimentation, tels que l'attention actuelle aux indices homéostatiques de la faim et de la satiété, tout en omettant d'autres facettes importantes telles qu'une curiosité sans jugement et une décentralisation. L'ignorance de certaines caractéristiques clés de la pleine conscience pause des difficultés lorsque vous essayez d'étudier les mécanismes de changement.

Mon troisième et dernier manuscrit abordait ainsi les limites psychométriques des anciennes échelles alimentaires conscientes. Notamment, mon manuscrit décrit l'élaboration et la validation d'une échelle complète de l'alimentation consciente à travers une série de trois études. L'échelle de consommation consciente à quatre facettes (FFaMES) se compose de 29 éléments avec 4 facteurs qui évaluent à la fois les composantes de l'attention et des attitudes de la pleine conscience spécifique à l'alimentation. Les résultats de mon manuscrit témoignent de la fiabilité de l'échelle et de la validité de sa construction. À l'aide de cette nouvelle échelle, les recherches

futures devraient continuer d'étudier les effets différentiateurs de divers aspects de la pleine conscience propre à l'alimentation dans la prévention et le traitement de l'obésité et de ses comorbidités.

En somme, ma thèse fournit un examen détaillé des effets si la formation basée sur la pleine conscience sur la gestion de l'obésité. Les résultats de mes trois études fournissent d'autres preuves des effets différentiels de divers processus de pleine conscience sur le poids et les résultats liés à l'alimentation. La recherche future doit continuer à examiner ces processus afin de mieux comprendre le *comment* et le *pourquoi* des effets de la formation de pleine conscience sur les changements de comportement dans la gestion de l'obésité.

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Contributions of Authors

I am the first author of the three studies presented in this dissertation.

For my first manuscript, I conducted a comprehensive-effect size analysis on the effects of mindfulness-based interventions on weight loss and obesity-related eating behaviours. I was responsible for conducting the comprehensive literature search and the review of articles with the third author, Mia Günak. The second author, Dr. Bassam Khoury oversaw the effect-size analysis and provided consultation. I was responsible for conceptualizing and writing all sections of the paper. Dr. Knäuper assisted in the organization of the paper and edited the various iterations of the manuscript. All authors read and approved the final manuscript. The paper is published in *Obesity Reviews.*

For my second manuscript, I designed and conducted the pilot intervention, analysed the data, and prepared the manuscript for publication. Elena Dikaios assisted in conceptualizing and writing the discussion section as well as assisted in the manuscript's preparation. Dr. Bärbel Knäuper supervised all aspects of the study, from the conceptualization and development of the brief intervention to the preparation and editing of the manuscript. All authors read, edited, and approved the final manuscript. The manuscript is submitted to the journal of *Eating and Weight Disorders.*

For my third and final paper, I designed and conducted the three studies, analysed the data, and prepared the manuscript for publication. Syeda (Huma) Shireen assisted in the conceptualization process and the scale development phase. Nellie Siemers and Christian Preissner assisted in the manuscript preparation and data collection. Josh Starr and Dr. Carl Falk provided consultation and assistance in data analyses for studies 1 and 2. Dr. Bärbel Knäuper supervised all aspects of the project from its inception to the preparation of the manuscript. All

authors read, edited, and approved the final manuscript. The manuscript has been submitted to *Appetite*.

Original Contribution to Knowledge

The first manuscript in my dissertation provides a comprehensive effect size analysis to investigate the effectiveness of mindfulness-based interventions for obesity management. This was the first effect size analysis that explored the independent effects of mindfulness on weight loss and obesity-related eating behaviours. An investigation of its kind was necessary to address the limitations of several other reviews that included intervention components that were not mindfulness specific. This distinction between mindfulness and non-mindfulness strategies is important to disentangle certain confounds that can create difficulties in effectively determining the independent effects of mindfulness training on eating and weight outcomes. Moreover, our meta-analysis was the first of its kind to investigate the independent effects of formal and informal mindfulness techniques for weight management. This investigation was thus an important contribution because it provided further evidence for the independent effects of mindfulness interventions on obesity-related eating behaviours and weight loss.

The second manuscript was the first study of its kind to test the efficacy of a brief mindful eating program for addressing problematic overeating in individuals with overweight and obesity. This study highlighted the feasibility of implementing a manualised program to community-members by facilitators who are not experts in mindfulness. Even though several mindful eating programs include meditation practice, ours purposefully did not. Although we did not include meditation practice, our brief program achieved statistically significant post-treatment reductions in body weight and overeating, as well as increases in mindful eating and interoceptive awareness. Although these results are preliminary, they are noteworthy because they point to the question of active ingredients in mindful eating programs. In particular, are domain-specific skills sufficient to cultivate greater levels of eating-specific mindfulness or are

more traditional approaches, such as meditation practice, necessary? The preliminary results of the pilot study suggest that meditation practice may not be necessary for cultivating eating-specific mindfulness. This would render mindfulness programs more accessible to a wider range of people. Future research must continue to decipher the exact processes that drive the effectiveness of mindful eating intervention in order to further refine and improve them.

The third manuscript in my dissertation contributes to the literature by providing a comprehensive questionnaire to assess mindful eating. The development of this questionnaire addressed the psychometric limitations of former mindful eating scales. Specifically, previous mindful eating questionnaires emphasized the attentional domains of eating-specific mindfulness while not assessing other crucial domains such as a non-judgmental curiosity and decentering. The disregard of certain attitude features of mindful eating is particularly problematic when attempting to investigate mechanisms of change. The Four Facet Mindful Eating Scale (FFaMES) provides researchers with a psychometrically strong scale that can better assess all components of the mindful eating construct. This is particularly important for future research that investigates the differential effects of various mindful eating processes on health outcomes.

In sum, my three studies contribute to scientific knowledge by providing evidence for the differential effects of various mindfulness processes on weight and eating-related outcomes.

Chapter 1: General Introduction and Literature Review

Over two-thirds of North Americans are overweight or obese (Yang & Colditz, 2015). Obesity is the leading cause of preventable death worldwide and is associated with poorer mental health outcomes, reduced quality of life, as well as an increased risk for developing type II diabetes, heart disease, cancer, and stroke (Peeters et al., 2003; Janssen, 2013). Although a combination of causes and individual factors contribute to the development of obesity, one major factor are lifestyle behaviours. In other words, the successful prevention and treatment of obesity requires an individual to develop healthy eating and exercise habits that are sustainable over the long-term.

Behaviour Change Programs for Obesity Management

Over the past ten years, intensive behavioural change programs have become the gold standard for the treatment of overweight and obesity. Programs such as the Diabetes Prevention Program (Albright & Gregg, 2013) use a cognitive behavioural approach to help participants develop better diet and exercise habits (Olsen & Emery, 2015). They use techniques such as self-monitoring, problem-solving, and goal setting to help people change their habits. With the help of these techniques these programs aim to decrease certain identified barriers to behavioural change as well as to address psychological and environmental factors that are associated with long-term weight loss success (Delahanty et al., 2019). Although these programs are effective in the short-term, they are less successful in the long term (Butryn, Webb & Wadden, 2011): While participants lose an average of 7 to 10% of initial body weight at the end of the program (DPP Research Group, 2002), they tend to regain one-third of this lost weight within a year after treatment, and by five years approximately half of all participants will return to their original weight (Perri, Ariel-Donges & Wadden, 2018, Wing, 2011). Even the best examples of intensive

behavioural change programs have only succeeded in maintaining clinically relevant weight losses (≥ 5% of initial body weight) in half of their participants at follow-up (DPP Research Group, 2009; Look AHEAD Research Group; 2014). Because long-term weight management and behaviour modification remains a challenge, researchers have begun to investigate other programs that may be more fruitful in the longterm (Godsey, 2013). A potiential reasons why these Cognitive Behavioural Therapy (CBT) based behaviour change programs have been less effective in the long-term is that they do not efficaciously address emotion regulation difficulties that are associated with managing urges to eat for non-homeostatic reasons (Frayn & Knäuper, 2018). Specifically, these programs do not include emotion regulation as a target for therapeutic change. Instead, they emphasize increases in self-regulation for diet and exercise behaviours that may not be sustainable in the longterm, especially when experiencing high levels of emotional distress. Several approaches have thus been proposed to address the limitations of traditional behavioural weight loss interventions. These approaches include: Acceptance and Commitment Therapy (Hayes, Strosahl & Wilson, 2009), Dialectical Behaviour Therapy (Linehan, 1987), and Mindfulness-Based Therapy (Khoury et al., 2013).

Acceptance and Commitment Therapy for Obesity Management

Acceptance and Commitment Therapy (ACT; Hayes, Strosahl & Wilson, 2009) is a third-generation cognitive behavioural therapy that was desiged to increase psychological flexibility (Hofmann & Hayes, 2019). Psychological flexibility can be defined as an individual's ability to identify and manage barriers to therapeutic change in a way that is self-directed and proactive (Bond, Hayes & Barnes-Holmes, 2006). ACT has been theorized to be beneficial for weight management because it can encourage greater tolerance of internal (emotions) and external (food) experiences that prompt urges to overeat. Several ACT-based treatments specific to eating

behaviours have recently been developed to test the efficacy of these programs on weight related outcomes (e.g., Forman et al., 2013, Lillis et al., 2015; Niemeier et al., 2012). Three underlying skills have been theorized to contribute to the benefical effects of these programs on weight-related outcomes (Forman & Butryn, 2014; Katterman et al., 2014): (1) value clarification, (2) mindfulness, and (3) distress tolerance. Two out of these three fundamental skills, notablly, mindfulness and distress tolerance, are elements of Buddist principles that explore the nature of human suffering and the nature of the human experience (Hayes & Stricker, 2014). In other words, according to Buddist philosophy, human suffering is the product of an individual's inability to examine present-moment thoughts, emotions, and sensations without judgment. By improving one's non-judgmental awareness, an individual is better able to "sit with" their experiences rather than attempting to avoid or escape them. In line with this view, studies that have assessed the effects of ACT-based progams on weight-related outcomes have found significant associations between decreases in experiential avoidance and improvements in weight and eating behaviours (Manlick, Cochran & Koon, 2013; Lillis, Hays & Levin, 2011). In other words, as participants decrease their tendency to avoid uncomfortable experiences, they are more likely to lose weight and to reduce their tendency to overeat for non-homeostatic reasons (Rawal, Park & Williams, 2010).

Dialectical Behavior Therapy for Obesity Management

Dialectal Behavioral Therapy (DBT; Linehan, 1987) was originally developed to treat Borderline Personality Disorder (BPD). Individuals with BPD demonstrate reduced abilities to emotionally regulate. As such, DBT as a therapy aims is to increase an individual's ability to manage emotional distress. Specifically, the purpose of DBT-based therapies is to increase acceptance of emotional experiences and to reduce impulsive reactions (McKay, Wood, &

Brantley, 2019). DBT-based programs are theorized to be helpful for managing obesity-related eating behaviours because they emphasize affect regulation (Linehan, Bohus, & Lynch, 2007). This is a relevant target because many individuals with overweight and obesity use food to regulate negative emotions (Levitan & Davis, 2010). DBT-based skills may reduce episodes of non-homestatic eating by encouraging individuals to regulate their emotions without eating. Similar to ACT, DBT is informed by Buddist principales of non-judgmental observation of present-moment experiences. This ability to not-act on impulsive urges to overeat may be an important process of therapeutic change that requires further investigation. Currently, DBT has been apapted as a therapy for addressing Binge Eating Disorder (Dafer and Jo, 2010; Telch et al., 2001). Results of the clinical trial by Safer and Jo (2010) demonstrated significant improvements in emotional eating and the frequency of binge episodes. Another study by Roosen and colleagues (2012) found significant decreases in emotional eating. Further results of these studies suggest that the efffiacy of these interventions may be driven by their large emphasis on mindfulness-based principles. Similar to ACT-based programs, participants in these DBT trials were encouraged to develop a greater ability to accept and to tolerate their emotional experiences. This ability to accept and to tolerate uncomfortable experiences is a skill that is fundamental to mindfulness. By learning to tolerate distressing experiences (e.g., thoughts, emotions, physical sensations), participants are theorized to be less likely to impulsively act on their urges to eat when experiencing emotional distress. Due to the potiential significant role of mindfulness training for obesity management, the present dissertation will focus exclusively on the indepdent effets of mindfulness-based programs on weight loss and obesity-related eating behaviours. Although ACT and DBT contain components of mindfulness-based programs, they contain several non-mindfulness elements that may result in confounds.

Mindfulness-Based Therapy for Obesity Management

Past decades have seen a sharp increase in the use of mindfulness-based programs for obesity management. Western conceptualizations define mindfulness as a state of awareness that arises from purposefully attending to ongoing experiences in a non-judgmental and accepting way (Brown & Ryan, 2003; Kabat-Zinn, 2003; Shapiro, Carlson, Astin, & Freedman, 2006). This present-moment awareness is primarily thought to be cultivated through regular meditation practice (Kabat-Zinn, 2009; Siegel, Germer & Olendzkim 2009). When meditating, an individual is believed to develop or to improve their ability to sustain mindful awareness to present-moment experiences in a way that is non-judgmental. This non-judgmental awareness is theorized to transfer to daily life, thus promoting improvements in psychological wellbeing (Baer, 2011; Kabat-Zinn, 2009). Although mindfulness is primarily assumed to be cultivated via formal meditation practice, it can also be cultivated through non-formal exercises, such as mindful walking or mindful eating, that are incorporated into daily life.

In general, mindfulness training has been associated with increases in psychological well-being (Khoury et al., 2013, 2015). Specifically, higher levels of self-reported mindfulness are associated with greater levels of self-compassion (Neff & Dahm, 2015) and emotion regulation (Chambers, Gullone & Allen, 2009), as well as lower levels of rumination, anxiety, and depression (Desrosiers et al., 2013). Training in mindfulness may be helpful for treating and managing obesity for several reasons. Firstly, obesity-related eating behaviours such as emotional eating are theorized to derive from maladaptive responses to internal (thoughts, emotions, physiological sensations) and external (sight, smells) triggers to eat (Kakoschke, Aarts, & Verdejo-García, 2019; Van Strien, 2018). These maladaptive responses are understood as being largely rooted in an individual's inability to effectively employ introspective awareness

to facilitate the recognition and differentiation of various sensations of hunger, satiety, and emotional arousal (Elliston, Ferguson, Schüz, & Schüz, 2017; Goldschmidt et al., 2014; Willem et al., 2019) as well as an individual's reduced ability to emotionally regulate when under emotional duress (Evers, Marijn Stok, & de Ridder, 2010; Macht, 2008; O'Reilly, Cook, Spruijt-Metz, & Black, 2014; Van Strien, 2018). Mindfulness may therefore be an effective tool in obesity management because it is assumed to foster greater non-judgmental awareness of body-related sensations, thoughts, and emotions regarding food and food-related environments (Baer, Fischer, &Huss, 2005; Clementi, Casu, & Gremigni, 2017; Kristeller & Epel, 2014). By learning to "pause" and to non-judgmentally introspect desires and impulsive urges to eat, mindful eating is theorized to strengthen an individual's capacity to avoid the automatic trigger-response cycle that often accompanies obesity-related eating behaviours (Brewer et al., 2018; Kristeller, 2015). In other words, higher present-moment, non-judgemental awareness may assist an individual in recognizing and altering behavioural responses to internal cues (e.g., thoughts/ emotional reactions) and external cues (e.g., environmental triggers) that would otherwise go unnoticed.

Effectiveness of Mindfulness Training on Obesity and its Related Comorbidities

Over the past several years, a rising number of studies have begun to explore the effectiveness of mindfulness-based programs for reducing obesity-related eating behaviours and body weight. Past literature reviews and meta-analyses have reported significant improvements in binge-eating severity, emotional eating, external eating, impulsive eating behaviours, and weight loss (Carrière et al., 2018; Katterman et al., 2014; O`Reilly et al., 2014; Olsen & Emery, 2015; Ruffault et al., 2017; Rogers et al., 2017). Although weight loss and reductions in obesity-related eating behaviours are a target of these recently developed mindfulness-based programs, the content of these programs varies significantly. Some of these programs emphasize the

importance of formal meditation practice for behavioural change (Corsica et al., 2014; Mantizos & Giannou, 2014) while others focus on less traditional approaches such as mindful eating (Kidd et al., 2013; Timmerman & Brown, 2012).

In 2018, Carrière and colleagues (Chapter 2 of this dissertation) conducted a comprehensive effect size analysis to quantify the effectiveness of mindfulness-based programs on weight loss and eating behaviours associated with obesity (e.g., emotional eating). This meta-analysis was the first of its kind to begin exploring the differential effects of formal and informal mindfulness approaches on obesity-related outcomes. Results demonstrated that mindfulness-based programs are moderately effective for weight loss and largely effective for reducing problematic eating behaviours that are associated with obesity. Furthermore, the authors found larger effects for studies that used a combination of formal and informal approaches than for those that used formal strategies alone. However, no significant effects were found for informal mindfulness exercises on reductions in weight and obesity-related eating behaviours. Although all included studies used a mindfulness-based program, their implementation and program content varied. Some studies used a validated mindfulness-based protocol (e.g., MBSR, MB-EAT) while others used a modified version or a novel program that differed in treatment length and practice time. Moreover, less than half of the studies (i.e., 42 %) assessed changes in mindfulness using a validated measure and only one study assessed mindfulness at follow-up. This is particularly problematic given that these studies attributed the positive effects of these MBIs to increases in mindfulness. Without the use of validated measures of mindfulness, one cannot be certain whether the beneficial effects are the result of increases in mindfulness or due to other confounding variables. It is therefore crucial that future research includes at least one validated measure of mindfulness to better understand the unique benefits of changes in

mindfulness on obesity and its related comorbidities. Furthermore, it is important that future research begins to investigate the differential effects of formal and informal mindfulness approaches on weight loss and obesity-related eating behaviours such as emotional eating.

Update to Carrière et al. (2018)

Since the publication of this meta-analysis, a total of fifteen studies, including ten randomized controlled trials, one waitlist-controlled trial and four pre-post studies, evaluated the effects of mindfulness-based interventions on weight management among individuals with overweight and obesity. Among the ten randomized controlled trials, four reported reductions in post-treatment body weight (Chumachenko et al., 2021; Rahmani et al., 2018; Sant' Anna, et al., 2020; Woods-Giscombe et al., 2019), three reported decreases in dietary intake or reductions in obesity-related eating behaviours (Carpenter et al., 2019; Mantzios, Skillett, & Egan, 2020; Sant' Anna, et al., 2020), and four reported no changes in primary outcomes (Seguias & Tapper, 2018; Simonson et al., 2020; Tapper & Seguias, 2020; Whitelock et al., 2018). The waitlist-controlled trial (Schnepper et al., 2019) did not show significant reductions in weight although it did show significant changes in mindful eating. Of the pre-post studies, three studies reported changes in eating behaviours that are associated with obesity (Kristeller & Jordan, 2018; Lattimore, 2020; Mason et al., 2018;), whereas one study found no significant changes in outcomes (Wnuk et al., 2018). In sum, these 15 additional studies align with my previous meta-analytic results (Carrière et al., 2018). Namely, although there is evidence to suggest the efficacy of mindfulness-based training for addressing weight-related outcomes, there remain many questions in terms of how and why mindfulness enacts its beneficial effects on weight and eating behaviours. It is thus important that future research continues to explore the unique effects of mindfulness-based training on weight-related outcomes.

High discrepancies in the efficacy of mindfulness training for improving weight-related outcomes were also found in the 2018 meta-analysis. These discrepancies may be the result of several factors. One such factor may be the high levels of heterogeneity found across interventions. Specifically, there remains considerable variability in the methods and techniques used to promote mindfulness to address weight-related outcomes. For example, some studies use formal mindfulness exercises such as meditation practice (e.g., Sant' Anna et al., 2020; Wnuk et al., 2018) while other interventions encouraged participants to practice informal mindfulness exercises to target specific eating-related processes like cravings (e.g., Mason et al., 2018; Schnepper et al., 2019). These various instructional approaches may result in incongruent findings as well as present difficulties in identifying processes of therapeutic change (Carrière, Siemers, & Knäuper, in prep). It is thus important to begin discerning among these various approaches and to investigate their unique effectiveness in addressing weight-related outcomes such as emotional eating.

This variability in mindfulness approaches also extends to treatment dose. Of the fifteen included studies, treatment doses ranged from 20 hours to a one-hour lab inductions. These inconsistencies in treatment dose may play a role for differences in effectiveness. For example, programs that included a larger treatment dose (e.g., eight weeks, 2.5-hour sessions) reported significant effects on weight and eating behaviours (e.g., Rahmani et al., 2018; Woods-Giscombe et al., 2019;) whereas single-day lab inductions did not (e.g., Seguias & Tapper, 2018; Whitelock et al., 2018). Future research should further investigate the effects of mindfulness practice on related outcomes to better understand how practice influences the acquisition of mindfulness skills. Similar to the acquisition of any new skill, mindfulness must be practiced consistently and regularly in order to result in potential benefits (Kabat-Zinn, 2009). Although practice effects

seem obvious, almost none of the studies in the meta-analysis (Carrière et al., 2018) and the 15 additional studies published since 2018 measured time spent practicing. This is particularly problematic considering that mindfulness is assumed to increase via regular training (Lacaille et al., 2015). Such underlying assumptions cannot be verified if investigations do not measure time spent practicing this particular skill. Furthermore, only 40% of the 15 studies published since 2018 used a validated measure of mindfulness. This finding is similar to those of the 2018 meta-analysis. Consequently, it is difficult to ascribe the beneficial effects of mindfulness training on changes in mindfulness if mindfulness was not measured. Using a validated measure of mindfulness may furthermore help elucidate nonsignificant findings. Specifically, it may help verify whether the specific treatment efficaciously increased mindfulness. If the particular treatment did not significantly increase mindfulness, then it would be unsurprising to find significant changes in outcomes.

Objective of the Dissertation

Provided the aforementioned limitations of previous investigations, the purpose of the present dissertation is to further examine the independent effects of mindfulness-based programs on weight-related outcomes. Specifically, the aim of this dissertation is to provide clinically relevant information on the unique effects of mindfulness training in reducing obesity-related eating behaviours and improving weight management in individuals with overweight and obesity. This is done through a (1) comprehensive effect size analysis to quantify the effects of mindfulness-based programs on weight and eating behaviours among individuals with overweight and obesity (Manuscript 1); (2) developing and testing a pilot project to investigate the unique benefits of informal mindfulness strategies in improving tendencies to overeat for non-homeostatic reasons (Manuscript 2); and (3) developing and validating a comprehensive

mindful eating scale that assesses both the attitude and attention components of the construct (Manuscript 3). By better understanding the unique effects of mindfulness training, these three investigations will provide the literature with increased information on how mindfulness training contributes to therapeutic changes in weight-related outcomes.

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Chapter 2: Mindfulness-based interventions for weight loss: A systematic review and meta-analysis

Carrière, K., Khoury, B., Günak, M. M., & Knäuper, B. (2018). Mindfulness-based interventions for weight loss: A systematic review and meta-analysis. *Obesity Reviews*, *19*(2), 164-177.

Abstract

Background: An increasing number of studies are investigating the efficacy of mindfulness-based interventions (MBIs) for weight loss and obesity-related eating behaviours. However, the results of past reviews are inconsistent. Objective: To clarify these inconsistencies, we conducted a comprehensive effect size analysis to evaluate the efficacy of MBIs on weight loss and eating behaviours. Data source: Data sources were identified through a systematic review of studies published in journals or as dissertations in PsychINFO, PubMed, CINAHL, Web of Science, Medline and Scopus, ProQuest or OATD from the first available date to March 10, 2017. Review methods: A total of 18 publications (19 studies, n = 1,160) were included. Results: Mean weight loss for MBIs at post-treatment was 6.8 and 7.5 lb at follow-up. In pre–post comparisons, effect-size estimates suggest that MBIs are moderately effective for weight loss (n = 16; Hedge's g = .42; 95% CI [.26, .59], $p < .000001$) and largely effective in reducing obesity-related eating behaviours (n = 10; Hedge's g = .70; CI 95% [.36, 1.04], $p < .00005$). Larger effects on weight loss were found in studies that used a combination of informal and formal meditation practice (n = 6; Hedge's g = .55; CI 95% [.32, .77], $p < .00001$) compared with formal meditation practice alone (n = 4; Hedge's g = .46; CI [.10, .83], $p < .05$). Conclusion: Results suggest that MBIs are effective in reducing weight and improving obesity-related eating behaviours among individuals with overweight and obesity. Further research is needed to examine their efficacy for weight loss maintenance.

Introduction

Obesity has become a major health concern over the past decade [1] and is associated with decreased life expectancy [2]. It is a leading cause of preventable diseases, including type 2 diabetes, high blood pressure, heart disease and stroke [3]. Annual health care costs attributed to obesity are upwards of $207 billion in the US alone [4, 5]. Lifestyle change programs that focus on diet and exercise are considered a gold standard for obesity treatment and prevention [6, 7]. Despite their initial success, many of these interventions are less robust in the long-term [8]. Although participants lose an average of 7% to 10% of initial body weight [9], they tend to regain one-third of this lost weight within a year after treatment, and by five years approximately half of all participants will return to their original weight [10, 11]. Even the best examples of lifestyle change programs have only succeeded in maintaining clinically relevant weight losses (≥ 5% of initial body weight) in half of their participants at follow-up [12, 13]. Although lifestyle modification programs are effective in the short-term, long-term weight loss and its maintenance remain a challenge [14].

Overweight and obesity can be conceptualized as a dysregulation of various physiological and psychological processes [15-17]. It has been theorized that obesity-related eating behaviours are partially explained by a failure to recognize and respond to internal cues of hunger and satiety [18, 19]. This lack of internal awareness has been associated with more episodes of overeating [20] and a higher risk for weight gain [21, 22]. Weaker skills in emotion regulation have also been shown to be associated with certain obesity-related eating behaviours, namely emotional eating and stress eating [23, 24]. More than half of all individuals with overweight and obesity compulsively overeat in response to negative emotions [25, 26]. Consequently, emotional eating is a strong predictor of BMI [27-29] and is negatively associated with weight loss and its

maintenance [30-32]. Furthermore, the physiological discomforts associated with highly decreased caloric consumption and increased physical activity may also present an added barrier to long-term weight loss [33]. Although many individuals with overweight and obesity consider these sensations as extremely unpleasant [34-36], most lifestyle change programs do not provide effective strategies to manage or overcome them. As a result, successful weight loss and its maintenance may be hindered.

Because effective weight management requires continued self-monitoring of weight and food intake [37], including an increased awareness of external triggers that drive overeating [38], mindfulness training has been proposed as a tool to help solve the growing obesity problem [39]. It has been theorized that mindfulness training may facilitate long-term changes in diet and exercise [40, 41]. Behavioural modification is central to successful weight loss and its maintenance. Higher present-moment, non-judgemental awareness may assist an individual in recognizing and altering behavioural responses to internal cues (e.g., thoughts/ emotional reactions) and external cues (e.g., environmental triggers) that would otherwise go unnoticed. Mindfulness may also improve the long-term compliance of life-style changes necessary for weight loss by facilitating the tolerance of adverse discomforts associated with calorie-restrictions and increased physical activity.

Western contemporary psychology defines mindfulness as a state of awareness that arises from purposefully attending to ongoing experiences in a manner that is non-judgmental and accepting [42-44] (for a more comprehensive review of different definitions of mindfulness please refer to Khoury and colleagues [45]). This present-moment awareness is predominantly cultivated in two ways. The first way is through formal meditation practice, which requires an individual to designate specific times during the day to meditate, as seen in programs such as *Mindfulness-*

Based Stress Reduction (MBSR) [46] or *Mindfulness-Based Cognitive Therapy* (MBCT) [47]. The second, non-traditional approach is through informal exercises that are incorporated in daily life. During these exercises, individuals are asked to be completely aware of sensations experienced during everyday activities like walking or eating. Both approaches encourage a heightened awareness of body experiences, such as hunger and satiety, which may be fundamental in interrupting habitual responses to overeat when under emotional distress.

In the past five years, three systematic reviews and two meta-analyses have examined the effectiveness of mindfulness-based interventions (MBIs) on problematic eating behaviours and weight loss. In a review by Katterman and colleagues [48], improvements in binge-eating and emotional eating were reported for nine out of the eleven studies reviewed. Further support was provided by O'Reilly and colleagues [49] who documented improvements in binge-eating, emotional eating, and external eating in 18 out of 21 studies reviewed. Significant weight reductions were also reported by Olsen and Emery [33] in 13 out of 19 studies reviewed. A meta-analysis of twelve studies conducted by Ruffault and colleagues [50] revealed negative effects for mindfulness training on impulsive eating behaviours and binge-eating as well as positive effects on physical activity levels. No significant effects were, however, found for weight loss. An additional meta-analysis by Rogers and colleagues [51] investigated the effects of MBIs on weight loss, eating behaviours, and psychological outcomes in individuals with overweight and obesity. Findings showed large effects of MBIs on eating behaviours, medium effects on psychological variables, and small effects on BMI for the 15 included studies.

Although the aforementioned reviews and meta-analyses showed promising effects of mindfulness training on obesity-related eating behaviours and physical activity, including mixed effects on weight loss, they have several notable limitations. Except for Rogers et al. (2017), all

authors included studies that combined formal meditation practice (e.g., Mantzios & Giannou [52]), informal mindfulness exercises (e.g., Kidd, Graor & Murrock [53]), or a mixture of both (e.g., Daubenmier and colleagues [54]) in their investigations. As stated earlier, formal meditation practice and informal mindfulness exercises differ significantly and should therefore be analyzed separately. Separating both approaches will help to determine their independent effects on weight loss and other obesity-related outcomes, which, until now, remain unclear. Moreover, the reviews and meta-analyses included studies that incorporated complementary strategies such as *Acceptance Commitment Therapy* (ACT) [33, 49, 50], *Cognitive Behavioural Therapy* (CBT) [33, 48, 50, 51] and *Dialectical Behaviour Therapy* (DBT) [50]. Even though ACT and DBT fall under an umbrella of "third-wave cognitive behavioural treatments" (for a comprehensive review of third wave behavioural strategies see Öst [55]), they do not contain the same elements that form the basis of traditional mindfulness meditation approaches, while CBT does not contain any mindfulness-related element. Combining such strategies may therefore result in misleading interpretations. Furthermore, both meta-analyses did not examine mindfulness as a potential moderator of the intervention effects, even though previous meta-analyses have found that mindfulness strongly moderates the effects of included interventions [56-58]. Examining mindfulness as a potential moderator is important as it assists in distinguishing the effects of mindfulness practice from the effects of other complementary strategies. In addition, all previous reviews and meta-analyses did not include quality scores for the selected studies, which are important indicators of the strength of the findings. A final limitation is that the authors [48-51] combined clinical (e.g., binge-eaters) and non-clinical populations in their findings. This could be problematic as these two groups may differ significantly in terms of their responsiveness to MBIs. Examining these two

populations separately will allow the investigation of potential differences in effectiveness between these two groups.

Objectives

To address the aforementioned weaknesses, we conducted a comprehensive effect-size analysis to examine the efficacy of MBIs on weight loss and other obesity-related outcomes among individuals with overweight and obesity. The objectives are as follows: (1) quantify and compare the magnitude of the effects of MBIs on weight loss, (2) investigate mindfulness' role in the effectiveness of MBIs on weight loss, specifically comparing the effects of formal and informal practices on weight loss, and (3) to quantify effects and moderators of MBIs on psychological outcomes.

Methods

Eligibility criteria

All studies examining the effects of MBIs on weight loss were eligible for inclusion in the meta-analysis. Studies were excluded if (1) weight loss was not a primary treatment objective, (2) mindfulness was not a primary treatment method, or (3) the study did not include sufficient data to compute effect size. MBIs included in the meta-analysis were *Mindfulness-Based Stress Reduction* program (MBSR) [59], *Mindfulness-Based Cognitive Therapy* (MBCT) [47], *Mindfulness-Based Eating Awareness Training* program (MB-EAT) [60], and derivatives of the aforementioned programs. MBSR was first developed to facilitate stress reduction in medical patients, while MBCT was originally created to prevent recurrent relapse of major depressive episodes. Although MB-EAT was first developed as a treatment for binge-eating disorder [61, 62], derivatives of the program are currently being implemented in non-clinical populations as an intervention for weight loss (e.g. Timmerman & Brown [63]; Mason and colleagues [64]; Daubenmier

and colleagues [54]). Even though third-wave cognitive behavioural therapies such as ACT and DBT contain elements of mindfulness, they were excluded from our analyses as these programs include additional cognitive and behavioural components, which can lead to confounding interpretations regarding the effectiveness of mindfulness as a strategy for weight loss.

Information sources

Studies were identified by searching PsychINFO, PubMed, CINAHL, Web of Science, Medline and Scopus. Dissertations were identified by searching ProQuest and OATD. An additional manual search involved references from retrieved articles, and by using Google Scholar to access the searched papers.

Search

We used the search terms: *mindfulness*, *mindful*, *mindfulness-based stress reduction*, *mindfulness-based eating awareness training*; and *mindfulness-based cognitive therapy* in combination with *weight*, *weight loss*, *weight management*, *obesity*, or *overweight.*

Study selection

Eligibility assessments were performed in a non-blinded, standardized manner by the first author and were reviewed by the third author. Disagreements between reviewers were resolved through discussions, when required, authors from the original studies were contacted for clarifications or to request missing data in order to compute effect sizes.

Data collection process

We developed an electronic data extraction sheet, pilot-tested it on three randomly selected studies, and refined it accordingly. Data collection was conducted in September 2016 and revised in March 2017. When duplicate reports were identified for the same data, only the most current ones were included.

Data items

Information was extracted from each trial based on: (1) the characteristics of the trial (including the year of publication, design, randomization, blinding, therapist qualifications, number of participants, types of outcome measures, and follow-up time in weeks); (2) the characteristics of the intervention (including the target population, length of treatment, treatment type, i.e., informal or formal mindfulness, or a combination of both, treatment setting). In order to provide a separation between our categorization of informal and formal practices, interventions were only classified under the category of "formal" meditation practice when study participants were specifically asked and expected to meditate outside of their daily activities throughout the duration of the intervention; (3) the characteristics of the comparison group, in controlled studies (including the number of participants, type of control, type of treatment, and length of treatment); and (4) the characteristics of participants (including mean age, percentage of males/females, and mean attrition rate for included studies).

Risk of bias in individual studies

To minimize the influence of data selection, we included data pertaining to all available psychological and weight-relevant outcomes, including among others, perceived stress, depression, emotional eating, and cognitive restraint. Among potential mechanisms of action, we included measures of mindfulness and eating behaviours. When available, we included data from follow-ups.

We also included a study quality score, which was comprised of items based on Jadad's criteria [65] and others pertaining to mindfulness/meditation. The items include the program's adherence to traditional mindfulness-based interventions (MBSR, MBCT, MB-EAT): administration of measures at follow-up; use of validated mindfulness measures [44, 66, 67] (see Baer

[68] for a more comprehensive review of mindfulness assessment measures); and training of therapists/facilitators (i.e., formal training in mindfulness meditation). For controlled studies, items included, whether participants were randomized between the treatment and control groups, whether participants in both groups spent an equal amount of time in treatment, and whether evaluators or experimenters were blind in regards to the treatment/control conditions and/or participants were blind in regards to the study's hypotheses. For all binary items (i.e., true or false), a value of 1 was assigned if the item was true and a value of 0 was assigned if the item was false. For the study design, pre-post studies were assigned a value of 0; studies with a waitlist, no-treatment, or drop-out control group were assigned a value of 1; studies with an active treatment control were assigned a value of 2.

The inter-rater agreement was assessed by comparing the ratings of the first author (K.C.) to the ratings of the third author (M.G.), who received a written document including specific instructions on rating the studies and one-hour training about the rating procedure.

Results of individual studies

Hedge's g values for both clinical and mindfulness outcomes measures, and both post treatment and last follow-up are presented in Table 1.

Summary measures

The meta-analysis was performed by computing standardized differences in means. We completed all analyses using Microsoft Excel 2010 and Comprehensive Meta-Analysis, Version 3.070 [69].

Synthesis of results

Effect sizes were computed using means and standard deviations (SD) when available. For remaining studies, effect sizes were computed using others such as F, p, t *and* χ^2. In with-

group analyses, when correlations between pre- and post-treatment measures were not available, we used conservative estimate (r = .70) according to the recommendation of Rosenthal [70]. For all studies, Hedge's g, its 95% confidence interval (95% CI) and the associated z and p values were computed. To calculate the mean effect size for a group of studies, individual effect sizes were pooled using a random effect model rather than a fixed effect model, taking into account that the selected studies were not identical (i.e., their designs or target populations were not identical).

For all studies' groups, the mean Hedge's g, the 95% confidence interval (95% CI), and the associated p-values were computed. We systematically assessed the heterogeneity among studies in each group using I^2 and the chi-squared statistic (Q). I^2 measures the proportion of heterogeneity to the total observed dispersion and is not affected by low statistical power. Higgins, Thompson, Deeks, and Altman [71] suggested that an I^2 of 25% might be considered low, 50% might be considered moderate, and 75% might be considered high.

Risk of bias across studies

To assess publication bias, we computed the fail-safe N [70] and we constructed a funnel plot.

Additional analyses

According to the objectives of this meta-analysis, we conducted meta-regression analyses. The aim of a meta-regression is to explore one or more variables (called moderators) that account for the systematic differences in effect size, or outcome, that is being analyzed. In this meta-analysis, we only included pre-post effect sizes and we investigated two moderators: (1) study quality score and (2) treatment length. We also conducted a meta-regression analysis of the relationship between changes in mindfulness and eating behaviours on weight loss and psychological outcomes at post-treatment.

Results

Study selection

PSYCINFO searches produced 2024 publications, PubMed searches generated 373 publications, Web of Science yielded 369, CINAHL produced 94 publications, Cochrane Library generated 619 publications, and Scopus yielded 559 publications. We manually added seven publications, and then eliminated the publications that did not fit our inclusion criteria. This resulted in a final number of 18 publications (19 studies as one publication included two studies). Among these are 14 journal articles and four PhD dissertations. A detailed illustration of the study selection process is found in Figure 1.

Study characteristics

The effect size (Hedge's *g*) and other characteristics for each study are shown in Table 1. The total number of participants included in our meta-analysis was 1,160. Among them, 529 were assigned to a mindfulness-based intervention treatment and 548 were controls.

Most studies (*n* = 15) were conducted in 2010 or later and three were conducted in 2008. Overweight or obese individuals were the primary target of all studies. Eleven out of the 19 studies targeted adults from the general population, followed by students (*n* = 4), breast cancer survivors (*n* = 1), type II diabetics (*n* = 1), military employees (*n* = 1) and premenopausal women (*n* = 1). The majority of the participants (71.68%) were young adult females 37.53. The attrition rate was 24.96.

Risk of bias within studies

Table 1 presents the included studies and their quality scores. Four studies were (non-randomized) pre-post pilot studies, 14 were randomized controlled trials. Out of the 14 randomized controlled trials, two studies compared MBI to a waitlist control group [63, 54], seven

studies compared MBI to a standard weight loss program (of which five used a diet and exercise component similar to lifestyle change programs [77, 76, 64, 84], one used a diabetes self-management program [78], and one used psychoeducation for nutrition and exercise [81]), and five studies compared MBI to an active control group [52, 72-75].

Four of the 18 included papers used formal meditation practice as a primary intervention [52, 72, 74, 76] while seven studies used informal mindfulness exercises [53, 63, 73, 77-80] and the remaining seven studies used a combination of both [54, 64, 75, 81-84]. Due to a variation in protocols, treatment hours varied from five to 43.75, with a mean of 15.39. Eleven studies used at least one validated mindfulness measure, eight included a follow-up measure (average follow-up time was 16.25 weeks). Follow-up times were defined as the number of weeks following the active treatment. All follow-up analyses used the same calculated average of 16.25 weeks. Thirteen studies assured equal time between treatment and control groups. The quality score varied from a minimum of one (i.e., the lowest quality) to a maximum of nine (i.e., the highest quality) with a mean of 5.22 (*SD* = 2.46) and a median of 6. Inter-rater agreement was high (kappa = .95).

Results of individual studies

Hedge's *g* values for weight loss, eating behaviours, mindfulness, and clinical outcome measures at post-treatment and last follow-up for both within-groups (i.e., pre-post) and between-groups (i.e., MBI versus a control group) are presented in Table 1.

Synthesis of results

Weight loss. Results suggest moderate effects of MBIs on weight loss in pre-post analyses (n =16; Hedge's g = .42; 95% CI [.26, .59], p < .000001). Studies that used a combination of informal and formal meditation practice [54, 64, 75, 81, 82, 84] showed higher effects (n = 6; Hedge's g = .55; CI 95% [.32, .77], p < .00001) than formal meditation practice [52, 72, 74, 76]

alone (n = 4; Hedge's g = .46; 95% CI [.10, .83], p < .05). The effects of informal mindfulness exercises [53, 63, 73, 77-80] alone on weight loss were not significant (n = 6; p = .17). Effects of MBIs on weight loss were maintained at follow-up (n = 6; Hedge's g = .58; 95% CI [.12, 1.03], p < .05). Low to moderate effects of MBIs on weight loss were also found in controlled studies (n = 13, Hedge's g = .35; 95% CI [.02, .67], p < .05). Heterogeneity was high across all analyses (e.g., I^2 = 74.45, Q = 46.97 for controlled studies) suggesting caution in drawing definite conclusions. For studies comparing MBIs to lifestyle change programs, results were not significant (n = 5, p = .68). Studies that compared MBIs to an active control (e.g., resistance training, stress eating intervention), showed moderate effects on weight loss (n = 6; Hedge's g = .59; 95% CI [.04, 1.13], p < .05). Due to the limited number of studies, effects were however not significant at follow-up (n = 4, p = .21). At post-treatment, MBI participants lost an average of 6.8 pounds (n = 16), representing a 3.3% mean loss of initial body weight. Participants continued to lose weight at follow-up (n = 6), losing an average of 7.5 pounds, which constitutes 3.5% mean loss of initial body weight. At post-treatment, lifestyle change program participants lost an average of 9.6 pounds (n = 4), which constitutes 4.7 % mean loss of initial body weight. At follow-up, participants slightly gained weight, losing an average of 8.8 pounds (n = 2), representing 4.3 % mean loss of initial body weight.

Obesity-related eating behaviours. These behaviours include, among others, emotional eating, binge eating and restrained eating. Results suggest large effects of MBIs on obesity-related eating behaviours in pre-post analyses (n = 10; Hedge's g = .70; CI 95% [.36, 1.04], p < .00005); however, heterogeneity was high (I^2 = 88.73, Q = 79.86), suggesting caution in drawing definite conclusions. These effects were maintained at follow-up (n = 4; Hedge's g = .62; CI 95% [.13, 1.1], p < .05). Studies that used a combination of informal and formal meditation

practice showed high effects on eating behaviours (n = 5; Hedge's g = 1.15; CI 95% [.41, 1.89], p < .005). Results were not significant for studies that used formal meditation (p = .06) or informal meditation practice alone (p = .29). Moderate effects of MBIs on eating behaviours were found in controlled studies (n = 7; Hedge's g = .55; CI 95% [.26, .85], p < .0005), with low to moderate heterogeneity (I^2 = 42.79, Q = 10.49). Due to a limited amount of studies, effects were not significant at follow-up (n =5, p =.21).

Psychological Outcomes. Results from pre-post analyses suggest moderate effects of MBIs on anxiety (n = 3; Hedge's g = .44; CI 95% [.21, .69], p < .0005), with low heterogeneity (I^2 = 0, Q = .21); small effects on depression (n = 3; Hedge's g = .34; CI 95% [.08, .61], p < .05), with low heterogeneity (I^2 = 12.19, Q = 2.28); results were however not significant for stress (n =5, p =.07). Results were not significant at follow-up.

Mindfulness. Results form pre-post analyses suggest small effects of MBIs on mindfulness (n = 8; Hedge's g = .32, CI 95% [.12, .53], p < .005) with moderate heterogeneity (I^2 = 64.37, Q = 19.65). At follow-up, one study however yielded large effects (n = 1; Hedge's g = .76, CI 95% [.25, 1.27], p < .005). Results from controlled studies were not significant at follow-up (n = 3; p = .23).

Risk of bias across studies

The effect size for all pre-post analyses corresponded to a z value of 11.33 (p < .00001) indicating that 552 studies with a null effect size would be needed to nullify our results (i.e., for the two-tailed p value to exceed .05). Using the Trim and Fill method [85], three studies would need to fall on the right of the mean effect size to make the plot symmetric (Figure 2). Assuming a random effects model, the new imputed mean effect for all outcomes combined was Hedge's g = .32 (95% CI [.13, .58]). Similar results were obtained for the controlled studies, with a z value

of 4.35 ($p < .00005$) and a corresponding fail-safe N of 52. Using the Trim and Fill method [85], three studies would also need to fall on the right of the mean effect size to make the plot symmetric, the new imputed mean effect size for all outcomes combined was Hedge's $g = .28$ (95% CI [-.32, .59]). These analyses suggest that the effect size estimates were unbiased and robust.

Additional analyses

At the end of treatment, the average pre-post effect size of weight loss was positively moderated by changes in eating behaviours ($n = 9$; $\beta = .31$, $SE = .14$, $p < .05$) (Fig. 3) and weakly moderated by treatment hours ($n = 13$; $\beta = .02$, $SE = .005$, $p < .005$) as well as by study quality score ($n = 16$; $\beta = .07$, $SE = .005$, $p < .00001$). The average pre-post effect size was not moderated by changes in mindfulness from pre-to post treatment ($n = 7$, $p = .53$, ns). Psychological outcomes (i.e., anxiety, stress, and depression) were neither moderated by length of treatment ($n = 7$, $p = .58$), quality score ($n = 7$, $p = .96$) or mindfulness ($n = 3$, $p = .34$).

Discussion

Summary of evidence

The meta-analysis examined 18 papers using mindfulness-based interventions for a combined total of 1,160 participants. The results showed that MBIs were moderately effective for weight loss in both within and between-group analyses. Results additionally showed that MBIs were largely effective on eating behaviours in within-group analyses and moderately effective in between-group analyses (i.e., in comparison to a waitlist or to an active treatment). Five studies compared MBIs to active treatments; the effects were moderate, but this result cannot be generalized due to the limited number of studies and the differences among control

treatments (e.g., resistance training, stress eating intervention). In addition, the average attrition among participants in the selected studies (24.96%) was similar to the attrition rates (31 %) obtained in weight loss clinical trials [86]. These results suggest that MBIs are highly feasible and well received by individuals with overweight and obesity.

Our main objective was to determine if MBIs are effective in reducing weight and improving maladaptive eating behaviours among individuals with overweight and obesity. Our results showed that MBIs are moderately effective for weight loss and largely effective in reducing obesity-related eating behaviours. When compared to lifestyle change programs, even though effect size results were not significant, participants lost more weight in diet and exercise programs (4.7% of initial body weight) compared to MBIs (3.3% of initial body weight). However, at follow-up, participants in MBIs [52, 64, 73, 74, 76] showed continued weight loss (an additional 0.2% of initial body weight) loss while participants in diet and exercise programs [64, 75, 76, 81] slightly gained weight (an increase of 0.4% of initial body weight). These reductions in weight were moderated by changes in eating behaviours. Although these results are still preliminary, they suggest that MBIs might be more effective in the long-term.

Our second objective was to determine the role of mindfulness in the effectiveness of MBIs on weight loss. Our results showed that participants increased in trait mindfulness at post-intervention even though effect sizes were small (Hedge's g = .32). This result is inconsistent with previous meta-analyses [56-58] that found moderate to large increases in mindfulness following treatment. This inconsistency may, however, be explained by the included studies, which used a combination of formal (i.e. meditation practice) and informal mindfulness practices (i.e. exercises to increase eating-related awareness) whereas previous meta-analyses included studies that predominantly used formal meditation practice. Additionally, our results showed that

changes in measures of trait mindfulness did not moderate weight loss. This finding might be due to the limited number of selected studies that measured and reported mindfulness – only eight of 19 studies (42%) assessed and reported trait mindfulness. This lack of measuring or reporting mindfulness is a general criticism of mindfulness research that is highlighted by some authors [64, 65]. It is important that future research further investigate the role of trait mindfulness in weight regulation as it remains unclear how trait mindfulness affects weight-related behaviours.

Moreover, our results showed higher effects on weight loss for studies that used a combination of informal and formal strategies compared to formal meditation practice alone. The independent effects of informal mindfulness exercise were, however, not statistically significant. These results have important clinical implications as they suggest a benefit in combining both formal and informal mindfulness for weight loss. This advantage may result from a differentiating effect of informal and formal practices on various dimensions of mindfulness, namely effects on state versus trait mindfulness. Specifically, formal meditation practice may assist in strengthening dispositional or trait mindfulness (i.e., one's general tendency to be mindful [87]), whereas informal exercises may help strengthen state mindfulness (i.e. one's current expression of mindful attention and acceptance in every day activities [44]), specifically in the context of weight-related behaviours like eating and exercise. Research should incorporate both trait and state mindfulness measures to better capture these two dimensions and to further explore their comparative effects on weight loss and weight relevant behaviours associated with eating and physical activity.

Informal mindfulness exercises, like mindful eating, may also be important in reducing certain maladaptive eating behaviours by increasing awareness of hunger and satiety cues as well as taste satisfaction [60, 61] and decreasing impulsive tendencies to overeat when experiencing

negative emotions. Meditation practice, on the other hand, may additionally facilitate weight loss by increasing one's general ability to self-regulate. In fact, when meditating, an individual constantly redirects attention to on-going experience in a non-judgmental and accepting way [88]. This deliberate redirection of attention can be a mechanism through which general self-regulation capacity is increased, thus facilitating long-term behavioural change. For example, mindfulness meditation may assist an individual in increasing awareness of certain automatic patterns that drive their maladaptive eating behaviours. This in turn, may facilitate their disengagement from these automatic patterns [19]. If this is the case, mindfulness meditation may not only facilitate the tolerance of adverse discomforts associated with calorie-restrictions and increased physical activity, through non-judgmental awareness and acceptance, but it may also increase one's ability to initiate and maintain health-related behaviours in the long-term.

Our third and final objective was to examine the effects of MBIs on secondary outcomes (i.e., stress, anxiety, and depression). Results showed small to moderate effects on clinical measures, namely depression and anxiety. When calculating weighted means of studies measuring perceived stress, participants' levels of stress decreased from moderate levels at baseline (M = 15.07) to moderate-low levels at post-treatment (M = 13.64). This difference was, however, not statistically significant, probably due to the limited number (N = 5) of studies measuring stress and high heterogeneity among studies.

Limitations

When interpreting the findings of this meta-analysis, it is important to consider that even though all of the included studies used a mindfulness-based program, their implementations and program content varied. Some studies used a standard mindfulness-based protocol (e.g., MBSR, MB-EAT) while others used a modified version or a novel program that varied in treatment

length and practice time. Furthermore, included studies measured different variables using different scales. This diversity in study design and outcomes may have largely contributed to the observed heterogeneity in effect size. However, despite this heterogeneity, results support significant reductions in weight and obesity-related eating behaviours in six within-group and twelve between-group trials. Although all studies assessed the effectiveness of a MBI on weight loss and other obesity-related outcomes, less than half of the studies (i.e., 44.4%) included a validated measure of mindfulness and only one study assessed mindfulness at follow-up. This is particularly problematic given that these studies attributed the positive effects of these MBIs to increases in mindfulness. Without the use of validated measures of mindfulness, one cannot be certain whether these effects are the results of increases in mindfulness or due to other confounding variables. It is therefore important that future research include at least one validated measure of mindfulness.

Further limitations of our meta-analysis include the small number of selected studies, the assessed outcomes that widely varied across studies, and the high heterogeneity among study groups, which reduced, consequently, the specificity of obtained results. Due to the small number of included studies in the meta-analysis, we were inevitably required to use studies of varying quality, which we quantified via the study quality score.

Conclusions

Despite the aforementioned limitations, our results showed that MBIs are moderately to largely effective in reducing weight and improving obesity-related eating behaviours. Although average weight loss was modest at post-treatment (3.3% of initial body weight), continued decreases in weight at follow-up (3.5%) is encouraging and highlights the potential of using mindfulness training to support weight loss and its maintenance. More research is, however,

needed to examine the long-term effectiveness of MBIs on eating behaviours and weight loss maintenance. We recommend that further research investigate how integrating mindfulness training into lifestyle change programs can improve weight loss and produce better long-term results.

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Table 1

Description and effect size analyses of the efficacy of included studies

Study	Type Participants (*N*)	M. Age	% Female	Tx Group (*n*)	Comp. Group (*n*)	Rnd Ass	% Att	Tx hours	Outcome Measures (Mind. Measures)	Pre-Post *g*(*g*m)	Fup wks	PreFup *g*(*g*m)	Cntrl *g* post (gm)	Cntrl *g* fup (gm)	Sc
Alberts et al., 2010[84] (both)	Overweight and obese adults (19)	Tx+ Cntrl 51.88	Tx+ Cntrl 89.5	DGT +MT (10)	DGT (9)	Yes	0	10.5	Weight; G-FCQ-T	1.64	-	-	1.90	-	4
Barnes et al., 2016[80] (Informal)	Overweight and obese adolescents (40)	Tx+ Cntrl 16.2	Tx+ Cntrl 69.0	MB-EAT-A (18)	HE (22)	Yes	15.0	12.0	Weight; PSS; BES; TFEQ	-0.13	-	-	- 0.58	-	6
Blevins, 2008[76] (Formal)	College women (41)	Tx 21.0 Cntrl 21.0	Tx+ Cntrl 100.0	SBWL +MT (21)	SBWL (20)	Yes	43.9	6.0	Weight; BDI-II; STAI; QEWP-R (MAAS)	0.61	12	0.73	-0.61	-0.01	8
Chung et al., 2015[79] (Informal)	Overweight and obese AA women BC patients (26)	50.1	100.0	MEI (26)	-	-	15.4	12.0	Weight; (MEQ)	0.15 (0.38)	-	-	-	-	1
Corsica et al., 2014[74] (Formal)	Overweight adults (53)	Tx+ Cntrl 45.4	Tx+ Cntrl 98.0	MBSR-M (19)	SEI (20)	Yes	26.4	5.0	Weight; PSS; EADES-ESE	0.91	6	0.17	0.22	0.10	7

Table 1 *(continued)*

Study	Type Participants (*N*)	M. Age	% Female	Tx Group (*n*)	Comp. Group (*n*)	Rnd Ass	% Att	Tx hours	Outcome Measures (Mind. Measures)	Pre-Post *g*(*g*m)	Fup wks	PreFup *g*(*g*m)	Cntrl *g* post (gm)	Cntrl *g* fup (gm)	Sc
Dalen et al., 2010[83] (both)	Obese YMCA individuals (10)	44.0	70.0	MEAL (10)	-	-	0	12.0	Weight[1]; TFEQ; BES; BDI; BAI; PSS; (KIMS)	0.38 (0.42)	12	0.27	-	-	2
Daly et al., 2016[78] (Informal)	Obese adolescent Latinas (37)	Tx 15.4 Cntrl 15.6	Tx+ Cntrl 100.0	MEI (14)	TAU (23)	Yes	37.8	9.0	Weight; (MAAS)	-	4	-	0.95	-	5
Daubenmeir et al., 2011[54] (both)	Overweight and obese women (47)	Tx 40.4 Cntrl 41.4	Tx+ Cntrl 100.0	MPSE (24)	WLC (23)	Yes	25.5	29.5	Weight; BRS; WCSI; PSS; STAS; DEBQ (KIMS)	0.30 (0.64)	-	-	0.09 (0.86)	-	5
Davis, 2008[75] (both)	Overweight and obese adults (71)	Tx 45.5 Cntrl1 43.4 Cntrl2 46.2	Tx 95.0 Cntrl1 81.3 Cntrl2 86.7	SBWL +MT (24)	SBWL (24) SBWL +RT (23)	Yes	28.2	21.0	Weight; EBI (MAAS)	2.25 (0.20)	-	-	0.85 (-0.24)	-	8

Table 1 *(continued)*

Study	Type Participants (*N*)	M. Age	% Female	Tx Group (*n*)	Comp. Group (*n*)	Rnd Ass	% Att	Tx hours	Outcome Measures (Mind. Measures)	Pre-Post *g*(*g*m)	Fup wks	PreFup *g*(*g*m)	Cntrl *g* post (gm)	Cntrl *g* fup (gm)	Sc
Hamel, 2010[77] (Informal)	Overweight and obese adults (10)	53.8	90.0	MEI (10)	-	-	50.0	-	DEBQ; BDI-II (MAAS; MEQ)	0.15 (2.22)	-	-	-	-	1
Kidd et al., 2013[53] (Informal)	Obese women (12)	51.8	100.0	MEI (12)	-	-	42.0	10.0	Weight; CES-D; (MEQ)	0.04 (0.16)	-	-	-	-	2
Mantzios & Giannou, 2014[52] (Formal)	University students attempting weight loss (170)	Tx 22.4 Cntrl 23.4	Tx+ Cntrl 42.8	MM (83)	Act Cntrl (87)	Yes	10.6	14.0	Weight; (MAAS)	0.18 (0.10)	-	-	-	-	8
Mantzios & Wilson, 2014[73] (Study 2/3) (Informal)	University/ College students (136/122)	Tx+ Cntrl 21.1/ 23.3	Tx+ Cntrl 71.4/ 41.8	CC (36/48)	AC/ MM (36/50)	Yes	47.1/ 12.5	N/A	Weight; NATQ; CBAS; (MAAS)	0.15 (0.15)	12	1.59	0.32 (0.36)	-	6
Mantzios & Wilson, 2015[72] (Formal)	Military employees (88)	Tx1 22.4 Cntrl1 21.1 Cntrl2 22.2	Tx1+ Cntrl1+ Cntrl2 34.9	MM (29)	SC (29) Cntrl (30)	Yes	28.4	43.7	Weight	1.00	24	1.08	-	-	6

Table 1 *(continued)*

Study	Type Participants (*N*)	M. Age	% Female	Tx Group (*n*)	Comp. Group (*n*)	Rnd Ass	% Att	Tx hours	Outcome Measures (Mind. Measures)	Pre-Post *g*(*g*m)	Fup wks	PreFup *g*(*g*m)	Cntrl *g* post (gm)	Cntrl *g* fup (gm)	Sc
Mason et al., 2016[64] (both)	Obese adults (194)	Tx 47.2 Cntrl 46.8	Tx 79.0 Cntrl 86.0	SBWL +MT (100)	SBWL (94)	Yes	18.5	42.5	Weight; RED; PSS	-	48	-	-	-	7
Miller et al., 2012[82] (both)	Overweight and obese adults with type II diabetes (68)	Tx 53.9 Cntrl 54.0	Tx 63.0 Cntrl 64.0	MB-EAT-D (32)	DSME (36)	Yes	23.5	25	Weight	-	12	-	-	-	6
Spadaro, 2008[81] (both)	Obese and overweight adults (46)	Tx 45.8 Cntrl 44.8	Tx 83.3 Cntrl 90.9	SBWL+ MM (22)	SBWL (24)	Yes	23.9	23.9	Weight; EBI; (5FMQ; MAAS)	1.09	-	-	0.53	-	6
Timmerman & Brown, 2012[63] (Informal)	Healthy premenopausal women (43)	Tx+ Cntrl 49.6	Tx+ Cntrl 100.0	MREI (19)[1]	WLC (16)	Yes	18.6	12.0	Weight; EES; SEEBS	0.58	-	-	0.67	-	4

Table 1 *(continued)*

Note. Treatment and control groups: Att = Attrition; Cntrl = Control; Comp = Comparison; Fup = Follow-up (*Follow-up times were defined as the number of weeks following the active treatment*); *g* = Hedge's g of clinical outcomes; *g*m = Hedges g of Mindfulness and/or Compassion outcomes; M = Mean; Mind = Mindfulness; Rnd Ass = Random Assessment; Sc = Quality score; Tx = Treatment; Tx+Cntrl = Treatment and Control; wks = weeks; Interventions and conditions: Formal = Formal meditation practice; Informal = Informal mindful exercises; Both = A combination of Formal mediation practice and informal mindfulness exercises; AA = African American; AC = Abstract Construals; Act Cntrl = Active Control; BC = Breast Cancer; CC = Concrete Construals; DGT = Dietary Group Treatment; DGT+MT = Dietary Group Treatment plus Mindfulness Training; DSME = Diabetes self-management education; HE = Health Education; MB-EAT-A = Mindfulness-Based Eating Awareness Training for Adolescents; MB-EAT-D = Mindful-Based Eating Awareness Training for Diabetes; MBSR-M = Mindfulness-Based Stress Reduction – Modified; MEAL = Mindful Eating and Living; MEI = Mindful Eating Intervention; MM = Mindfulness Meditation; MPSE = Mindfulness Program for Stress Eating; MREI = Mindful Restaurant Eating Intervention; N/A = Not applicable; SBWL = Standard Behavioural Weight Loss Program; SBWL+MM = Standard Behavioural Weight Loss Program plus Mindfulness Meditation; SBWL+MT = Standard Behavioural Weight Loss Program plus Mindfulness Training; SBWL+RT = Standard behavioural Weight Loss Program plus Resistance Exercise Training; SC = Self-Compassion; SEI = Stress Eating Intervention; TAU = Treatment as Usual; WLC = Waitlist Control; Outcome measures**:** BAI = Beck Anxiety Inventory; BDI = Beck Depression Inventory; BES = Binge Eating Scale; BRS = Body Responsiveness Scale; CES-D = Center Epidemiologic Studies-Depression Scale; CBAS = Cognitive Behavioural Avoidance Scale; DEBQ = Dutch Eating Behaviour Questionnaire; EADES-ESE = Eating and Appraisal due to Emotions and Stress; EBI = Eating Behaviour Inventory; EES = Emotional Eating Scale; G-FCQ-T = General Food Craving Questionnaire Trait; KIMS = Kentucky Inventory of Mindfulness Skills; MAAS = Mindful Attention and Awareness Scale; MEQ = Mindful Eating Questionnaire; NATQ =

Negative Automatic Thoughts Questionnaire; PSS = Perceived Stress Scale; QEWP-R Questionnaire of Eating and Weight Patterns; RED = Reward-based Eating Drive; SEEBS = Self-Efficacy for Eating Behaviours Scale; STAI = State-Trait Anxiety Inventory; STAS = State-Trait Anxiety Scale; TFEQ = Three-Factor Eating Questionnaire; WCSI = Wheaton Chronic Stress Inventory; 5FMQ = Five Factor Mindfulness Questionnaire; [1] authors were contacted and did not provide standard deviation scores of weight loss.

Figure 1.

Flow diagram of the study selection process

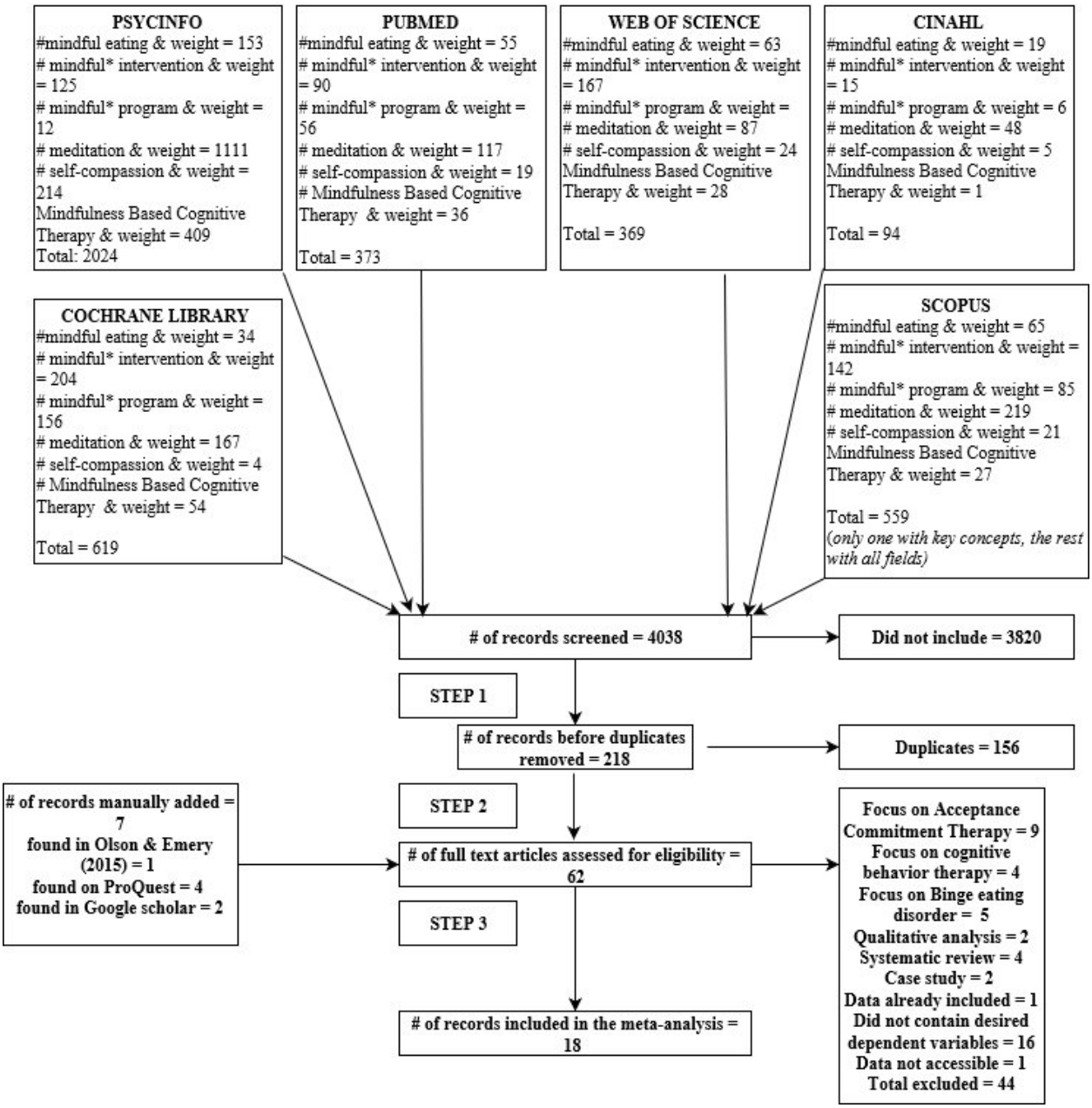


Figure 2.

Funnel plot of precision by Hedge's g for pre-post data

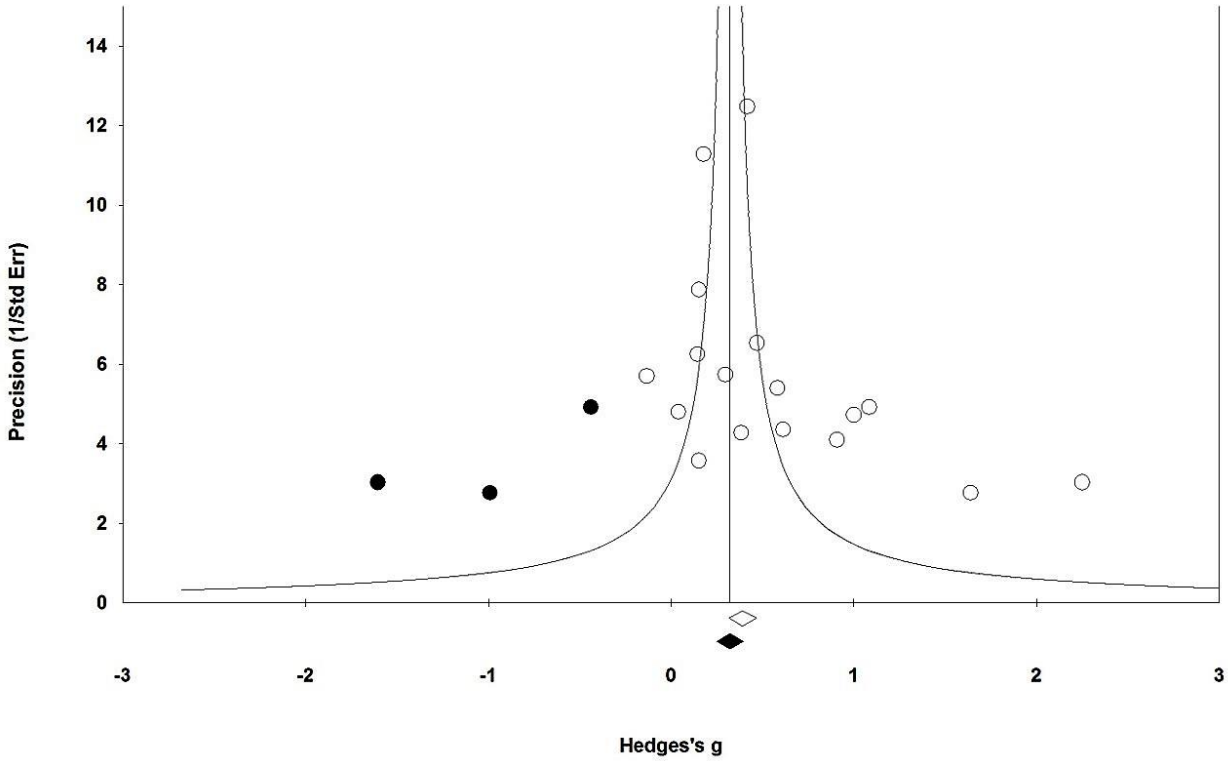
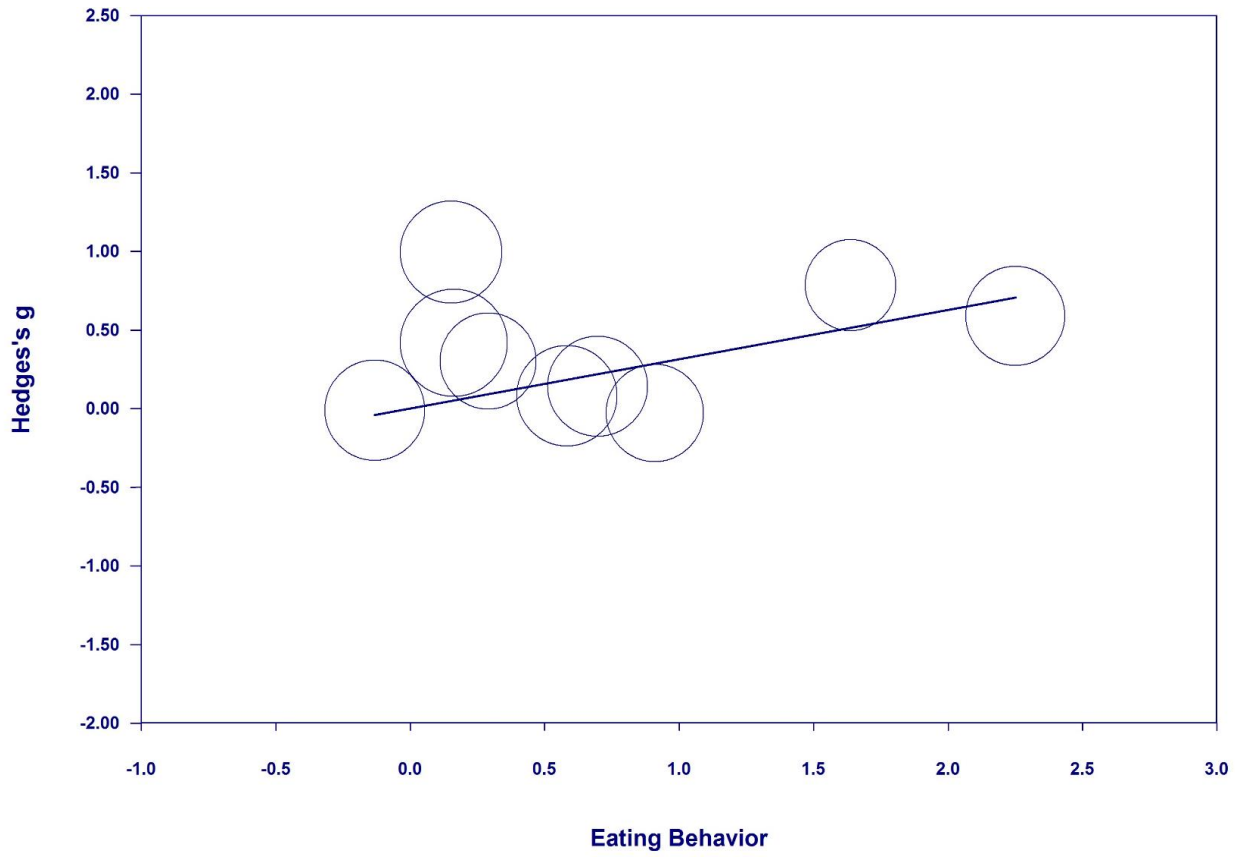


Figure 3

The relationship between changes in eating behaviour effect sizes and changes in weight loss at the end of treatment pre-post data



Preface to Chapter 3

Chapter 2 provided an overview of the effectiveness of mindfulness-based interventions for weight loss and reducing obesity-related eating behaviours. Although my effect size analysis showed that mindfulness-based interventions are beneficial for obesity management, the meta-analysis highlighted great variability in program content and strategies used to cultivate mindfulness in individuals with overweight and obesity. Specifically, there was a distinction between formal mindfulness-based approaches (meditation practice) and informal mindfulness-based approaches (e.g., mindful eating). Although both approaches encourage a heightened awareness of body experiences and non-judgmental equanimity, they may contribute differently to health-outcomes. Little research has thus attempted to decouple the independent effects of such strategies on obesity-related outcomes. The uncoupling of formal and informal approaches is necessary to better understand their independent effects on various processes that support behavioural change.

The purpose of the study described in Chapter 3 (i.e., Manuscript 3) was therefore to develop a brief mindful eating program that only used informal mindfulness strategies to address problematic overeating in individuals with overweight and obesity. The purpose of this pilot project was to gain insight into the independent effects of informal mindfulness approaches for obesity management. The data and insights gained from this project informed the development and validation of a new mindful eating psychometric scale that will be further elucidated in Chapter 4.

Chapter 3: Testing a brief mindful eating program for reducing obesity-related eating behaviors and body weight

Carrière, K., Dikaios, E., Frayn, M., Bernstein, I., & Knäuper, B. *Testing a brief mindful eating program for reducing obesity-related eating behaviours and body weight: Feasibility and proof of concept.* Manuscript under review at the Journal of Eating and Weight Disorders.

Abstract

Purpose*:** We evaluated the effects of a brief manualized mindful eating intervention as a treatment for overeating in individuals with overweight and obesity. The program consists of nine weekly 10- to 15-minute sessions. ***Methods: Self-report measures of overeating, mindful eating and interoceptive awareness were assessed, as well as the participants body mass index (BMI). Participants rated the extent to which they found the intervention helpful in addressing their tendency to overeat. ***Results***: Sixty-eight participants were recruited (91.12% female, mean age = 51.06). Forty-six participants were considered "intervention completers" (i.e., attending at least six of the nine brief sessions). These participants experienced significant reductions in self-reported overeating (p = .0001, Cohen's d = .88), as well as significant increases in self-reported mindful eating (p = .0001, Cohen's d = .76) and interoceptive awareness (p = .0001, Cohen's d = .94). Greater increases in mindful eating and interoceptive awareness were significantly correlated with greater reductions in overeating. Treatment effects were maintained at a 3- and 6-month follow-up. ***Conclusion***: Taken together, the results suggest an affordable and highly disseminable intervention to address problematic overeating in individuals with overeating and obesity.

Introduction

Overeating is one of the strongest predictors of obesity [1]. Individuals with overweight and obesity are more likely to compulsively overeat in response to environmental triggers [2] and negative emotions [3-4]. Effective eating regulation (i.e., not overeating) is largely determined by an individual's level of awareness and responsiveness to internal cues of physiological hunger and satiety [5-8]. This sensitivity to internal cues is called interoceptive awareness and has been shown to be lower in individuals with overweight and obesity [5, 9-11]. Consequently, lower sensitivity to internal cues of hunger and satiety is associated with more episodes of overeating [12] and an increased risk of weight gain [13-14]. Strengthening interoceptive awareness in individuals with overweight and obesity may therefore be beneficial in reducing certain maladaptive eating behaviours. Notably, awareness of internal cues of hunger and fullness may facilitate adaptive eating behaviours where eating-related decisions are guided by physiological sensations rather than emotions (e.g., boredom, stress, sadness) or environmental factors (e.g., large portion sizes, increased visibility of high calorie/high fat foods, tempting packaging).

Because adaptive eating regulation requires sensitivity and responsiveness to internal cues of hunger and satiety [5, 10, 15-18], mindfulness has been theorized as a potential tool for increasing interoceptive awareness and reducing certain obesity-related eating behaviours [19]. Mindfulness is defined as a state of conscious awareness that emerges from deliberately attending to experiences in the present moment in a way that is non-judgmental and accepting [20-22]. Although conceptualized as an inherent human trait that varies across individuals [23], one's capacity to be mindful can be further developed through regular mindfulness training such as meditation practice or informal mindfulness exercises [20]. By increasing non-judgmental awareness of homeostatic hunger (hunger driven by caloric needs) and satiety cues (the physical

sensations of homeostatic fullness), individuals with overweight and obesity may be better able to recognize and modify impulsive tendencies to overeat when experiencing a distressing emotion (e.g., sadness) or an external prompt (e.g., leftover donuts in the staff room). Learning to recognize and differentiate physiological hunger from non-physiological desires to eat may therefore help individuals to reduce maladaptive eating behaviours that perpetuate tendencies to overeat.

In recent years, many studies have demonstrated the efficacy of mindfulness-based interventions in reducing maladaptive eating behaviours and improving weight-related outcomes [24-28]. Several systematic reviews and meta-analyses have documented significant improvements in emotional eating, binge-eating, and external eating, as well as weight loss [29-33]. The content of such programs varies significantly as recently demonstrated in a meta-analysis [29]. Some of these interventions tend to emphasize the importance of formal meditation practice for behavioural change [34-36], while others focus on less traditional approaches such as mindful eating [37-39].

Mindful eating refers to the non-judgmental awareness of the physical and emotional sensations experienced while eating [40]. It has been shown to be associated with an increased sensitivity to the physical signs of hunger and satiety [40-41], as well as a heightened awareness of food-related triggers that elicit overeating [42-43]. This increased interoceptive awareness to internal and external cues may be fundamental in the self-regulation of eating behaviours, particularly when attempting to manage emotional overeating or urges to consume large quantities of high-caloric foods [7, 10, 44-46]. Mindful eating programs have indeed been shown to increase interoceptive awareness of hunger and satiety cues, reduce episodes of overeating [25, 46-48], and lead to significant weight loss in individuals with overweight and obesity [39,

50]. Supplementing these preliminary findings is cross sectional evidence showing that individuals who regularly eat mindfully are less likely to partake in maladaptive eating behaviours and consume large quantities of energy dense foods (41, 51).

Although recent research has demonstrated the efficacy of mindful eating programs in improving a variety of health-related outcomes, existing programs involve lengthy group sessions, require extensively trained staff, and are not widely accessible to the greater community. Most recently developed mindful eating-focused programs span the course of several weeks with time commitments in the range of at least 1 to 2 hours per session. Integrating these programs into the greater community may therefore be a challenge, particularly when accounting for the logistical burdens of engaging in such interventions over an extended period for both staff and participants. A potential way to increase the impact and accessibility of these programs is to identify and target their active ingredients to reduce content length. By exclusively focusing on the active ingredients and necessary skills required to cultivate mindful awareness of homeostatic hunger and satiety, the development of brief mindful eating interventions could be achieved. Due to their brevity and associated cost-savings, such programs could easily be scaled up for delivery in the community, thus increasing their scope and impact.

Current Study

The current study addresses the aforementioned challenges by developing a brief mindful eating program that encourages homeostatic awareness of hunger and satiety cues. The goal of the present research is to test the feasibility of the program in reducing overeating in individuals with overweight and obesity using a pre-post design. Healthy eating behaviours are the cornerstone of effective weight loss and its long-term maintenance [52-54] Unfortunately, eating behaviours are often not effectively addressed in weight loss programs even though individuals

with obesity are more likely to overeat in response to environmental triggers and emotions compared to those with normal weight [2, 32, 55]. Thus, this study examines whether reductions in overeating and weight are associated with increases in eating-related interoceptive awareness and mindful eating. Because our study was a proof of concept investigation, it did not employ a control group.

Methods

The study was approved by the Research Ethics and Compliance Board of the Faculty of Psychology and Graduate Studies office at McGill University (Montreal, Canada). Participants provided written consent prior to the start of the program.

Participants

Study participants were 46 adult employees and students (females = 42) from a Canadian University who endorsed overeating as a challenge to weight loss and successful weight management. The study was conducted between September 2017 and September 2018. Employees were eligible if they were overweight or obese (BMI of 25 to 45 kg/m^2) and expressed a willingness to commit to the program and to complete various assessment measures. Exclusion criteria included any limitation that would prevent full participation in the intervention or could have confounding effects on the primary outcomes, namely (1) having been pregnant in the past six months or planning on becoming pregnant in the next year, (2) undergoing treatment for cancer, (3) using medications that affect body weight or appetite, and (4) being diagnosed with bulimia nervosa, binge-eating disorder, major depression disorder, or another severe psychiatric disease (including dementia). Study participants were recruited through the use of flyers and email announcements (e.g., internal emails sent to faculty and staff).

Procedure

After providing informed consent, participants were assigned to a mindful eating group based on time preferences. The brief program was administered over nine weekly group sessions lasting between 10 and 15 minutes each. All group facilitators followed a standardized manual and protocol developed by the first author and PI of the project (available upon request). A maximum of five participants was assigned to each group to ensure an intimate and productive learning environment. Two facilitators administered the program. One facilitator was a clinical PhD student and the other was an undergraduate psychology research assistant. Both were trained by the PI in using the manualized protocol. Neither of the facilitators had substantial experience in mindfulness or mindful eating prior to their training. This was intentional so as to examine the efficacy of the standardized manual and protocol in guiding facilitators throughout the nine weeks. Specifically, our intention was to test whether or not the brief program could be easily taught by untrained mindfulness facilitators with the aim of increasing the program's accessibility to individuals with overweight and obesity.

Intervention

To maintain content brevity and enable participants to integrate new program content into their daily lives, each session was structured around one evidenced-based mindful eating exercise aimed at reducing compulsive tendencies to overeat. Throughout the program, participants were taught simple mindful eating exercises that focused on increasing mindful awareness of physiological cues (e.g., hunger, satiety), emotional states (e.g. stress, anxiety, boredom), as well as environmental triggers (e.g., potluck) that could prompt urges to compulsively overeat when not physically hungry. For example in Session 1, participants were introduced to a brief belly scan to encourage mindful awareness of their physical bodies, specifically that of their stomach region [56], and in Session 5, participants were introduced to

the STOP technique [57] as a means to minimize eating speeds and impulsive tendencies to eat when experiencing negative emotions or external cues that are unrelated to homeostatic hunger.

Altogether, the purpose of the program's various exercises was to assist participants in curbing the automaticity of their maladaptive eating behaviours by cultivating their ability to distinguish between sensations of homeostatic hunger (e.g., hunger pangs) and psychological hunger (e.g., an abrupt desire to eat in response to a stressful event). These simple evidence-based techniques and messages were reinforced through weekly homework exercises and the application of session techniques in daily life. To increase participant application of the taught techniques, previously learned techniques were regularly reviewed to facilitate the acquisition of knowledge and skills. In this sense, each session had a rehearsal component and built on previous sessions to encourage mastery of program content and the continuous practicing of all learned techniques.

Study Design

In order to evaluate the short and long-term effectiveness of the program, outcome measures were assessed at four time points: baseline, post-intervention, 3-month follow-up, and at a 6-month follow-up. We hypothesized that participants in the brief mindful eating program would report reduced levels of overeating (primary outcome) in addition to increased levels of mindful eating and eating-related interoceptive awareness at post-intervention (9 weeks). Additionally, we hypothesized that study participants would lose a significant amount of body weight following the brief program (secondary outcome). We further predicted that these effects would be maintained at the 3-month and 6-month follow-ups. Moreover, we predicted that greater increases in mindful eating and eating-related interoceptive awareness would be

associated with larger reductions in both overeating and body weight following the brief program.

Measures

Demographics. At the beginning of the study, participants provided demographic information including their age, gender, and any previous mindfulness experience.

Overeating. Overeating was measured using the *Overeating Questionnaire* (OQ) [58], which assesses significant habits, thoughts, and attitudes associated with overeating. Only the Overeating (OVER) subscale was administered in the study. This 10-item subscale assesses an individual's tendency to continue eating after homeostatic hunger is satisfied and has shown high internal consistency and adequate test–retest reliability [58]. Cronbach's alpha in this sample was .91.

Interoceptive awareness of eating-related cues. The 23-item *Intuitive Eating Scale-2* (IES-2) [59] was used to measure the participants' ability to recognize and respond to eating-related cues of homeostatic hunger and satiety. The IES-2 contains four subscales: unconditional permission to eat, eating for physical rather than emotional reasons, reliance on hunger and satiety and body-food choice congruence. Items are rated on a 5-point Likert-type scale (1 – "strongly disagree"; 5 – "strongly agree") with greater scores reflecting greater interoceptive awareness. The IES-2 has shown acceptable internal consistency and high retest reliability [59]. Cronbach's alpha in this sample was acceptable (.68). Similar reliability coefficients were reported in other investigations [60-61].

Mindfulness. Mindful eating was assessed using the *Mindful Eating Questionnaire* (MEQ) [62]. The 28-item scale includes five subscales that assess multiple domains of eating: dishibition, external cues, awareness, emotional response, and distraction. Items are rated on a

4-point Likert-type scale (1 – *never/rarely*; 4 – *usually/always*) with higher scores reflecting greater mindful eating. The scale has demonstrated adequate reliability and validity [61]. Cronbach's alpha in this sample was .87.

Data Analysis

All analyses were performed using R, version 3.6.3. [63]). Descriptive statistics, including means, standard deviations, and frequencies are included in Table 1. Analyses were only conducted on study completers. This procedure is suitable for studies that are exploratory in nature and whose primary goal is to evaluate new treatment programs [64].

Treatment Effects

Paired sample t-tests were used to compare baseline, post-treatment, and follow-up means on study outcomes. Alphas were set at .05 and effect sizes were calculated using Coden's *d*. A value between 0 and 0.3 is considered a small effect, 0.3 and 0.6 a moderate effect and a value over 0.6 as a large effect [65]. Assumptions of skewness and kurtosis were met for all outcome variables. When post-program scores were missing, the participant's last available data was used. For example, if a participant's post-program weight was not recorded due to absence, their last available recorded weight was carried forward as their post-program weight. Maintenance of treatment effects were calculated by comparing post-treatment scores to 3- and 6-month follow-up, respectively.

Results

Participants

Recruitment occurred over a 4-month period between September 2017 and December 2017. Out of 140 participants who expressed initial interest, 24 were deemed ineligible after a pre-screen and 48 were no longer available or interested in participating (Figure 1). Sixty-eight

participants were assigned to a group and completed the baseline questionnaire. Study participants were considered non-completers if they attended fewer than six sessions. Given the brevity of each session's content, a minimum of six sessions was considered essential for acquiring the fundamental skills taught in the program. Of the completers (N = 46), 4% attended six sessions (N = 2), 11% (N = 5) attended seven sessions, 24% (N = 11) attended eight sessions and 61% (N = 28) attended all nine sessions. Program attrition was 32.53% (see Figure 1 for dropout reasons). There were no significant differences at baseline between study completers (N = 46) and non-completers (N = 22) in all demographic variables and primary outcomes.

Mean age for program completers was 51.59 years (SD = 9.93). 91% were female (N = 42) and 76% (N = 35) identified as Caucasian. 41% were married or cohabitating (N = 19), 6% were separated or divorced (N = 3) and 33% (N = 15) had never been married and 20% specified "Other" (N = 9). With regards to education, 7% (N = 3) were high school graduates, 21% (N = 10) had some college/university education, 33% (N = 15) completed a bachelor's degree, 37% (N = 17) completed a graduate degree and 1 participant preferred not to answer. Forty-two participants reported earning more than the median Canadian individual income of $36,400 [66]. The majority of the sample (63%, N =29) did not have previous mindfulness experience. Mean BMI was 32.19 kg/m^2 (SD = 5.18) and ranged between 25.86 and 49.95. Sixteen of the participants were classified as overweight and 30 were classified as obese.

Effects of Intervention

Univariate analyses showed that all outcomes significantly differed over time. Within-subject contrasts demonstrated significant pre- to post-treatment decreases in overeating (p < .0001) and body weight (p < .001; M = 2.58 pounds), as well as significant increases in mindful eating (p < .001) and eating-related interoceptive awareness (p < .001). Specifically, after the

brief nine-week intervention, participants demonstrated a significant increase in their ability to recognize and respond to their internal cues of homeostatic hunger and fullness ($p < .001$), as well as a decrease in the tendency to engage in emotional ($p < .001$) and mindless eating ($p < .001$). Post-treatment changes were maintained at a 3-month and 6-month follow-up. However, weight regain occurred (Table 1).

Correlations

Pearson-product bivariate correlations were conducted to evaluate the associations between mindful eating, eating-related interoceptive awareness, overeating, and body weight. Greater increases in mindful eating were associated with greater reductions in body weight ($r = -.48$, $p = .001$) and overeating ($r = -.74$, $p = .0001$) at post-program. Greater increases in eating-related interoceptive awareness were not, however, statistically significantly associated with changes in weight ($p > .05$) but were associated with greater reductions in overeating ($r = -.48$, $p = .001$).

Treatment Satisfaction

Treatment satisfaction was assessed using a 5-point Likert-type rating scale where participants were asked to report on general and specific elements of the program (e.g., "The program was easy to follow", "The homework wasn't too difficult for me to complete"). Most of the study participants stated that the program assisted in reducing their tendency to overeat (90%) and was easy to follow (88%) and to integrate into their daily lives (86%) in the long-term (98%).

Discussion

The results of the present study provide preliminary support of the effectiveness of a brief mindful eating intervention delivered across nine 10- to 15-minute sessions. After the completion

of the brief program, participants demonstrated statistically significant reductions in overeating and body weight, as well as statistically significant increases in mindful eating and eating-related interoceptive awareness. The majority of these results was maintained at both a 3-month and 6-month follow-up.

Out of the study completers, more than half of the participants (68%) completed six or more sessions and out of these participants, 61% attended all nine sessions. This attrition rate (32.53%) is consistent with other behavioural weight loss interventions [67]. Furthermore, participants reported high treatment satisfaction such that the majority of participants reported that the intervention reduced their tendency to overeat, was easy to follow, and was easy to integrate into their daily lives. This positive endorsement is noteworthy because it speaks to the potential accessibility of the program. Program accessibility was further demonstrated by its method of delivery: To our knowledge, this brief mindful eating program is the first manualized intervention that is being delivered by nonexperts. Neither of the program's facilitators had substantial mindful eating expertise prior to the study and they were exclusively trained using the facilitator manual developed by the PI of the project. This is significant because it exemplifies a potential method of delivery that is relatively cost effective and easily integrated into the community. Specifically, the development and implementation of a brief manualized program that can be delivered by nonexperts could facilitate the dissemination of mindful eating skills to a large number of community adults who wish to address certain problematic eating behaviours that perpetuate obesity.

While participants maintained statistically significant changes in their eating behaviours, they did not maintain their significant weight loss at a 6-month follow-up. A number of factors may account for this. The primary objective of our brief program was to increase the participants'

mindful and interoceptive awareness to internal cues of hunger and fullness, as suggested by the homeostatic theory of obesity [8, 68]. However, preliminary research has demonstrated that increasing levels of interoceptive awareness without also encouraging interoceptive reliance (i.e. one's interaction with and use of bodily states and sensations to adapt behaviour) may paradoxically increase the risk of emotional overeating, due to a lack and effective employment of adaptive coping strategies [69]. For example, an individual who is developing interoceptive awareness for monitoring hunger and satiety cues may inadvertently become hyperaware of their non-homeostatic cravings to eat, which may inevitably increase their overall distress. If participants do not develop an ability to manage and tolerate these uncomfortable sensations and emotional states, they may unavoidably return to their maladaptive coping strategies (e.g. emotional eating) to alleviate their immediate distress. After overeating, an individual may feel increased negative affect and may once again eat in response to their distress, thus sustaining this vicious cycle of maladaptive eating. Future research should continue to decipher the importance of and interactions between interoceptive awareness and interoceptive reliance in the reduction of weight and obesity-related eating behaviours. Similarly, the development of awareness without acceptance appears to be limited in its ability to effectively address problematic eating behaviours. Namely, recent research has shown that high levels of self-focused attention are positively associated with negative affect, and that this association is reduced when attention is coupled with non-judgment and non-reactivity [70]. We also proposed that high levels of interoceptive awareness can be associated with increased emotional intensity [70]. Given that individuals with overweight or obesity demonstrate reduced emotion regulation abilities – including the tendency to compulsively overeat in response to negative emotions [3-4] – instructions to enhance awareness of the body, emotions, and thoughts may amplify negative

affect and result in overeating. Individuals with overweight and obesity may fare better in an intervention that develops the non-judgment and non-reactivity aspects of mindfulness, in addition to increasing awareness of internal cues of hunger and satiety. Such a program may encourage not only more mindful and intuitive eating, but also more equanimous and adaptive coping in the face of difficult emotions. A last possible explanation for the discrepancy between weight and eating outcomes at the 6-month follow-up is that in Session 5 of the program, participants were encouraged to eat five small meals a day, rather than three large ones, to facilitate reliance on hunger and satiety cues as well as to reduce the risk of overeating. It is possible that participants did not decrease their daily caloric intake over the course of the program, but rather spread the same amount of food over five smaller meals. Consequently, they may have reduced their frequency of overeating while still gaining the weight back slowly over time. It is also possible that participants increased their caloric intake unknowingly overtime. To increase the reliability and specificity of findings, future research could consider using daily food diaries or Ecological Momentary Assessment (EMA) to provide richer data on the effect of such interventions on eating behaviours [71].

Regardless of these discrepancies in weight and eating outcomes at the follow-up, an increasing number of studies have found that changes in eating behaviours, such as the reduced consumption of high fat, high sugar, and high calorie foods, can improve several health markers even in the absence of weight loss [72-75]. These treatment outcomes are particularly notable when considering the brevity of the program. Most recently developed mindful eating-focused programs are several weeks in length, with sessions typically at least 1 to 2 hours. These considerable time commitments present a significant challenge for the integration of these programs into the larger community. Our program of nine weekly 10- to 15-minute sessions

demonstrated similar effects as more intensive mindful eating programs. These preliminary results are encouraging because they suggest a potential solution to the logistical and economical burdens of attempting to implement full length mindful eating interventions in the general public. If brief programs are equally effective to their lengthier counterparts because they focus on the active ingredients, then they present an opportunity for greater accessibility and availability whereby these programs could be more easily integrated into the daily lives of those who require them.

In order to develop the most effective brief interventions, future research must continue to investigate the relevant processes that underlie the beneficial effects of mindful eating programs on various health-related outcomes. Although several eating specific mindfulness programs [76-78] include meditation practice, ours did not. In spite of that, our program still achieved statistically significant post-treatment reductions in body weight and overeating, as well as statistically significant increases in mindful eating and eating-related interoceptive awareness. While these results are preliminary, they are noteworthy because they point to the question of active ingredients of mindful eating programs: Are domain-specific skills sufficient to develop mindful eating or are more traditional approaches (i.e., formal meditation practice) required? Our preliminary results indicate that mediation practice might not be necessary to achieve effectiveness. It is fundamental that future research determines the exact processes that drive the effectiveness of these interventions in order to focus on them and to refine and enhance them further.

Of our study participants, only 35% reported having had previous mindfulness experience. A limitation of many mindfulness-based interventions is the potential for a self-selection bias. Notably, that a participant's decision to dedicate large amounts of time to formal

meditation practice is atypical and is presumably associated with a configuration of individual differences [79]. In a recent census, only 14.2% of American adults [80] reported having practiced meditation at least once in the last year. Although meditation practice has gained popularity over the past decade [80], it still is only being sought out by a minority of people. Consequently, it may be necessary to develop programs that do not emphasize formal meditation practice but rather encourage the incorporation of mindfulness skills through informal training exercises. Our program did not include meditation practice and thus presents an opportunity for those individuals who are not interested in pursuing formal practice as a means to address their problematic eating behaviours. The incorporation of mindful eating exercises into daily life, in the absence of formal meditation, increases the program's accessibility. Future research must continue to test the efficacy of mindfulness interventions that do not incorporate meditation practice as means to appeal to a greater audience of individuals seeking help.

Limitations

Limitations of the present study include a small sample size and a lack of a control group. Due to the nature of the intervention as a feasibility study, the goal was to provide proof-of-concept rather than compare the intervention to a control condition in a larger RCT. Also, the majority of participants were Caucasian, female, and university educated, so future research should focus on testing such interventions in a more diverse population. Finally, eating behaviours were assessed through self-report questionnaires.

Future Directions

Findings from the present study may help to provide direction for future research. First, as mentioned in our limitations, upon establishing initial feasibility, it would be useful to test the intervention against a control condition (e.g., standard behavioural weight loss treatment) to

determine its efficacy in a larger sample. It would also be pertinent to ensure greater diversity in the sample to increase the generalizability of results. Furthermore, it could be useful to test the intervention in other real-world settings, for example in primary care, to help expand the accessibility of such interventions. Moreover, future interventions should test the efficacy of brief interventions that also target the development of the non-judgment and non-reactivity features of eating-specific mindfulness to encourage more adaptive coping strategies when experiencing difficult emotions.

The present study additionally supported the efficacy of a mindfulness-based intervention that did not incorporate formal meditation as a component. Given that most mindfulness interventions do include meditation, it would be informative to test those with and without formal meditation side-by-side to compare effects. Isolating the effects of meditation may help to identify if and what meditation adds to mindfulness interventions, while also helping to tailor interventions to those who find meditation more versus less appealing (i.e., including it when beneficial and removing it when detrimental).

Conclusions

Findings from the present study support the feasibility and initial efficacy of a brief mindful eating intervention for addressing overeating, thus challenging the notion that such interventions have to be time and resource intensive to be effective. Given the large proportion of the population that struggles with eating and weight concerns, future interventions should focus on optimizing brevity and efficacy to ultimately increase availability and accessibility.

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Table 1

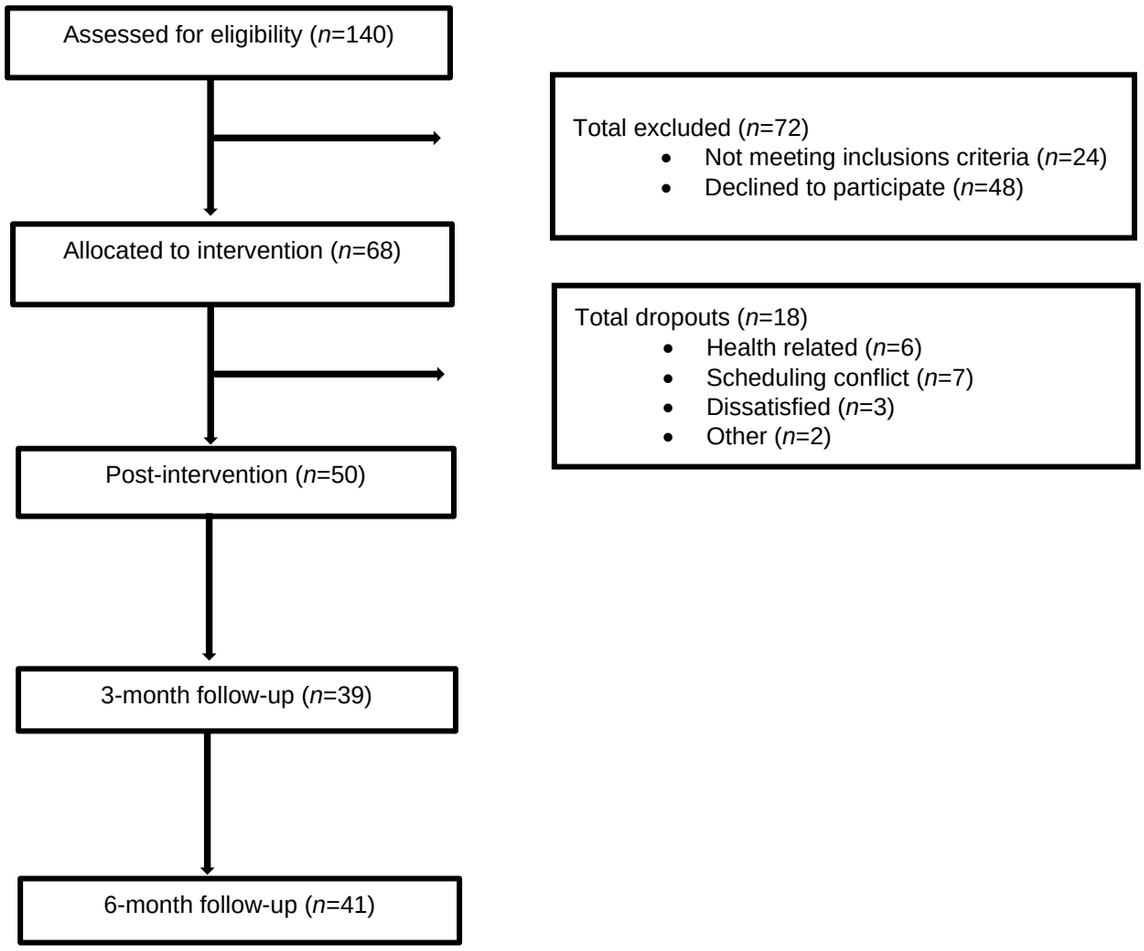
Pre-, post- and follow-up scores with paired sample t tests for study completers

Outcome	Baseline (*N* = 46)	Post-assessment (*N* = 44)					3-month follow up (*N* = 39)				6-month follow up (*N* = 41)			
	M(*SD*)	*M*(*SD*)	*t*	*p*	*d*	CI	*M*(*SD*)	*t*	*p*	CI	*M(SD*)	*t*	*p*	CI
Weight	185.37 (39.14)	182.79 (39.01)	6.24	0.0001	0.92	[1.75, 3.41]	184.33 (41.48)	-0.92	0.37	[-2.83, 1.07]	185.91 (42.04)	-.86	0.40	[-4.23, 1.71]
OEQ	2.71 (0.92)	2.13 (0.74)	5.88	0.0001	0.88	[0.40, 0.78]	2.15 (0.82)	-1.01	0.32	[-0.20, 0.07]	2.09 (0.67)	.33	0.74	[-0.15, .21]
MEQ	2.56 (0.46)	2.92 (0.40)	-4.98	0.0001	0.76	[-0.54, -0.23]	2.99 (0.35)	-1.10	0.28	[-0.15, 1.10]	2.93 (0.39)	.33	0.74	[-0.10, 0.12]
Disinhibition	2.53 (0.64)	2.97 (0.59)	-5.34	0.0001	0.81	[-0.65, -0.29]	3.11 (0.58)	-1.79	0.08	[-0.23, .01]	3.08 (0.48)	-1.57	0.12	[-0.22, 0.03]
Awareness	2.50 (0.61)	2.92 (0.53)	-4.41	0.0001	0.67	[-0.65, -0.24]	2.96 (0.50)	-.54	0.60	[-0.21, 0.12]	2.87 (0.53)	1.02	0.31	[-0.70, 0.22]
Emotion	2.70 (0.79)	3.18 (0.68)	-4.33	0.0001	0.66	[-0.68, -0.25]	2.29 (0.55)	-.71	0.48	[-0.17, .08]	3.10 (0.65)	1.54	0.13	[-0.04, 0.28]
Distraction	2.47 (0.66)	2.81 (0.48)	-2.85	0.007	0.43	[-0.53, -0.09]	2.84 (0.53)	-.44	0.66	[-0.19, 0.12]	2.89 (0.50)	-0.69	0.49	[-0.19, 0.09]
External	2.61 (0.55)	2.76 (0.59)	-1.88	0.07	0.28	[-0.35, 0.01]	2.74 (0.62)	-.05	0.96	[-0.17, 0.16]	2.72 (0.65)	.76	0.45	[-0.11, .25]
IES	2.99 (0.57)	3.41 (0.50)	-6.08	0.0001	0.94	[-0.56, -0.28]	3.44 (0.51)	-.22	0.82	[-0.13, .11]	3.44 (0.47)	-0.44	0.66	[-0.15, 0.10]
Cue reliance	2.90 (0.72)	3.63 (0.69	-5.97	0.0001	0.90	[-1.00, -0.50]	3.54 (0.63)	.53	0.60	[-0.16, .27]	3.55 (0.68)	.77	0.45	[-0.15, 0.33]
Food congruence	3.48 (0.85)	3.98 (0.63)	-4.70	0.0001	0.71	[-0.71, -0.29]	3.89 (0.70)	1.05	0.30	[-0.10, .30]	3.87 (0.73)	.56	0.58	[-0.10, 0.26]
Permission	3.09 (0.66)	2.98 (0.58)	.98	0.34	0.30	[-0.09, 0.27]	3.18 (0.57)	-2.63	0.01	[-0.32, -0.04]	2.23 (0.59)	-3.66	0.001	[-0.40, -0.12]
Physical	2.81 (0.99)	3.36 (0.95)	-4.52	0.0001	0.68	[-0.77, -0.30]	3.39 (0.98)	.16	0.88	[-0.19, 0.23]	3.35 (0.89)	.23	0.82	[-0.19, 0.24]

Note. *MEQ* = Mindful Eating Questionnaire, *IES* = Intuitive Eating Scale- 2, *OEQ* = Overeating Questionnaire.

Figure 1.

Participant flow chart



Preface to Chapter 4

Chapter 3 (i.e., Manuscript 3) described a pilot study that investigated the effectiveness of a brief mindful eating program for reducing problematic overeating in individuals with overweight and obesity. This study highlighted the feasibility of implementing a manualised program by non-mindfulness experts for community-members. The preliminary results of the study are noteworthy because they point to the question of active ingredients in mindful eating programs. Specifically, are domain-specific skills sufficient to cultivate greater levels of eating-specific mindfulness or are more traditional approaches such as meditation practice necessary? This question is crucial for refining and improving future mindful eating interventions. It was however a challenge to acquire this information in that study. This difficulty was the result of several psychometric limitations from former mindful eating questionnaires. Although previous mindful eating questionnaires highlight the attentional domains of eating-specific mindfulness, they did not assess other important facets such as non-judgmental equanimity. This exclusion of certain key features of mindfulness is a limitation in as much as it prevents the comprehensive assessment of mindful eating.

The purpose of Chapter 4 (i.e., Manuscript 4) is to thus develop and validate a comprehensive measure of mindful eating. Developing a scale that can assess both the attentional and attitudinal facets of mindful eating will provide the literature with a psychometrically strong scale that can validly assess all components of the construct. This is particularly important for determining the differential effects of various mindfulness processes on weight and eating-related outcomes.

Chapter 4: Development and Validation of the Four Facet Mindful Eating Scale (FFaMES)

Manuscript 3

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Development and validation of the Four Facet Mindful Eating Scale (FFaMES).

Manuscript under review at Appetite.

Abstract

Objectives: Previous mindful eating scales stress the attentional domains of eating-specific mindfulness such as present-moment attention to homeostatic cues of hunger and satiety, while discounting other important domains such as a non-judgment and decentering. The purpose of the series of studies was to develop and evaluate a multifaceted mindful eating scale that assesses several domains of eating-specific mindfulness. **Methods**: A multistep process was used to construct the *Four Facet Mindful Eating Scale* (FFaMES). Study 1 outlined the initial scale construction and the development of a novel item pool (N = 480). Study 2 examined the internal structure of the observed variables using exploratory analysis (N = 445) and confirmatory analysis in a separate sample (N = 445). Reliability and validity were assessed in Study 3 (N = 166). **Results**: The final scale consists of 29 items with 4 factors: Non-Reactance, Non-Judgment, External Awareness, and Internal Awareness. The FFaMES demonstrated good internal consistency, retest reliability as well as preliminary convergent and divergent validity. **Conclusions**: Our findings provide reliability evidence and initial support for the construct validity of the FFaMES and for the continued study of multiple facets of eating-specific mindfulness. Future research should continue to investigate the differential effects of various aspects of eating-specific mindfulness in the prevention and treatment of obesity and its comorbidities.

Introduction

Currently, two-thirds of North Americans have overweight or obesity (Chassé & Fergusson, 2017). Obesity is the leading cause of preventable diseases such as type 2 diabetes and heart disease (Janssen, 2013). Annual health care costs attributed to obesity are estimated upwards of $11.08 billion in Canada (Tran, Nair, Kuhle, Ohinmaa, & Veugelers, 2013) and $207 billion in the US (Cawley & Meyerhoefer, 2012; Finkelstein, Trogdon, Cohen, & Dietz, 2009) alone. As such, interventions aimed at increasing healthy eating habits and long-term weight management are warranted.

In recent years, there has been an increased interest in investigating the effectiveness of mindfulness-based programs for obesity treatment (Godsey, 2013; Rogers, Ferrari, Mosely, Lang, & Brennan, 2017; Ruffault et al., 2017; Warren, Smith, & Ashwell, 2017). Past literature reviews and meta-analyses have reported significant improvements in binge-eating severity, emotional eating, external eating, impulsive eating behaviours, and weight loss (Carrière, Khoury, Günak, & Knäuper, 2018; Katterman, Kleinman, Hood, Nackers, & Corsica, 2014; O`Reilly et al., 2014; Olsen & Emery, 2015). Although weight loss and reductions in obesity-related eating behaviours are a target of these recently developed mindfulness-based programs, the content of these programs vary significantly. Some of these programs emphasize the importance of formal meditation practice for behavioural change (Corsica et al., 2014; Mantizos & Giannou, 2014; Mantizos & Wilson, 2015) while others focus on less traditional approaches such as mindful eating (Kidd, Graor, & Murrock, 2013; Mantizos & Wilson, 2013; Timmerman & Brown, 2012). Although preliminary evidence has been found for the effectiveness of both programs (Barnes & Kristeller, 2016; Chung et al., 2016; Corsica et al., 2014; Daly, Pace, Berg, Menon, & Szalacha, 2016; Dunn et al., 2017; Mantizos & Giannou, 2014; Mantizos & Wilson, 2014, 2015), training in mindful eating has gained increased attention due to its domain-specificity and the ease with which it can be integrated into daily life (Schultz, 2018).

Mindful Eating

Mindful eating is typically defined as “the non-judgmental awareness of physical and emotional sensations while eating or in a food-related environment” (Framson et al., 2009). Similar to other conceptualizations of mindfulness (Bishop et al., 2004), mindful eating can be theorized as comprising two fundamental facets. The first facet is attention, which consists of an individual’s ability to bring present-centered awareness to all thoughts, emotions, and physical

sensations that accompany eating-related experiences. The second facet is attitude, which consists of an individual's ability to defuse from negative-self judgment and to respond to eating-related experiences with acceptance and equanimity (Juneau, Shankland, & Dambrun, 2020; Shapiro, Carlson, Astin, & Freedman, 2006). Obesity-related eating behaviours such as emotional eating are theorized to stem from maladaptive responses to internal (thoughts, emotions, physiological sensations) and external (sight, smells) triggers to eat (Kakoschke, Aarts, & Verdejo-García, 2019; Van Strien, 2018). These maladaptive responses are understood as being largely rooted in an individual's inability to effectively employ introspective awareness to facilitate the recognition and differentiation of various sensations of hunger, satiety, and emotional arousal (Elliston, Ferguson, Schüz, & Schüz, 2016; Goldschmidt et al., 2014; Willem et al., 2019) as well as an individual's reduced ability to emotionally regulate when under emotional duress (Evers, Marijn Stok, & de Ridder, 2010; Macht, 2008; O'Reilly, Cook, Spruijt-Metz, & Black, 2014; Van Strien, 2018). Mindful eating may therefore be an effective tool in obesity management because it is assumed to foster greater non-judgmental awareness of body-related sensations, thoughts, and emotions regarding food and food-related environments (Baer, Fischer, & Huss, 2005; Bays, 2009; Clementi, Casu, & Gremigni, 2017; Kristeller & Epel, 2014). By learning to "pause" and to non-judgmentally introspect desires and impulsive reactions to eat, mindful eating is theorized to strengthen an individual's capacity to avoid the automatic trigger-response cycle that often accompanies obesity-related eating behaviours (Brewer et al., 2018; Kristeller, 2015).

In recent years, a growing number of studies has demonstrated the efficacy of mindful eating interventions in reducing obesity-related eating behaviours and body weight (e.g., Alberts, Mulkens, Smeets, & Thewissen, 2010; Blevins, 2008; Corsica, Hood, Katterman, Kleinman, & Ivan, 2014; Dalen et al., 2010; Daly et al.,2016; Kidd, Graor, & Murrock, 2013; Mantzios & Giannou, 2014; Mantzios & Wilson, 2014; Mason et al., 2016; Tapper et al., 2009). Training in eating-specific mindfulness has been shown to increase awareness of the physiological sensations of homeostatic hunger and fullness (Clementi et al., 2017; Clifford et al., 2015; Dalen et al., 2010), as well as environmental (Baer et al., 2005; Bays, 2009) and emotional triggers to eat (Daubenmier et al., 2011; Kristeller, Wolever, & Sheets, 2013), all of which are fundamental in decreasing mindless overeating that is associated with obesity (Warren et al., 2017).

Although the empirical literature on the efficacy of mindful eating interventions has been growing rapidly, few studies have examined the mechanisms or processes by which the practice of mindful eating leads to beneficial outcomes. Psychometrically sound methods for assessing eating-specific mindfulness are required for the clarification of these processes. Such measures are necessary to examine whether individuals who practice mindful eating become more mindful over time and whether these changes mediate the effects of mindfulness training on various health outcomes. Furthermore, the clarification of specific processes is required for the development of more effective interventions that target problematic eating behaviours in individuals with overweight and obesity.

Questionnaires to Assess Mindful Eating

Over the past ten years, three psychometric measures have been developed to assess eating-specific mindfulness. Although these scales present a significant contribution to the literature, each has several shortcomings as outlined below. Such shortcomings prevent the accurate assessment of mindful eating and thus limit the examination of specific mechanisms through which mindful eating may exert its beneficial effects.

The *Mindful Eating Questionnaire* (Framson et al., 2009) was the first developed measure of eating-specific mindfulness and remains the most cited in the literature. It is a 28-item questionnaire that comprises five subscales: *disinhibition, awareness, external cues, emotional response,* and *distraction.* Although the items in the subscales of *awareness, external cues,* and *distraction* seem to capture certain attentional features of mindfulness, namely an individual's capacity to notice external and internal food-related triggers, the *emotional response* and *disposition* subscales do not. Rather than assessing an individual's capacity to non-judgmentally observe the effect of internal states (thoughts/emotions) and external triggers (environment) on eating-related experiences, the items in the *disinhibition* subscale seem to assess self-regulation of food-intake (e.g., "If there are leftovers that I like, I take a second helping even though I'm full"). This is also the case for items in the *emotional response* subscale, which appears to assess emotional eating (e.g., "When I am sad, I eat to feel better") rather than an individual's capacity to allow negative or uncomfortable thoughts, emotions, and physical sensations to arise in one's awareness without feeling the urge to distance oneself from such experiences or to engage in avoidance behaviours. The MEQ's inclusion of processes that are beyond the scope of mindfulness (e.g., behaviour and emotion regulation) may inadvertently

contribute to confounding effects that could potentially result in misleading interpretations of the unique benefits of mindful eating skills on health-outcomes. Moreover, although the MEQ addresses the attention components of mindful eating, it omits the attitudinal features of the construct. This exclusion may be problematic given the significant role of non-judgment in the reduction of eating disorder pathology and obesity management (Baer et al., 2005; Kristeller, Baer, & Quillian-Wolever, 2006; Kristeller & Wolever, 2011, Wolever & Best, 2009). Further limitations include the presence of overly specific items (e.g., "I notice when just going into a movie theater makes me want to eat candy or popcorn" and "When I eat at 'all you can eat buffets' I tend to overeat") that may inadvertently diminish the scale's construct validity because it prevents a comprehensive assessment of mindful eating across various eating-related situations. In summary, although the MEQ seems to assess certain attentional components of mindful eating, its disregard for the attitudinal features of the construct as well as its inclusion of processes outside the scope of mindfulness may limit its construct validity.

The *Mindful Eating Scale* was developed by Hulbert-Williams, Nicholls, Joy, and Hulbert-Williams (2014) to provide a psychometric measure that demonstrates greater agreement with standard definitions of mindfulness as operationalized by other validated measures of dispositional mindfulness. The 28-item questionnaire contains six subscales: *acceptance, awareness, routine, non-reactivity, act with awareness,* and *unstructured eating.* Although several facets of the MES, notably its subscales of *acceptance, awareness, act with awareness,* and *non-reactivity*, seem to have similar face validity to other dispositional measures of mindfulness, its subscales of *routine* and *unstructured eating* do not. Similar to the *Mindful Eating Questionnaire,* these subscales contain items that appear to assess processes that are beyond the scope of mindfulness (e.g., "I eat the same thing for lunch every week" and "I eat between meals"). Such issues in construct validity may consequently reduce the scale's ability to effectively assess the unique mechanisms of change that account for the beneficial effects of mindful eating on problematic eating behaviours and obesity.

The *Mindful Eating Behaviour Questionnaire* (Winkens et al., 2018) is a 17-item questionnaire that was developed to assess an individual's ability to "eat with attention and awareness" (p. 11). The MEBQ contains four subscales: *focused eating, hunger and satiety cues, eating with awareness,* and *eating with distraction*. Although the scale appears to sufficiently assess certain domain-specific processes of mindful eating, its exclusive focus on the attentional

aspects of mindful eating may be problematic when attempting to understand just *how* mindful eating interventions work. Specifically, are these interventions beneficial because individuals develop a greater awareness of the sensory properties of food and homeostatic cues of hunger and fullness, or are they effective because individuals develop less reactivity to their internal and external triggers to eat? Addressing such questions enables the advancement of more refined treatment programs that emphasize the necessary skills responsible for therapeutic change. In summary, although the MEBQ appropriately assesses the attentional features of mindful eating, its narrow focus prevents a comprehensive evaluation of the construct, thus reducing its ability to effectively assess the underlying mechanisms of change responsible for health-related outcomes.

Given these limitations, the development of a comprehensive scale that assesses eating-specific mindfulness is warranted. This mindful eating scale would (1) assist in better elucidating the independent effects and underlying processes of mindfulness skills that contribute to the effectiveness of mindful eating programs on health-related outcomes, (2) assist in examining the potential differences between individuals with overweight, obesity, or normal weight with regards to mindful eating, (3) facilitate the development and refinement of mindful eating-based training programs for clinical and non-clinical populations, and (4) provide mindful eating educators with an effective tool to assess the varying strengths and weaknesses of clients.

Research Aims

The purpose of the following series of studies was to develop and evaluate a multifaceted mindful eating scale that assesses several domains of mindfulness directed at the eating experience. These dimensions include both the attentional and the attitudinal facets of the construct: internal awareness, external awareness, disidentification, non-judgment, and non-reactance. We used a multi-step process in the creation of the Four Facets Mindful Eating Scale (FFaMES), realized through three separate studies. Study 1 outlines the initial scale construction. Study 2 details the inclusion of additional indicators based on the results of Study 1 as well as a re-examination of the factor structure of the revised item pool using factor analysis and a confirmatory analysis of the factor structure using a separate sample. Study 3 continues the scale's development process through a test-retest analysis and an examination of the scale's associations with BMI, the *Dutch Eating Behaviour Questionnaire* (Van Strien, Frijters, Bergers, & Defares, 1986) and the *Five Facet Mindfulness Questionnaire* (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). A crowd sourced sample was used for the initial scale

development in Studies 1 and 2. An unselected North American sample was chosen for Study 1 and 2 because it was expected to exhibit considerable variability with respect to eating specific mindfulness. More specifically, response variability is forded by large unselected samples and is recommended during the initial development and validation of a new measure (Boateng, Neilands, Frongillo, Melgar-Quiñonez, & Young, 2018; Clarke & Watson, 2016). A community sample rather than a crowd sourced sample was chosen for the scale's validation and retest reliability assessment in Study 3. This was done to prevent the exclusive use of crowd sourced samples in the FFaMES development as well as to reduce any potential biases that may occur with similarly sourced samples.

Study 1: Item Generation and Preliminary Factor Analysis

Overview. The aim of Study 1 was to generate a broad item pool representing mindful eating. Resources for initial item development included previous research (e.g., Anderson, 2016; Jordan, Wang, Donatoni, & Meier, 2014; Lacaille et al., 2014; Tapper & Ahmed, 2018;), empirical reviews (e.g., Godfrey, Gallo, & Afari, 2015; Katterman et al., 2014; O'Reilly et al., 2014;Tapper, 2017; Warren, Smith, Ashwell, 2017), relevant clinical materials (e.g., Kristeller, Wnuk & Du, 2018; Kristeller & Wolever, 2011), and the authors clinical experience in the instruction of mindfulness and mindful eating interventions. Emphasis was placed on developing a broad range of items with potential relevance to the conceptualization of mindful eating. A five-point Likert-type response format was chosen. Respondents are asked to read each statement carefully and to select a number that best describes them using the response options "never" (1), "rarely'' (2), ''sometimes'' (3), ''often'' (4), and ''very often'' (5). The preliminary item pool was piloted in two stages. The PI of the project conducted in-person interviews with six participants (n = 4, female) who ranged in age from 22 to 84 years in order to ensure item intelligibility and coherency. Based on these interviews, five items were dropped, and several were modified to reduce ambiguity. This 90-item pool was then forwarded to three research experts in the field of mindfulness who provided specific feedback on (1) whether the scale was an accurate reflection of mindful eating, (2) whether the items were clearly worded, (3) whether or not certain items should be removed and why, (4) whether any components of mindfulness were missed, and (5) whether the response format was clear. The item pool was modified and reduced to 79 items following this expert feedback.

Methods for Study 1

Participants. A sample of 579 adults were recruited through the online crowd sourcing platform Amazon Mechanical Turk (MTurk). Inclusion criteria included: (1) Adulthood (18 years or older), (2) North American residency (Canada or USA), (3) English fluency. Participants were recruited and compensated with $5.00 to complete the 30-minute survey. Participants were excluded if (1) they appeared to be responding randomly, as evidenced by failing our attention checks, (2) the participant's IP address fell outside of North America, and/or (3) the participant failed a simple English proficiency check. The final sample consisted of N = 480 participants. Demographic information is shown in Table 1.

Procedure. MTurk was used to distribute the online survey to a sample of adults. MTurk has been shown to provide quality data as well as an ethnically, geographically, and socio-economically diverse sample (Casler, Bickel, & Hackett, 2013). MTurk has also been used as an acceptable method for collecting data on eating behaviours (Scharmer, Donahue, Heiss, & Anderson, 2020; Schulte, Avena & Gearhardt, 2015), body mass index/obesity (Bickel et al., 2014; Black, Vartanian, & Faasse, 2020; Pearl et al., 2014), and mindfulness (Jordan et al., 2014; Klussman, Curtin, Langer, & Nichols, 2020). Participants provided consent via an electronic consent form at the beginning of the survey and subsequently responded to the items of the preliminary item pool of FFaMES and a sociodemographic questionnaire. Five quality control items were included to ensure that participants were not randomly responding (e.g., "Please disregard the following question and enter your age in the space provided"; "Please describe in one sentence what, in your opinion, makes something taste delicious"). All participants received their financial compensation following the completion of the survey through the platform.

Results for Study 1

We examined the factor structure of the 79 items to identify items for the final scale. Exploratory factor analysis with maximum likelihood estimation and Promax (oblique) rotation was conducted using SPSS version 24 (IBM, 2016). The most appropriate factor structure was determined using a combination of the scree test (Cattell, 1966), the parallel analysis (Hayton, Allen, & Scarpello, 2004), and the interpretability of each factor (for 4-7 factor solutions). The initial results of the EFA revealed five interpretable factors that accounted for 59.22 % of the variance of the indicators. The variance explained by each factor was 27.8, 18.6, 5.3, 4.6, and 2.9 %, respectively. The mindful eating dimensions captured by these factors were identified as

Awareness of thoughts and emotions (25 items, factor loadings .28-.95), *Disidentification* (17 items; factor loadings .45-.87), *Non-judgmental observation* (14 items; factor loadings .28-.93), *Awareness of physical sensations of hunger and fullness* (14 items; factor loadings .38-.87), and *Non-reactance* (9 items; factor loadings .65-.91). Based on these results, several adjustments to the scale were made prior to the next round of data collection. Specifically, items were flagged if they demonstrated low main loadings (e.g., < .30) and high cross loadings (e.g., > .20). Of these flagged items, those that contained content that was considered inconsistent or incidental to the factor of their primary loading were deleted, while poorly worded items (e.g., double-barrelled) were rewritten to improve clarity. Additional items were furthermore written for the *Non-reactance* factor to provide a balance across the five dimensions. This elimination and revision process occurred between the first, fifth and sixth authors.

Summary of Study 1

Eliminating and modifying items from the initial item pool resulted in a 68-item pool to be used in the next study.

Study 2: Exploratory and Confirmatory Factor Analyses

Overview. The primary aim of Study 2 was to strengthen the factors observed in Study 1 with the goal of identifying items for the final scale. Eight additional items were generated to augment the *Non-Reactance* factor and several items were re-written to improve clarity of item content. Items that were double-barrelled or contained double negatives were identified and reformatted to enhance readability. A final exploratory analysis and a confirmatory analysis were conducted on the 68-item pool to determine its factor structure and model fit.

Methods of Study 2

Participants. Data were collected from a separate MTurk sample of 1,028 adults. Demographic information is shown in Table 1. Inclusion and exclusion criteria were the same as in Study 1. However, participants who completed Study 1 were prohibited from participating in Study 2. After the removal of participants who failed the attention checks, the final sample consisted of 890 participants. This sample was subsequently randomized and divided into two separate datasets for the purpose of exploratory and confirmatory factor analyses.

Procedure. Procedural steps paralleled those of Study 1. To avoid performing exploratory (EFA) and confirmatory analyses (CFA) on the same data, the sample for Study 2 was split into two (e.g., Cudeck & Browne, 1983).

Results of Study 2

Exploratory analyses. An EFA with maximum likelihood (ML) estimation and Promax (oblique) rotation was conducted using SPSS version 24 (IBM, 2016) on the first half of the randomly divided sample (N = 445). The most appropriate factor structure was determined using a combination of the scree test (Cattell, 1966), the parallel analysis (Hayton et al., 2004), and the interpretability of each factor (for 4-6 factor solutions). Results of the EFA indicated four interpretable factors. These four factors accounted for 54% of the total variance. Variance explained by each factor was 37.0, 8.7, 4.4, and 4.3%, respectively. The dimensions captured by the four factors are as follows: (1) *Non-reactance*, or an individual's ability to maintain a mental distance from impulsive reactions to eat, as well as a willingness to permit uncomfortable experiences to arise in awareness without feeling the need to push them away or to engage in avoidance behaviours, (2) *Non-judgment,* or an individual's ability to avoid negative self-judgment and respond with acceptance towards one's eating behaviours, (3) *External awareness*, or an individual's ability to observe or examine the effects of external factors on one's eating behaviour, and (4) *Internal awareness,* or an individual's ability to observe or examine the effects of one's mental and emotional processes on one's eating behaviour.

Item reduction. Several methods were used to shorten the scale based on EFA results. Items were flagged if they demonstrated low main loadings (e.g., < .3), high cross loadings (e.g., > .2), with the final decision to eliminate items based on consensus between the first, fifth, and sixth authors (e.g., items were eliminated if they contained content deemed inconsistent with or not central to the factor of their primary loading). A total of 39 items were eliminated over three iterations of the above procedure and re-fitting the EFA model(s). Items were then also considered for elimination if content was determined to be redundant with other items (Flora & Flake, 2017). For example, the item *I avoid uncomfortable thoughts by eating* was removed because of content overlap with the item *I distract myself with food when I have uncomfortable thoughts*. Factor loadings for the EFA conducted with the items selected for the final scale are displayed in Table 2. Eigenvalues for the final correlation matrix were: 13.0, 2.6, 1.8, and 1.7 and the variance explained by each factor was 44.4, 8.9, 6.2, and 6.0%, respectively, for a total of 65.8%. All factors demonstrated adequate internal consistency: *Non-reactance* (α = .95), *Non-judgment* (α = .90), *External awareness* (α = .86) and *Internal awareness* (α = .79).

Confirmatory analyses. The CFA was conducted using a separate sample (N = 445), and with latent variable analysis software in R (Rosseel, 2012) using ML and fit based on a mean and variance adjusted test statistic to correct for nonnormality (Savalei, 2018). Model fit was assessed using four different goodness of fit indices: Root mean squared error of approximation (RMSEA), Comparative Fit Index (CFI), Tucker Lewis Index (TLI), standardized root-mean squared residuals (SRMR). According to convention criteria, excellent model fit represents RMSEA $\leq$ 0.06, TLI $\geq$ 0.95, CFI $\geq$ 0.95, SRMR $\leq$ 0.08 (Hu and Bentler, 1999) though we note that use of strict cut-off values for fit indices is controversial (Bentler, 2006). Results of the CFA suggest adequate model fit for the four-factor solution ($\chi^2(371) = 1051.90$, $p < .001$, RMSEA = 0.07, 90 % CI [.068, .078], CFI =0.90, TLI = 0.89, SRMR = 0.08). The model is displayed in Figure 1.

Summary of Study 2

Results of the second EFA supported a four-factor solution. Each factor demonstrated good internal consistency. Moreover, the CFA supported a four-factor solution that demonstrated adequate fit. The final 29-item scale, its scoring rubric, and a description of its subscales can be found in the Appendix.

Study 3: Validity and Reliability Testing of the Four Facet Mindful Eating Scale (FFaMES)

Overview. The aim of Study 3 was to examine the convergent and discriminant validity of the newly developed scale as well as its test retest reliability. A primary goal was to examine the discriminant validity of the FFaMES subscales to indicators of obesity. Notably, we wanted to assess the relationship of FFaMES with BMI as well as with disordered eating behaviours such as emotional eating, restrained eating, and external eating (Bellisle, Dalix, & Slama, 2004; Dykes, Brunner, Martikainen, & Wardle, 2004; Konttinen, Haukkala, Sarlio-Lähteenkorva, Silventoinen, & Jousilahti, 2009; Macht, 2008; Provencher, Drapeau, Tremblay, Després, & Lemieux, 2003; Van Strien, 2018). Obesity-related eating behaviours are associated with higher levels of impulsivity and increased attentional biases towards food-related cues (Doolan, Breslin, Hanna, & Gallagher, 2015; Hendrikse et al., 2015) and affective states (Frayn, Livshits, & Knäuper, 2018; Haedt-Matt & Keel, 2011; Sung, Lee, & Song, 2009; Van Strien, Herman, Anschutz, Engels, & de Weerth, 2012) as well as self-directed judgment (Ferreira, Fortunato, Marta-Simões, Trinidade, 2016; Ferreira, Pinto-Gouveia & Duarte, 2013; Hilbert et al.,2015; Pinto-Gouveia et al., 2017; Ratcliffe & Ellison, 2013; Pinto-Gouveia, Duarte, Matos, & Fráguas,

2014). Due to increased levels of attentional bias, impulsivity, and judgment, we hypothesized that individuals who endorse higher levels of obesity-related eating behaviours will demonstrate opposite associations with the attentional versus attitudinal facets of our mindful eating scale. Namely, individuals with higher levels of emotional eating, restrained eating, and external eating will score higher on the attentional facets of the FFaMES (i.e., subscales of internal and external awareness) but score lower on the attitudinal facets of the FFaMES (i.e., subscales *of non-reactance* and *non-judgment*). In view of the positive association between BMI and obesity-related eating behaviours, we hypothesized a similar pattern of response between the FFaMES subscales and body weight. Because eating-related mindfulness is conceptualized as a subset of general mindfulness (Hulbert-Williams et al., 2014; Winkens et al., 2018), we furthermore hypothesized that the subscales of the FFaMES will be moderately associated with a measure of dispositional mindfulness. Specifically, we predicted that our subscales of *non-reactance* and *non-judgment* will be positively associated with the *Five Facet Mindfulness Questionnaire*'s (FFMQ) subscales of *non-judging* and *non-reactivity of inner experience*. We furthermore predicted that our subscales of *internal awareness* and *external awareness* will be positively related to the FFMQ's subscales of *observation.*

Methods of Study 3

Participants. A sample of (N = 166) adult participants were recruited from the community in a North American metropolis. Participants were recruited through the use of flyers circulated in several community-based organizations as well as online advertisements on several social media platforms (e.g., Facebook, Instagram). Demographic information is displayed in Table 1.

Procedure. After providing informed consent, participants were administered an online questionnaire that contained FFaMES and several other measures of interest. Prior to completing the scale, participants were asked if they would be willing to complete the survey for a second time. Participants who consented were sent another survey two weeks after the completion of the first one. This second survey contained only the FFaMES. All participants received $10.00 following the completion of both surveys. If participants only completed one survey, they were compensated with $7.00.

Measures. In addition to the FFaMES the following measures were administered:

The *Dutch Eating Behaviours Questionnaire* (DEBQ; Van Strien et al., 1986). The DEBQ is a 33-item self-report measure that assesses three dimensions of eating behaviours:

emotional eating, restrained eating, and external eating. Individuals are asked to indicate the extent to which they agree with each statement from 1 (seldom) to 5 (very often). Sample items include "Do you have a desire to eat when you are anxious, worried or tense?" and "If you see others eating, do you also have the desire to eat?" This measure has shown high internal consistency (Cronbach's alpha = .95, Allison, Kalinsky, & Gorman, 1992). Cronbach's alpha for our sample was .88 for the *restraint eating* subscale, .96 for the *emotional eating* subscale and .89 for the *external eating* subscale.

The *Five Facet Mindfulness Questionnaire* (FFMQ; Baer et al., 2008). The FFMQ is a 39-item self-report measure that assesses five dimensions of dispositional mindfulness: *observing, describing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience*. Individuals are asked to rate the extent to which they agree with each statement from 1 (never or very rarely true) to 5 (very often or always true). Sample items include: "I perceive my emotions and feelings without having to react to them" and "When I am walking, I deliberately notice the sensations of my body moving." This measure has shown high internal consistency (Cronbach's alpha = .92, Baer et al., 2008). Cronbach's alpha for our sample was .74 for the *observe* subscale, .92 for the *describe* subscale, .91 for the *act with awareness* subscale, .91 for the *non-judge* subscale and .76 for *non-react* subscale.

Body Mass Index. Height and weight were assessed in order to calculate the participants' Body Mass Index. BMI is considered a general marker of caloric intake and a risk factor for disease (World Health Organization, 2020).

Results of Study 3

Means, standard deviations and correlations between the FFaMES subscales and the included measures can be seen in Table 3.

Reliability. Internal consistency of the FFaMES facets was good with Cronbach alpha's ranging from .92 for *non-reactance*, .91 *non-judgement*, .82 *external awareness* and .92 *internal awareness*. Out of the original sample (N = 166), 152 participants completed the FFaMES at the second time point. No significant differences were found between these participants and those who did not complete the second survey. Test retest reliability was sufficient with single measure ICCs ranging from .88 to .92. Paired sample *t*-tests showed no significant differences between the scores at both assessments.

Construct Validity. As expected, the FFaMES subscales of *non-reactance* and *non-judgment* demonstrated a negative significant relationship with obesity-related eating behaviours. A significant opposite relationship was furthermore found for the subscales of *internal* and *external awareness*. That is, greater levels of *internal* and *external awareness* were associated with more obesity-related eating behaviours. Although no significant associations were found between the FFaMES and BMI, the subscales of *non-reactance* and *non-judgment* demonstrated a significant negative relationship with successful weight maintenance. That is, successful long-term weight management was associated with a greater ability to not react or to not judge internal and external eating-related experiences. The subscales of the FFaMES also showed differential patterns of associations with a measure of dispositional mindfulness. As expected, the subscales of *non-reactance* and *non-judgment* were positively associated with the FFMQ subscales of *non-judging* and *non-reactivity to inner experience*. Moreover, a positive significant relationship was found between the FFaMES subscale of *internal awareness* and the FFMQ subscale of *observe.*

Summary and Discussion of Study 3

The FFaMES demonstrated good convergent and discriminant validity as well as good test-retest reliability. Results provided some preliminary evidence that the attention and attitude facets of the FFaMES show the expected differential patterns of associations. Notably, the subscales of *non-reactance* and *non-judgment* are negatively associated with obesity-related eating behaviours and successful weight maintenance, while the subscales of *internal* and *external awareness* are positively associated with indicators of obesity. Differential patterns of associations were also found for the subscales of the FFaMES and a measure of trait mindfulness.

Discussion

In a series of three studies, we developed the Four Facet Mindful Eating Scale (FFaMES). The final scale consists of 29 items that make up four distinct factors: *Non-Reactance*, which describes the ability to maintain a mental distance from impulsive reactions to eat as well as a willingness to sit with uncomfortable experiences without engaging in avoidance behaviours; *Non-Judgment*, which describes the ability to avoid negative self-judgment and to respond with acceptance towards one's eating behaviours; *External Awareness* that involves the ability to observe or to examine the effects of external factors on one's eating behaviours; and *Internal Awareness* that involves the ability to observe or examine the effects of one's mental

and emotional processes on one's eating behaviours. The questionnaire demonstrates adequate psychometric properties with high Cronbach alphas for all subscales, good retest-reliability coefficients as well as preliminary convergent and discriminant validity.

Previous mindful eating scales were limited in their scope and their ability to assess mindful eating in its entirety. Specifically, previous scales focused too heavily on the attentional components of mindful eating while disregarding the attitudinal components of the construct. This is problematic in as much as it prevents the clarification of underlying processes that contribute to the beneficial effects of eating-specific mindfulness on obesity-related outcomes. Our study attempted to develop a questionnaire that assessed both components of mindful eating. To do this, we developed an initial item pool (Study 1) that did not contain recycled items from former scales but rather included items that were created by the first and second author employing both empirical research and clinical expertise in the instruction of mindfulness-based programs. This facilitated the development of a range of items that assessed both the attentional and attitudinal facets of mindful eating construct.

The subscales of the final FFaMES (29-items) were consistent with the hypothesized domains with one exception. Rather than supporting five latent variables, a factor analysis (Study 2) revealed four interpretable factors whereby the hypothesized domain of *disidentification* got subsumed by the facet of *non-reactance*. There could be several reasons for this merging of facets. Notably, the dimensions of *disidentification* and *non-reactance* are theoretically related. For example, the disidentification or decentering of experience may be a necessary first step in the prevention of automatic behavioural reactions to distressing thoughts and emotions. Past research has demonstrated similar difficulties in disentangling these constructs (Baer et al., 2006, 2008; Bravo et al., 2016; Brown, Creswell, & Ryan, 2015; Desbordes et al., 2015; Keng, Smoski, & Robins, 2011; Pearson, Brown, Bravo, & Witkiewitz, 2015) especially in nonmeditating samples. Because the majority of our participants were nonmeditators and thus do not have practice or expertise in applying these mindfulness processes, they may have interpreted the objective assessment of one's thoughts and feelings (disidentification) as a identical step to not acting on impulsive reactions to eat. Conversely, individuals with increased mindfulness experience have been shown to better differentiate these subtleties of experience (Bravo et al., 2016; Cebolla et al., 2018). In sum, the similarities between the facets of *disidentification* and *non-reactance* as well as our nonmeditating sample, may explain the merging of these two latent

variables. Future research should continue to investigate the deferential interpretations of various mindfulness facets between meditators and nonmeditators, especially in the area of eating-specific mindfulness.

The interfactor correlations of the FFaMES subscales ranged between weak to moderate, with theoretically related dimensions correlating moderately and unrelated dimensions correlating weakly. For example, the *non-reactance* and *non-judgment* subscales demonstrated weak to moderate negative correlations with the subscales of *external* and *internal awareness*. The FFaMES subscales of *non-reactance* and *non-judgment* belong to the attitude domain of the mindful eating construct, while the facets of *external* and *internal awareness* belong to the attentional domain of the construct. Although an individual may be able to notice and to pay attention to their internal or external processes (e.g., internal sensations of hunger or external triggers to eat), they may be unable to maintain a mental distance from these processes, while remaining non-judgmental. This difficulty in maintaining a mental distance from internal and external processes may result in impulsive reactions to eat especially when under distress. Due to this discrepancy between the attitude and attentional components of mindful eating, it is unsurprising that these facets were not strongly correlated. Low interfactor correlations between the attention and attitude components of mindfulness were additionally found in studies assessing dispositional mindfulness (Baer et al., 2008; Bravo et al., 2016; Brown et al., 2015; Pearson et al., 2015). In fact, when developing the *Five Facet Mindfulness Questionnaire* (Baer et al., 2006), the authors found no association (p = -.07) between the *observing* and the *non-judgment* facets of their scale thus alluding to the potential difference between the attitude and awareness domains with the mindfulness construct. These results are notable in as much as they point to the importance of further investigating the independent role of the various facets of mindfulness on outcomes. Using the FFaMES, future research can better elucidate the various facets of mindful eating that are necessary for successful weight management and reductions in obesity-related eating behaviours.

Our study is not the first to demonstrate a negative relationship between the various mindfulness facets of awareness and attitude. When looking at the broader field of mindfulness, previous research has suggested a potential distinction between the attentional and the attitudinal components of mindfulness (Keng et al., 2011). Notably, several studies have found weak to moderate negative correlations among various facets of mindfulness such as a distinction

between an individual's ability to *observe* versus *not-judge* their inner experience ($r = -.07$, Baer et al., 2006; $r = -.36$, Bravo et al., 2016; $r = -.38$, Brown et al., 2015; $r = -.31$, Pearson et al., 2015). A similar inverse relationship has also been shown between an individual's ability to *act with awareness* versus *not react* to their experience ($r = -.23$, Bravo et al., 2016). In accordance with our findings, present-centered awareness has been shown to be positively associated with poor psychological outcomes in non-experts (Anālayo, 2019; Britton, 2019; Cebolla, Demarzo, Martins, Soler, & Garcia-Campayo, 2017; Farias & Wikholm, 2016; Reynolds, Bissett, Porter, & Consedine, 2017). Previous research suggests a level of malleability between the endorsement of various facets of mindfulness and their influence on outcomes based on an individual's level of expertise (Baer et al., 2008; van Dam, Earleywine & Danoff-Burg, 2009). Consequently, an individual new to mindfulness may only be able to bring present-moment attention to their experience while certain skills of non-judgment and equanimity may only transpire with continued practice. As previously mentioned, it is thus integral to develop both an awareness of one's internal and external experiences and an ability to maneuver this experience through consistent training that emphasizes the attitudinal facets of mindfulness. The preliminary results of our study allude to this interplay between the various facets of awareness and attitude such that awareness in of itself may be insufficient in reducing disordered eating behaviours associated with obesity. Rather, it is how an individual responds to this awareness that is most important. Future research should continue to investigate the differential effects of various aspects of eating-specific mindfulness in the prevention and treatment of obesity and its comorbidities. Notably, it is important that future research continues to examine how various facets of mindful eating develop and interact to reduce obesity-related eating behaviours.

All of the significant associations between the subscales of the FFaMES and a measure of dispositional mindfulness were in the expected direction, which suggests good convergent validity. Divergent validity was also demonstrated amongst the subscales of the FFaMES and a measure of obesity-related eating behaviours. Although a significant positive relationship was found between successful weight maintenance and the subscales of *non-reactance* and *non-judgment*, no significant relationship was found for BMI. There could be many reasons for this unexpected finding. Notably, the mean BMI of our sample was 24.08 ($SD = 7.34$). The differential patterns of associations between the various subscales of the FFaMES and weight may only occur in individuals with overweight or obesity. Preliminary results in Study 2 (mean

BMI = 26.5, *SD* = 7.28) support this hypothesis such that a negative relationship was found between body weight and the FFaMES subscales of *non-reactance* (r = -.26, p < .001) and *non-judgment* (r = -.23, p < .001). Inverse relationships were furthermore found for the subscales of *external awareness* (r = .20, p < .001) and *internal awareness* (r = .18, p < .05). That is, greater levels of eating-related awareness were associated with higher body weight. These findings are analogous to our findings in Study 3 where greater levels of emotional eating, external eating, and restrained eating were associated with lower levels of *non-reactance* and *non-judgment*, as well as greater levels of *external* and *internal* eating-related awareness. Future research should validate the FFaMES in populations with a range of BMIs including individuals with greater levels of obesity and those with problematic eating behaviours such as emotional eating, external eating, or binge eating. This will further assist in clarifying the relationship between the various subscales of the FFaMES, body weight, and disordered eating behaviours associated with obesity.

The preliminary results of the FFaMES suggest a clear distinction between the attitudinal and attentional facets of mindful eating. Although both facets of attitude (e.g., non-judgment, disidentification) and attention (e.g., observing) are well known in the mindfulness literature, present-moment awareness has received more interest from Western empirical investigations particularly in the domain of mindful eating (Arch et al., 2014; Cavanagh, Strauss, Forder, & Jones, 2014; Higgs & Donohoe, 2011; Mantzios & Wilson, 2014). Interestingly, the results of our study allude to the potentially significant role of the attitudinal facets of eating-related mindfulness for healthy weight management. Although an individual may be aware of the thoughts, emotions, or physical sensations that accompany their urges to eat, they may be unable to successfully decenter from habitual patterns of reaction and negative self-judgment (Lacaille et al., 2014; Tapper, 2017). This difficulty in maintaining a mental distance from feelings of distress or self-judgment may be particularly problematic for emotional eaters or binge eaters as it may paradoxically increase their risk of compulsive overeating (Heatherton & Baumeister, 1991; Williamson, White, York-Crowe, & Stewart, 2004). For example, if an individual is encouraged to bring increased attention to their hunger and satiety cues, they may also become aware of their non-homeostatic urges to eat. This increased self-awareness of non-homeostatic urges may inevitably produce psychological distress (Aldao, Nolen-Hoeksema, & Schweizer, 2010) especially in individuals with a history of weight-cycling (Petroni et al., 2007; Qazi &

Keval, 2013). If an individual is unable to tolerate their increased distress, they may return to old coping strategies such as emotional eating to alleviate their discomfort. Furthermore, after indulging in a non-homeostatic urge to eat, an individual may feel increased levels of negative affect, shame, and self-judgment, which may trigger more urges to eat to relieve their psychological distress. This trigger-response cycle of is a feature of disordered eating behaviours associated with obesity (Brewer, 2017; Brewer et al., 2018; Mason, Jhaveri, Cohn, & Brewer, 2018). Learning to cultivate an attitude of non-judgment and non-reactance may assist in breaking this trigger-response cycle thus reducing impulsive reactions to eat for non-homeostatic reasons. An individual cannot however effectively respond to their eating-related experience with non-judgment and equanimity if they are not aware of this experience. Present-centered attention is thus a fundamental step in developing an awareness of certain problematic trigger-response cycles that perpetuate obesity-related eating behaviours. Nevertheless, cultivating awareness in the absence of other necessary skills of non-judgment and equanimity will only perpetuate problematic eating behaviours. It is thus important to develop both an increased awareness of problematic trigger-response cycles, as well as an ability to manage these experiences through the skills of decentering and an attitude of non-judgmental curiosity. Future research should continue to investigate how certain aspects of eating-specific mindfulness can help disrupt trigger- response cycles that reinforce obesity-related eating behaviours. Despite the various strengths of our scale, there are several limitations that must be addressed. Firstly, MTurk was used in the scale development process (Studies 1 and 2). Although MTurk is now frequently used in psychological research (Chandler & Shapiro, 2016), this choice in sample may have resulted in certain self-selection biases. Nevertheless, the use of MTurk afforded the collection of a large heterogenous sample which is recommended in scale construction (Boateng et al., 2018; Clarke & Watson, 1995) and recent research has shown that MTurk data is reasonable in quality (Behrend, Sharek, Meade, & Wiebe, 2011; Kees, Berry, Burton, & Sheehan, 2017; Mason & Suri, 2012). Second, the FFaMES was validated in a primarily homogeneous sample (Study 3). Future research should continue to validate the scale in different racial and ethnic groups, as well as male populations and individuals with overweight and obesity. Third, our sample was restricted to individuals who did not present with an eating disorder. Future studies should therefore examine the scale in patients with eating disorders such as binge eating. Fourth, labels for the four facets represent our best subjective interpretation, yet

as with any scale development endeavour, there is room for future research to further clarify the meaning and interpretation of the FFaMES. Lastly, all of our data was collected via retrospective self-reports. Future research should consider investigating the extent to which the FFaMES predicts eating behaviours in the context of daily food diaries or Ecological Momentary Assessments (EMA). Irrespective of these limitations, we believe that the FFaMES is a valuable instrument that contributes to the growing field of eating-specific mindfulness.

Conclusions

Our findings provide preliminary support for the construct validity of the FFaMES and for the continued study of multiple facets of eating-specific mindfulness. The assessment of the separate elements of mindful eating will further assist in determining the independent effects and underlying processes that contribute to the effectiveness of mindful eating programs on health-related outcomes. Although continued research is required to further evaluate the instrument's psychometric properties, the development of the FFaMES is a notable first step in the identification and clarification of the various elements of mindful eating.

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Table 1

Demographic Information for Each Study Sample

	Study 1	Study 2	Study 3
Sample size	480	890	166
Mean age (*SD*)	39.96 (10.81)	37.10 (10.86)	38.08 (12.95)
Gender (% female)	50.84	54.49	58.43
Race/ethnicity (%)			
American Indian or Alaskan Native	1.0	0	0.6
Asian	7.5	7.0	6.0
Black or African American	7.3	8.5	9.6
Hispanic or Latino	3.5	5.6	1.8
Native Hawaiian or Pacific Islander	0.4	1.0	0
White	78.3	59.4	75.9
Multiracial	0.2	7.6	3.6
Middle Eastern	1.0	0	0
Prefer not to answer	0.6	11.0	2.4
Education (%)			
Less than a high school diploma	0.4	0.5	0
High school diploma or equivalent	13.5	15.4	7.2
Some college/university	36.0	31.7	24.1
Bachelor's degree	41.0	42.5	56.6
Graduate degree	9.0	9.8	11.5
Prefer not to answer	0	0.2	0.6
Employment (%)			
Employed	71.0	71.0	67.5
Self-employed	18.4	17.4	8.4
A homemaker	2.3	2.7	2.4
A student	1.0	2.0	14.5
Retired	3.1	1.8	3.6
Unemployed	2.5	3.0	2.4
Unable to work	0.6	1.6	0.6
Prefer not to answer	1.0	0.6	0.6
Income (%)			
$20,000 or less	13.4	12.4	6.6
Between $20,001 - $40,000	31.2	25.0	7.8
Between $40,001 - $60,000	22.4	22.7	12.1
Between $60,001 - $80,000	15.3	19.0	26.5
Between $80,001 - $100,000	7.8	9.1	16.3
Between $100,001 - $120,000	5.0	4.9	8.4
More than $120,000	4.8	6.3	10.2
Prefer not to answer	0	0.7	12.1
Maintained weight (%)			
Yes	71.0	69.3	68.1
No	29.0	31.0	32.0
BMI Group (%)			
Normal	38.8	44.7	61.6
Overweight	30.8	28.8	23.3
Obese	30.4	26.5	15.1
Mindfulness experience (%)			
Yes	14.4	25.1	27.7
No	85.6	75.0	72.3

Exploratory Factor Analysis (EFA) Factor Loadings (N = 445)

Table 2

	Factor			
	1	2	3	4
03. I feel a sense of urgency to follow my thoughts to eat.	**.426**	.018	.237	.064
06. I eat to make myself feel better.	**.852**	-.008	.052	-.079
10. I use food to numb my emotions.	**.947**	-.023	.021	-.118
13. My emotions control what I eat.	**.878**	.041	-.099	.004
17. I distract myself with food when I have uncomfortable thoughts.	**.941**	-.016	-.063	-.016
22. My emotions control how much I eat.	**.851**	.023	-.048	.053
23. I push uncomfortable feelings away by eating.	**.942**	.005	-.070	-.006
26. I get carried away by my thoughts while I eat.	**.466**	.101	.178	.061
28. I escape uncomfortable emotions by eating.	**.890**	.050	-.120	.051
02. I get frustrated when I notice a craving.	.125	**.629**	.061	-.002
05. I get mad at myself for overeating.	-.036	**.935**	-.131	.071
07. I get mad at myself for eating unhealthy foods.	.006	**.883**	-.129	.048
12. I feel like a bad person when I give into a craving to eat.	.069	**.844**	-.052	.007
15. I judge my eating as good or bad.	.032	**.774**	.113	-.143
18. I judge my cravings as good or bad.	-.027	**.636**	.281	-.106
20. I feel guilty when I eat too much.	-.038	**.850**	-.113	.065

24. I believe that I should not have certain thoughts about food.	.171	**.490**	.211	-.095
08. I pay attention to my mood while I eat.	-.020	-.014	**.798**	-.070
11. I notice my thoughts after I eat.	.001	.065	**.638**	.004
14. I pay attention to how my food affects my mood.	.048	-.035	**.754**	.030
21. I pay attention to my thoughts while I eat.	-.151	-.106	**.813**	-.074
25. I notice my mood after I eat.	.043	.038	**.691**	.053
29. I pay attention to how my surroundings affect my desires to eat.	.029	.005	**.637**	.075
01. I notice how my desires to eat change when I'm surrounded by my favorite foods.	.166	-.015	.362	**.387**
04. I notice when the smell of food makes me want to eat.	.030	-.160	.003	**.705**
09. I pay attention to how my surroundings affect my desires to eat.	-.027	.014	-.034	**.761**
16. I notice how my desires to eat change when I see or smell something delicious.	-.110	.090	-.071	**.784**
19. I notice that I tend to eat more when others are also eating.	.085	.155	.075	**.351**
27. I notice how talking about food affects my desires to eat.	.065	.016	.229	**.499**

Note. The factor loadings reflect values from the pattern matrix. Bolded coefficients denote primary factor loadings. Factor 1 = Non-Reactance; Factor 2 = Non-Judgment; Factor 3 = Internal Awareness; Factor 4 = External Awareness.

Table 3

Study 3 correlation coefficients between FFaMES and other self-report measures

Variable	Mean	*SD*	Non-Reactance	Non-Judgment	External Awareness	Internal Awareness
Demographic characteristics						
Gender						
Age	38.08	12.95	.06	.06	-.13	-.24**
BMI	24.08	7.34	-.02	-.01	-.05	-.06
FFaMES						
Non-Reactance	3.76	0.77	1.00	.51**	-.47**	-.47**
Non-Judgment	3.24	0.87		1.00	-.46**	-.33**
External Awareness	3.26	0.64			1.00	.47**
Internal Awareness	2.76	0.86				1.00
DEBQ						
External eating	3.08	0.68	-.58**	-.41**	.70**	.33**
Emotional eating	2.16	0.93	-.83**	-.46**	.43**	.34**
Restrained eating	2.92	0.75	-.12	-.47**	.25**	.28**
FFMQ						
Observe	3.38	0.58	.03	-.05	.08	.41**
Describe	3.56	0.73	.34**	.13	-.09	-.01
Act with awareness	3.38	0.65	.46**	.26**	-.16*	.02
Not judge	3.23	0.85	.29**	.56**	-.28**	-.20*
Not react	3.09	0.58	.23**	.23**	-.23**	-.11

Note. The presented associations of study measures reflect partial correlations. FFaMES = Four Facets Mindful Eating Scale; DEBQ = Dutch Eating Behaviour Questionnaire; FFMQ = Five Facet Mindfulness Questionnaire

* $p < .05$; ** $p < .01$

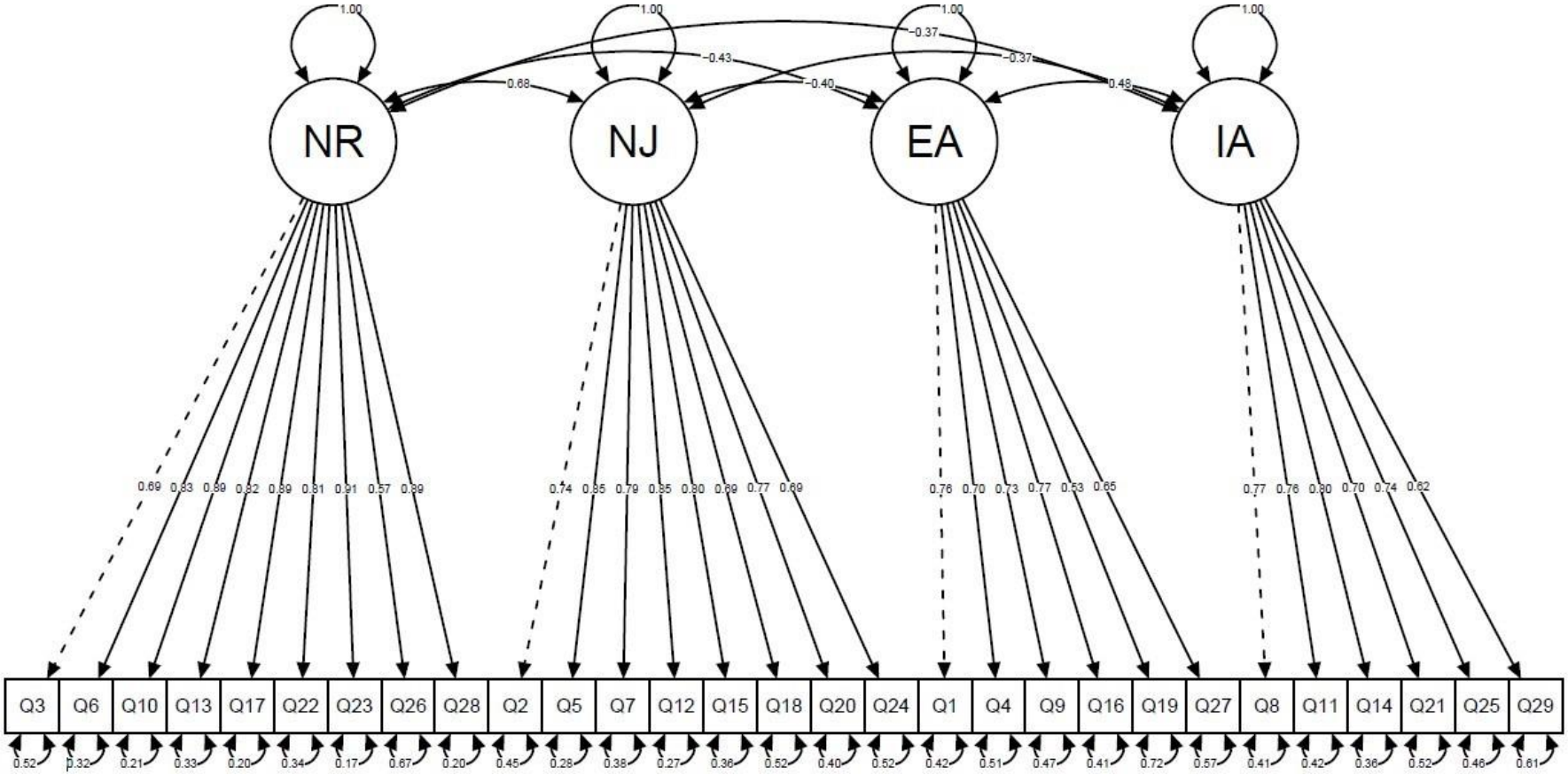

Figure 1.

Confirmatory Factor Analysis (CFA) Model of the Four Facets Mindful Eating Scale (N = 445).

Note. NR = Non-Reactance; NJ = Non-Judgment; EA = External Awareness; IA = Internal Awareness

Appendix

The Four Factor Mindful Eating Scale

Description: The Four Factor Mindful Eating Scale (FFaMES) is a 29-item scale designed to assess eating-related mindfulness. Specifically, FFaMES is designed to assess the attentional and attitudinal components of mindful eating.
Instructions: Please read each statement carefully and select a number from 1 to 5 that best describes you.
Rating Scale:

1 – Never 2 – Rarely 3 – Sometimes 4 – Often 5 – Very often

1. I notice how my desires to eat change when I'm surrounded by my favorite foods.
2. I get frustrated when I notice a craving.
3. I feel a sense of urgency to follow my thoughts to eat.
4. I notice when the smell of food makes me want to eat.
5. I get mad at myself for overeating.
6. I eat to make myself feel better.
7. I get mad at myself for eating unhealthy foods.
8. I pay attention to my mood while I eat.
9. I notice when the sight of food makes me want to eat.
10. I use food to numb my emotions.
11. I notice my thoughts after I eat.
12. I feel like a bad person when I give into a craving to eat.
13. My emotions control what I eat.
14. I pay attention to how my food affects my mood.
15. I judge my eating as good or bad.
16. I notice how my desires to eat change when I see or smell something delicious.
17. I distract myself with food when I have uncomfortable thoughts.
18. I judge my cravings as good or bad.
19. I notice that I tend to eat more when others are also eating.
20. I feel guilty when I eat too much.
21. I pay attention to my thoughts while I eat.
22. My emotions control how much I eat.
23. I push uncomfortable feelings away by eating.
24. I believe that I should not have certain thoughts about food.
25. I notice my mood after I eat.
26. I get carried away by my thoughts while I eat.
27. I notice how talking about food affects my desires to eat.
28. I escape uncomfortable emotions by eating.
29. I pay attention to how my surroundings affect my desires to eat.

Scoring Instructions

All negative worded items must be reverse scored (i.e., 1 = 5, 2 = 4, 3 = 3, 4 = 2, 5 = 1). Subscale scores are computed by calculating the mean of subscale item responses. A description of the four subscales is provided below. We suggest that researchers use individual subscale scores when analyzing their data rather than computing a total score.

Description of Subscales

Non-Reactance: The ability to maintain a mental distance from impulsive reactions to eat, as well as a willingness to permit uncomfortable experiences to arise in one's awareness without feeling a need to push them away or to engage in avoidance behaviours.

Non-Judgment: The ability to avoid negative self-judgement and respond with acceptance towards one's eating behaviours.

External Awareness: The ability to observe or examine the effects of external factors on one's eating behaviour.

Internal Awareness: The ability to observe or examine the effects of one's mental and emotional processes on one's eating behaviour.

Coding Key

Non-Reactance

03R, 06R, 10R, 13R, 17R, 22R, 23R, 26R, 28R

Non-Judgment

02R, 05R, 07R, 12R, 15R, 18R, 20R, 24R

External Awareness

01, 04, 09, 16, 19, 27

Internal Awareness

08, 11, 14, 21, 25, 29

Chapter 5: General Discussion

Over the past decade, mindfulness-based interventions have gained popularity as a tool for managing obesity and its related comorbidities. Specifically, increases in present-moment, non-judgmental equanimity has been theorized as an effective tool for reducing obesity related eating behaviours. As such, the aims of the present dissertation were to: (1) quantify the effectiveness of mindfulness-based interventions on obesity management; and (2) investigate the differential effects of various mindfulness techniques and processes on health-outcomes.

Findings and Significance

The first manuscript in my dissertation was a comprehensive effect-size analysis that evaluated the effects of mindfulness-based interventions on weight loss and obesity-related eating behaviours. The results of the meta-analysis demonstrated moderate effects of mindfulness-based interventions on weight loss and large effects in reducing problematic eating behaviours in individuals with overweight and obesity. The meta-analysis additionally highlighted a diversity in study design and outcomes as well as a variability in the how mindfulness is taught. Notably, there was a distinction between the use of formal and informal strategies to cultivate mindfulness. Decoupling the independent effects of both approaches on weight loss and disordered eating behaviours is necessary to examine their differentiating effects on various health outcomes. Moreover, the results of this meta-analysis highlight the importance of measuring changes in mindfulness for elucidating its beneficial effects on various weight-related outcomes. Less than half of the included studies (42%) measured mindfulness using a validated assessment tool. This is problematic because it renders it impossible to draw definite conclusions with regards to the unique benefits of mindfulness training for weight loss and

reducing obesity-related eating behaviours. Future research must regularly include a validated measure of mindfulness to objectively quantify changes in mindfulness and to explore how these changes affect outcomes. Moreover, future studies must include a detailed assessment of "time spent practicing" to allow testing underlying assumptions of therapeutic change. In other words, benefits of mindfulness-based programs are assumed to result from increased time spent practicing mindfulness. Although participants are encouraged to practice mindfulness throughout these interventions, there may be a large discrepancy in the time spent practicing that may result in inconsistent findings. It is thus important that future research regularly includes an assessment of daily practice to better elucidate how the consistency of mindfulness training affects weight and eating-related outcomes.

The aim of the second manuscript was to develop a brief mindful eating intervention to investigate the independent effects of informal mindfulness strategies on reducing problematic eating in individuals with overweight or obesity. Although the pilot project demonstrated statistically significant improvements in eating outcomes, it was difficult to effectively assess the independent mindful eating processes that may have contributed to these effects. This challenge was primarily due to several psychometric limitations of previous mindful eating scales. Although previous questionnaires assess the attentional domains of eating-specific mindfulness, they do not effectively assess the attitudinal facets of the construct. This is problematic because it prevents the comprehensive assessment of mindful eating. Even though these psychometric limitations prevented the investigation of potential mechanisms of therapeutic change, the results of our pilot did challenge the idea that meditation practice is a necessary treatment modality for changing eating behaviours in individuals with overweight and obesity. Only 35% of our study participants reported previous mindfulness experience. A limitation of many mindfulness-based

programs is their potential for self-selection bias. Namely, a participant's decision to devote large amounts of time to formal meditation practice is not typical and is presumed to be associated with a range of individual differences, such as personality and sociodemographic differences, that may confound outcomes (Davidson & Kaszniak, 2015; Huberty et al., 2019; Upchurch & Johnson, 2019). In a recent census, only 14.2% of American adults reported having practiced meditation at least once in the last year (Clarke et al., 2018). Even though meditation practice has gained popularity over the past decade (Sun, 2014), it is only being sought out by a minority of individuals. Consequently, it may be necessary to develop programs that do not emphasize formal meditation practice but rather encourage the incorporation of mindfulness skills through informal training exercises. However, in order to develop fruitful programs, future research must continue to identify which informal mindfulness exercises may lead to beneficial effects. In other words, there are various non-meditation approaches that may support changes in obesity-related eating behaviours, however, not all of these strategies may facilitate changes equally.

Given that individuals with overweight or obesity demonstrate reduced emotion regulation abilities –including the tendency to compulsively overeat in response to negative emotions (Davis, 2013)– mindfulness strategies that exclusively emphasize the importance of increasing awareness of sensory properties of food and homeostatic cues of hunger a satiety may inadvertently prompt overeating rather than adaptive eating. In other words, an individual who is asked to cultivate greater awareness towards their homeostatic cues of hunger and satiety may inadvertently become hyperaware of their non-homeostatic cravings to eat, which may increase their overall distress. Consequently, if participants do not develop an ability to manage and tolerate uncomfortable sensations and emotional experiences, they may unavoidably return to

their maladaptive coping strategies (e.g., emotional eating) to alleviate their immediate distress. It is thus important that future investigations develop and test informal mindfulness strategies that are aimed at cultivating both an increased awareness of internal cues of hunger and satiety as well as encourage an ability to observe present moment experience from a lens of non-judgment and equanimity.

The third and final manuscript built on the results of the pilot study by addressing several of its limitations. Specifically, the purpose of the three-study project described in Manuscript 3 was to develop and validate a comprehensive measure of mindful eating that is able to assess both the attention and attitude components of the construct of mindfulness. The Four Facet Mindful Eating Scale (FFaMES) is a questionnaire that assesses both the attention and attitude components of eating-specific mindfulness. The results of the project provide further evidence for the differential effects of various mindful eating processes on obesity-related outcomes. Specifically, the results suggest a clear distinction between attitudinal and attention facets of mindful eating. Although both facets of attitude (e.g., non-judgment, disidentification) and attention (e.g., observing) are well known in the mindfulness literature, present-moment awareness has received more interest from Western empirical investigations particularly in the domain of mindful eating (Arch et al., 2016; Cavanagh, Strauss, Forder, & Jones, 2014; Higgs & Donohoe, 2011). Interestingly, the results of our study allude to the potentially more significant role of the attitudinal facets of mindful eating for healthy weight management. These results echo similar sentiments as the results from my pilot project (Chapter 3). Specifically, although an individual may be aware of the thoughts, emotions, or physical sensations that accompany their urges to eat, they may be unable to successfully decenter from habitual patterns of reaction and negative self-judgment (Lacaille et al., 2014; Tapper, 2017). This difficulty to maintain a mental

distance from feelings of emotional distress or self-judgment may be particularly problematic for emotional eaters or binge eaters because it may paradoxically increase their risk of compulsive overeating (Heatherton & Baumeister, 1991; Williamson, White, York-Crowe, & Stewart, 2004). Developing an ability to observe present-moment experiences from a lens of non-reactance and non-judgment may be an important skill for breaking impulsive tendencies to overeat for non-homeostatic reasons. However, as mentioned in Chapter 4, attention is a necessary first step for changing automatic and reactive patterns of behaviour. In other words, an individual cannot effectively response to their eating-related experience with non-judgment and equanimity if they are not aware of these experiences. Provided this symbiotic relationship between the attention and attitude facets of mindful eating, future research must continue to assess how specific mindfulness exercises improve these facets and how improvements in these various facets support the treatment and management of obesity.

Methodological Considerations

The first manuscript of my dissertation was an effect size analysis of various mindfulness-based interventions for individuals with overweight and obesity. By combining the data of multiple studies, the analysis permitted a more comprehensive account of the effectiveness of mindfulness-based training on weight loss and obesity-related eating behaviours. However, even though the meta-analysis only included mindfulness-based programs, the implementation and program content differed significantly across studies. This diversity in study design and outcomes contributed significantly to the observed heterogeneity in effect sizes. Furthermore, less than half of the studies used a validated measure of mindfulness. This is particularly problematic providing that these studies ascribed the positive effects of these interventions to an increase in mindfulness. However, it is difficult to assess the legitimacy of

such claims if authors do not measure the construct at hand. Without a validated measure of mindfulness, one cannot be certain whether the changes in outcomes are the result of an increase in mindfulness or other confounding variables. Future research should consistently assess mindfulness in all investigations to better understand its independent effects on health outcomes.

The second manuscript assessed mindful eating using a widely cited questionnaire. Despite being the most widely used measure of mindful eating, the *Mindful Eating Questionnaire* (MEQ; Framson et al., 2009) has several limitations that warrant discussing. A major psychometric limitation of the MEQ is that it includes several processes that are beyond the scope of mindfulness. This inclusion of non-mindfulness specific constructs is particularly problematic given that these processes may produce confounds that can misrepresent the differential effects of mindfulness skills on health outcomes. Moreover, the MEQ provides a narrow assessment of mindful eating such that it addresses the attentional components of the construct while not assessing its attitudinal features. This omission of certain features of mindful eating is particularly problematic given the theorized role of non-judgment and equanimity in decreasing eating disorder pathology (Baer et al., 2005; Kristeller & Wolever, 2011, Wolever & Best, 2009). Taken together, it is important to consider the psychometric limitations of the MEQ in its ability to effectively evaluate mindful eating. Future research should consider integrating more comprehensive measures of mindful eating, especially in investigations that attempt to determine the unique benefits of eating-specific mindfulness on obesity and its related comorbidities.

The third manuscript describes the development and validation of a new mindful eating scale. Akin to all scale development projects, methodological limitations must be considered. Specifically, when considering the constraints of exploratory factor analysis (EFA). Although

EFAs form the foundation of scale development, they have several shortcomings that must be addressed. An exploratory factor analysis is a statistical method that is used to describe the relationship among a set of observed variables. A basic assumption of EFAs is that the observable relationships between certain measurable variables (e.g., items) is explained by a set of underlying latent factors that can never be observed. The existence of these latent variables is rather inferred. The success of this inference process is thus contingent on the researchers' ability to generate a complete and accurate set of measurable variables (i.e., items) in the initial item pool. If certain important features are missing from this preliminary item pool, the efficacy of the EFA will be dramatically reduced. Furthermore, the identification and interpretation of latent factors from observed correlations is a subjective process that requires a strong psychometric background and knowledge of the latent constructs at hand. Given the subjective nature of EFAs, it is important for future research to continue to evaluate the psychometric properties of the scale in various populations. Scale development is thus an evolving process. Modifications of the FFaMES may be warranted in the future as more knowledge is acquired with regards to its psychometric properties.

Contributions to Knowledge

The first manuscript in my dissertation provided a comprehensive effect size analysis of the effectiveness of mindfulness-based interventions on weight loss and the reduction of obesity-related eating behaviours. This was the first effect size analysis to explore the independent effects of mindfulness training on obesity management. This investigation was an important contribution to the literature because it provided additional evidence for the independent effects of mindfulness interventions on obesity-related eating behaviours and weight loss. This was the first investigation of its kind to attempt to quantify the unique benefits of formal and informal

mindfulness strategies on weight and eating outcomes. Future investigations must continue to disentangle the potential benefits of various mindfulness strategies for successful weight management. By testing and identifying the specific mindfulness strategies that support therapeutic change, researchers will be better able to develop mindfulness-based programs that facilitate long-term changes in eating-behaviours.

The second manuscript was the first study of its kind to test the effectiveness of a brief mindful eating intervention on decreasing overeating in individuals with overweight and obesity. This pilot project was an important contribution because it demonstrated the feasibility of implementing a manualised program to community-members by non-mindfulness experts. This project furthermore highlighted the importance of identifying the active ingredients of therapeutic change. Our program did not advocate the use of meditation practice as a tool to increase eating-specific mindfulness. To preserve the brevity of the intervention, we chose to focus on informal mindfulness techniques that were domain specific. The results of our study thus sheds light on the possibility that meditation practice is not fundamental for therapeutic change when addressing obesity-related eating behaviours. More research must continue to assess the underlying mechanisms of action that explain the changes in outcomes. Specifically, are domain-specific skills sufficient to cultivate eating-specific mindfulness or are more general mindfulness skills required?

The third manuscript in my dissertation contributes to the literature by providing a comprehensive questionnaire to assess mindful eating. The aim of this scale development project was to create a questionnaire that addressed the psychometric limitations of former mindful eating scales. The Four Facet Mindful Eating Scale (FFaMES) provides the literature with a psychometrically strong scale that can better assess all components of the mindful eating. This is

particularly important for future research that investigates the differential effects of various mindful eating processes on health outcomes. Unlike previous scales, the FFaMES assesses both the attentional and attitude components of the mindful eating construct. By providing the literature with a measure that assesses both the attitude and attention components of mindful eating, future research can use this scale to better understand how specific mindfulness exercises improve certain aspects of mindful eating. Specifically, future investigations can use this measure to help disentangle the unique effects of meditation practice and informal mindfulness exercises on an individual's ability to cultivate non-judgmental awareness of present-moment food-related experiences. This will help provide more evidence for the role of meditation practice in addressing obesity-related eating behaviours such as emotional eating.

Future Directions

Although my dissertation provides further evidence for the benefits of mindfulness training on managing obesity and its related comorbidities, more research is required to better understand *how* and *why* mindfulness training is helpful. Specifically, what are the mechanisms of action that are responsible for the therapeutic changes seen in these programs? It is important that future research continues to identify the mindfulness skills that are beneficial in increasing present-centered non-judgmental observation of eating-related experiences. Discrepancies currently remain in how mindful eating is defined, taught, and assessed psychometrically. These discrepancies prevent the thorough and reliable investigation of the unique effects of mindful eating on obesity management. These disparities are particularly problematic in how mindful eating is taught. Certain instructional inconsistencies may result in mixed interpretations of the effectiveness of eating-specific mindfulness in addressing obesity-related eating behaviours. More research is thus necessary to evaluate the differential effects of various mindful eating

techniques on health outcomes. It is thus important that future investigations pay more attention to the methodological nuances of these programs and to begin assessing their active ingredients using validated measures of general and eating-specific mindfulness to quantify changes over time. Moreover, additional emphasis must be placed on determining whether domain-specific skills are sufficient in addressing problematic eating behaviours in individuals with overweight and obesity, or whether meditation practice is necessary for therapeutic change.

Concluding Statement

Put together, my dissertation provides additional evidence for the effectiveness of mindfulness on obesity management. Using both exploratory and intervention research, the studies that are included in this dissertation further clarify the unique benefits of mindfulness-based training on obesity-related eating behaviours. This dissertation package thus offers a stable foundation for the continued investigation of the advantages of mindfulness-based training for therapeutic change.

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Supplementary Materials

Mindful Eating Pilot Project - Manual

Text written in normal font is to be verbalized to the participants.
Text written in italic font is instructions for facilitators.
Text written in bold indicates section headings and points to emphasize.

Text written in normal font is to be verbalized to the participant.
Text written in italic font is instructions for coaches.
Text written in bold indicates section headings and points to emphasize.

Session 1: Overeating and Mindfulness

Objective: *Discuss mindfulness as a way to decrease overeating.*

Homework: *Practice belly scan exercise.*

Before we begin the program, I would like to briefly touch on exercise. Although it is not emphasized in our program, it plays an important role in weight loss. One simple and healthy way to integrate more exercise into your daily life, is to try to walk 7,000 steps each day. *Coaches can encourage the participants to count their daily steps with a pedometer. It is easier to reach a goal when we can see how many steps we are walking a day.* Although we won't be discussing this much in the program, I want to plant a seed and offer you the opportunity to consider adding more physical activity into your daily routine.

Overeating prevents weight loss

Overeating results in weight gain and happens when we eat more than our body needs. Overeating can be triggered by many things. We might overeat because we are distracted, at a buffet, or are just trying to cope with certain emotions. Learning to listen to your body's natural cues of hunger and fullness is an important step towards successful weight loss. When we ignore, or are unaware of these natural signals, we tend to eat more food than we need. By learning to tune in and to listen to our body's natural hunger and fullness signals, we can eat less and lose weight.

Tuning in to what our body tells us takes time. Over the course of this program, I will ask you to practice several exercises that will help you to become more aware of your body's hunger and fullness signals. By becoming more aware of these physical signals, you will be better able to recognize when to eat, when not to eat, and when to stop eating before you ate too much.

Mindfulness

This focused attention to your body sensations is a form of *mindfulness*. Mindfulness is a state of mind; it is being aware of everything that is happening around you and within your body. To become mindfully aware of your natural hunger and fullness signals, you need to focus your

attention inwards to your body. Although this may sound simple, most of us rarely take the time to focus inwards and to listen to what our body is telling us (i.e. that it is hungry, satiated, or full). For example, have you ever gone to the movies and finished a large bag of popcorn without even realizing it? Or have you ever had the urge to munch on snacks even though you just finished a large meal? These two examples are what we call *mindless eating. Briefly ask participants to identify times in the day when they mindlessly eat.* When we eat mindlessly, we tend to forget or tend to ignore our body's natural signals of hunger and fullness. It is this lack of eating awareness, or mindlessness, that results in weight gain and makes it harder to lose weight.

The goal of this program is to teach you techniques to reduce your mindless eating which will help put you back in control of your eating behaviours. Being back in control of your eating will have a cascading effect on your weight and will help you achieve sustained weight loss. The first technique that we will practice is called a belly scan. Belly scans are a type of mindfulness exercise that help individuals learn to direct their attention inwards, that is, towards their physical body. By practicing this brief belly scan every day, you will find it easier to tune in and listen to your stomach's natural hunger and fullness signals.

Homework

Every session, I will give you a homework sheet with things that you need to work on before the next session. It is VERY IMPORTANT that you do the homework and that you bring this sheet back to every session. *Define a strategy with the participant to make sure they put the homework sheet somewhere that they will remember to bring it back with them. For example, if they always carry a backpack with them, suggest that they keep it in their backpack so they will be sure to have it on them. You can also suggest that they put a reminder in their smartphone so they make extra sure that they don't forget.* This week, I want you to practice the belly scan exercise using the instructions provided *in your session 1 handouts*. Tuning in to your body signals, especially your stomach signals, is a crucial step in the program, so the more you practice this exercise, the less demanding it will be.

Session 2: Mindful Eating

Objective: *Explain mindful eating and do an exercise to practice it.*

Homework: *Practice mindful eating at home.*

Review session 1 homework. Ask the participants if they had any troubles practicing the belly scan exercise. Address any difficulties and/or questions. Some participants may express a dislike, or apprehension, to the belly scan. This is normal. Acknowledge their apprehension and remind them that this exercise is meant to help them tune in to their stomach signals. By learning to tune into their stomach and its physical sensations, they will be better able to identify and recognize when they truly need to eat and when they should stop eating.

There are many times in the day when we are not aware of what we are eating or how much we are eating because we are too distracted, too busy, too tired, or too preoccupied with other things like work, family, or even our emotions (stress, irritation, anxiety, etc.). This is what we call

mindless eating. The opposite of mindless eating is what we call *mindful eating*. Mindful eating is about being totally focused on your eating experience, which can also make the experience of eating more enjoyable and fulfilling. When we eat mindfully, we direct our attention to each sensation that occurs while eating, such as chewing, tasting, savouring, and swallowing. Mindful eating will help you become more aware of your body's natural fullness cues (i.e. when you have consumed enough food and should stop eating), which will help you eat less by eating in accordance with what your body needs, thus helping you lose weight. Let's do an exercise to practice mindful eating.

Mindful eating exercise (low carb chocolate)

This exercise is an exaggeration of mindful eating. By being fully aware of what you are eating, and how it feels to eat, you will make better eating decisions, know exactly when to stop eating, and will be more satisfied with your meal in general. *Eating mindfully is about enjoying the* ***entire eating experience****. Draw parallels to high-end restaurants, where their emphasis is not on large meals, but rather on meals that are full of flavor, color, and texture (i.e. quality vs. quantity).*

The purpose of this activity is to exaggerate the act of tasting and eating by having you **slow down** and **focus on all of the sensations** associated with eating this piece of chocolate. *Give the participants 1 piece of low-carb chocolate.* The goal is to mindfully eat this piece of chocolate.

Before putting the chocolate in your mouth, take some time to examine it. Make a mental note of what it smells like, looks like, and feels like. When you are ready, put the chocolate into your mouth. Do not chew it right away. Instead, notice how it feels on your tongue. How does the chocolate taste? What is its texture? When you are ready, start chewing. Focus on the act of chewing. What does it feel like to chew the chocolate? Does its texture and taste change as you continue to chew it? When you are ready, swallow the piece of chocolate. Notice how this feels. Finally, when you have finished swallowing, be mindful of no longer feeling the sensation of chocolate in your mouth. *You can participate in this exercise with the patient if you wish.*

Do you have any questions? *Make sure that you re-emphasize that this is an* ***exaggeration of mindful eating.*** *Participants are not expected to take 60 seconds in their everyday life to eat one mouthful of food.*

Homework

This week, I want you to practice mindful eating. **I want you to eat one meal or snack mindfully per day**. Just like today's exercise, I want you to slow down and to eat with all of your senses. Do not eat when you are distracted (e.g. watching television, working on the computer, etc.). Pay close attention to the smell, taste, and texture of your food. To help you slow your eating down, I want you to use an exercise called: **Stop-Bite-Breath**: That is, before eating a meal or snack, take a moment to ***Stop***: Examine your food; what does it look like? What does it smell like? Then, take a ***Bite:*** Pay close attention to the food's taste and texture. Finally, after swallowing your mouthful of food, take one deep ***Breath*** and savor the experience. Continue this sequence of stopping-biting-and breathing until you have completed your entire

snack or meal. By slowing down and being fully aware of what you are eating, you will have time to make better eating decisions and thus will be more satisfied with your meal/snack. When we eat mindfully, we tend to eat less high calorie foods because we have time to weigh the pros and cons of what we are eating. Every time that you eat something, especially high calorie or "bad" foods, ask yourself whether or not it is worth it; does the pleasure you are getting out of it warrant its calories, sugar or fat intake? Most of the time "bad foods" don't. When one takes the time to become fully aware of what they are eating, especially when eating "bad" foods, one tends to enjoy these "bad foods" less, or even dislike them.

Note again that the participants do not need to spend 60 seconds savoring each bite. The purpose of Stop-Bite-and Breath is to get the patient to slow down and to become consciously aware of what they are doing and eating.

Describe your experience of mindful eating in this session's handout. How does mindful eating differ from mindless eating? Did the taste and pleasure of your food warrant its calories, sugar or fat intake?

Session 3: Emotional Eating

Objective: *Discuss emotional eating. What emotions lead the patient to overeat?*

Homework: *Use STOP to help reduce emotional eating.*

Emotional Eating

Emotions, like stress, anxiety, and boredom can make us want to eat even though we are not **physically hungry**. This is called emotional eating. Emotional eating can lead to weight gain and can make it harder to lose weight because it makes you eat more than your body needs (i.e., **you are eating even though your body is not physically hungry**). When you feel the urge to eat, it is important to immediately step on the brakes and ask yourself, "what is driving this urge?" Is your urge to eat driven by physical hunger, or is it driven by emotional hunger (e.g., stress, boredom, sadness, etc.)? **If you realize why you are hungry and choose to eat only when you are physically hungry, you will eat in accordance with what your body physically needs, and in many cases eat less, which can contribute to sustained weight loss**. *Before continuing, ask the participants if they are emotional eaters. If they are not, skip the following step and immediately introduce the STOP technique. If the participant is an emotional eater, quickly brainstorm and identify the specific emotions that cause the participant to want to eat (e.g., stress, boredom, anxiety, etc.). If the participant is having difficulties identifying specific emotions that trigger their urge to eat, work backwards and get them to describe certain situations where this urge to eat usually occurs (e.g., in front of a television, after a stressful meeting, etc.). Ask them to describe the physical sensations they feel when they get this urge to eat. Sometimes people are unaware of their emotions, so it can be helpful to tie these emotions to physical symptoms. For example, tension in the neck and shoulders, a racing heart, a feeling of emptiness etc. that makes them want to eat.*

Introduce the STOP technique

To help you slow down enough to figure out whether your urge to eat is emotional or real hunger, I am going to teach you a technique called **STOP.** *If the participant is not an emotional eater, emphasize that STOP can be used whenever they experience an urge to eat.* Every time that you experience an urge to eat, I want you to apply this technique **before acting on this urge.** This technique will help **slow you down** and will put some distance between you and your emotions. By doing this, you will be less likely to automatically eat when you are not really physically hungry. *(Be sure to emphasize to use STOP BEFORE eating because it helps SLOW YOU DOWN)*

STOP stands for:

- **S**– Stop! Do not immediately act on your urge to eat.
- **T**–Take a breath— Slow down!
- **O-** Observe—Look inwards. Listen to your body. How are you feeling? Is this urge to eat physical or emotional? Are you feeling bored, tense, or sad perhaps?
- **P–** Proceed. Decide to eat or not to eat based on your observations. **If you are physically hungry, eat. If you are emotionally hungry, do not eat**; instead, take the time to really understand your emotions. Ask yourself what you are feeling and why? If you are feeling **depressed** and **lonely**, call or message someone who always makes you feel better. If you are feeling **anxious**, expand your nervous energy by dancing to your favorite song, squeezing a stress ball, or going for a walk. If you are feeling **exhausted**, consider taking a bath or relaxing with a cup of tea. If you are feeling **bored**, read a book, watch your favorite television show, or turn to an activity you enjoy.

Homework

This week, I want you to practice using STOP whenever you feel the urge to eat. When you use STOP, please go through the checklist on this session's handout and make sure that you are using all four steps correctly (**S**top, **T**ake a breath, **O**bserve, and **P**roceed). We will be using STOP throughout the program. It is a crucial tool in helping you be more in tune with your body's needs and thus reducing overeating. The more you practice STOP, the easier and more effective it will become.

Session 4: Identifying hunger cues

Objective: *Explain and clarify the difference between physical hunger and psychological hunger. Identify and clarify the participants physical hunger cues.*

Homework: *Practice only eating when physically hungry. Before deciding to eat, rate physical hunger using the hunger and fullness scale reviewed in-session.*
Briefly review session 3 homework. Did the participants observe any changes in their eating patterns after using STOP? Did it help reduce their automatic eating? Trouble-shoot where problems arose.
Physical hunger (true hunger) vs. psychological hunger

There are many times in the day when our urge to eat is not caused by a physical need to eat, but is instead caused by certain situations or emotions. *Briefly ask participants to identify and describe some of these emotions or situations.* Last session, we reviewed emotional eating which is a specific type of psychological hunger. Psychological hunger differs from true, physical hunger because our desire to eat is **unsupported by any physical proof that our body requires food** (e.g., feeling hunger pangs). When we are psychologically hungry, we eat for a variety of reasons; like being bored, having food in front of us, socializing with friends and family, or simply because eating is "fun." In order to lose weight, it is **important that you learn to recognize and distinguish true hunger from psychological hunger**. *Quickly brainstorm and identify the specific physical cues or body sensations that the participants uses to determine **their physical (true) hunger**. If the participant is having difficulties identifying these cues, you can help by providing some examples: physical hunger develops gradually; it is accompanied by a growling or an empty feeling in the stomach. Sometimes its feeling is less localised in the stomach region and is a more general sensation in the abdomen, especially the upper abdomen. Low energy, headaches and a feeling of moodiness can be signs of extreme hunger.*
Psychological hunger does not have these physical signals.

Rating physical hunger

Every time that you have an urge to eat, ask yourself: Is my body really hungry? Rate your level of hunger on a scale from 1 (*starving; feeling weak, dizzy*) to 10 (*stuffed*; *so full you feel sick*). To help you, use the scale provided on this session's handout. **When you rate your level of physical hunger, be sure to check-in with your body signals and listen to your true hunger cues**. Does your stomach feel empty, is it growling? Did your urge to eat develop gradually or was it sudden? ***Emotional hunger generally develops very quickly**, often immediately after experiencing a specific emotion or emotional situation. If a patient experiences an abrupt, almost urgent need to eat, it is very likely that this urge is driven by emotions rather than true, physiological hunger.* Postpone eating if your true hunger score is a 4 or higher. Your body does not need food at this moment in time.

Homework

This week, I want you to practice **only eating when physically hungry, i.e. when rating your hunger at 3 or lower.** Whenever you experience an urge to eat, I want you to apply STOP. Remember, STOP is a technique that will help **slow you down**. By slowing down, you will be better able identify and distinguish whether your urge to eat is physical or psychological.
Let's quickly review STOP and integrate what we discussed in today's session.

- ✤**S** – Stop! Do not immediately act on your urge to eat.
- ✤**T** – Take a breath— Slow down!
- ✤**O -** Observe—Look inwards. Listen to your body signals.
  - How are you currently feeling? Are you bored, tense, or sad perhaps?
  - Do you feel any of your physical hunger cues (i.e. is your stomach growling, does it feel empty)? If yes, rate your current level of hunger from 1 (*starving; feeling weak, dizzy*) to 10 (*so full you feel sick*).
- ✤**P –** Proceed. Decide whether or not to eat based on your observations. If you are physically hungry and have scored below a 4, eat. If you are psychologically hungry, or have scored above a 4, do not eat.

When rating your hunger, use the scale provided on this session's handout. Describe your experience. Note how your level of hunger varies throughout the day.

Session 5: Identifying fullness cues

Objective: *Discuss and clarify the physical sensations of fullness.*

Homework: *Stop eating when "comfortably satisfied." During a meal, rate your level of hunger using the hunger and fullness scale.*

Fullness Cues

While learning to recognize and distinguish when to eat and when not to eat (true hunger vs. psychological hunger) is important, it is equally important to learn **when to stop eating before eating too much (i.e. when your body has eaten enough food and is satisfied).** Often when we eat, we overeat, and this contributes to unwanted weight gain. This tendency to overeat happens when we do not listen to our stomach's signals. When we do not listen to these signals, we do not realize when we have eaten enough. Over time, after years of not listening to our stomach cues, a discrepancy develops between what we *think* it feels like, and what it *actually* feels like to have eaten enough. To get rid of this discrepancy, it is important to turn your awareness inwards and tune into your stomach signals. By doing this, you will reconnect with your body's signals of having eaten enough. We have eaten enough when we feel "comfortably satisfied" rather than "full". *Ask participants to describe their body's physical sensations of fullness. Most participants will likely describe a feeling of pressure or discomfort in their belly, a feeling of stuffedness or being weighed down. They may describe their stomach as being bloated, distended, or inflated like a balloon. They may also describe feeling tired, lethargic, or sluggish after eating.* ***Explain that these sensations all indicate that they have overeaten. True stomach satiety, or "comfortable satisfaction" is a different type of sensation; it is a feeling that is more subtle or subdued.***

When your stomach is truly satisfied, a light, almost gentle pressure will appear in your abdomen. It is at this point in your meal when you should stop eating. Although you could eat more, you choose not to because your body is no longer physically hungry. Initially, this new feeling of stomach satisfaction may be hard to recognize. Don't worry, this is normal. To help you start recognizing this sensation, I would like you to perform a belly scan whenever you eat. As you are eating, focus on your stomach's physical sensations. Imagine that your stomach is a fuel tank, and that your awareness is the fuel gauge. At the start of your meal, you may feel that your stomach is empty or hallow. As you continue to eat, this empty sensation will be slowly replaced by a gentle pressure. **Stop eating once you feel this gentle pressure.** This is your body's fuel gauge telling you that it is "comfortably satisfied" and that its tank is full! At this point in your meal, you should still feel light and energetic, not tired or lethargic. If you feel stuffed, or uncomfortably full, you have overeaten. If you frequently feel stuffed after eating, you will have a harder time managing your weight because you are taking in more food than your body needs.

Homework

This week, I want to you to practice recognizing and identifying the feelings in your stomach when you eat and after you ate. Before taking a bite of food, rank your hunger on a scale from 1 to 10. Use the hunger and fullness scale we reviewed last session. **Make sure to stop eating when you feel comfortably satisfied**. *Emphasize that our body's physical hunger and fullness cues are on a continuum; this feeling of fullness, or "comfortably satisfied" is mid-way between*

extreme hunger (starving; feeling weak, dizzy) and extreme fullness (so full you feel sick). As you eat, use the eating belly scan to help you recognize this feeling of stomach satisfaction. **Pay special attention to how your stomach feels after every bite of food**. Notice how the empty sensation in your stomach is slowly replaced by a gentle pressure. Remember to **stop eating once you feel this gentle pressure**, **even if food is still left on your plate.** When practicing identifying these fullness cues, use **Stop-Bite-Breath** *(From your session 2 handout).* This exercise will help slow you down between bites, making it easier to recognize when you should stop eating.

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Session 6: Mindful Awareness of Food Choices and Portion Size

Objective: *Learning the importance of being aware of daily food choices and portion sizes.*

Homework: *Moderate your daily portion sizes and carb intake using the three tips reviewed in session.*

Up to this point, we have been focusing on the importance of tuning in and listening to our body signals as a way to eat more in accordance with what our body needs and in the long-term, lose weight. Now you are ready to start paying attention to and becoming aware of HOW MUCH you eat. This increased awareness will help you eat less, which over time will help you lose weight.

Everything that we eat and drink contains calories; some more than others. When we overeat, even the right types of foods, we take in more calories than our body can "burn." It is these extra calories that result in weight gain. To eat more in accordance with what your body needs and to gradually lose weight and keep it off in the long run, it is important that you become mindfully aware of your portion sizes, that is, how much you are eating at each meal or snack. When we eat, we tend to overeat because our portion sizes are too large. Effectively managing your portions is therefore an important factor in successful weight loss. Today, we're going to review 3 tips that will help you eat less by decreasing your portion sizes, while still leaving you feeling satisfied throughout the day.

1) **The Power of a Smaller Plate**
   Studies have shown that eating from a smaller plate tricks our brain into believing that we are consuming more food than what we actually are. When we eat from a large dinner plate, we tend to eat more because our portions always appear much smaller. **To help you lose weight, use a small plate (like a dessert plate) for your meal**. This reduction in plate size will help you eat less while still feeling satisfied. *Ask the participants if they can imagine themselves using a dessert plate in their home instead of a regular plate. Explain that if a family member makes a comment regarding this change in plate size, they will only comment 1 or 2 times. After that, it will no longer be an issue.*

   This same principal can also be applied to drinking beverages in the case that you have to drink beverages that contain calories (water is best!). When drinking a beverage other

than water, always choose a tall, slender glass instead of a large wide one. This will help you drink less, while still feeling satisfied!

2) **Moderate your carbohydrates**
   Although many of us love to eat foods that are rich in carbohydrates, like bread, pasta and sweets, these types of foods are **extremely high in calories** and can prevent weight loss when overeaten. They also spark insulin secretion, which contributes to weight gain. It is therefore **very important to minimize your daily carb intake when losing weight**. Here's some simple ways to do this:
   - Trade your breakfast carbs (e.g. cereal or bread) for high protein alternatives like low-fat cheese or a boiled egg. These lean proteins will fill you up and will help keep you going until lunch!
   - When plating your meal, double up on your vegetables! Reduce your carbs (e.g. potatoes, pasta, rice) to a ½ a cup.
   - Avoid sugary drinks (juices, sodas, sweetened ice tea, etc.). Drink water instead!

3) **Eat a soup or salad before your meal**
   Try eating a green leaf salad or low-calorie soup before your main course; this will help fill you up! Studies have shown that people who eat a healthy appetizer before their main course, tend to eat smaller portions at their main meal and are more satisfied in general. *Emphasize that **the soup must be broth-based and not high in cream**. Also, emphasize that patients **should choose their salad dressing wisely and use it sparingly**. Adding the wrong toppings to a salad (e.g. any cream-based dressing, like ranch, blue cheese, Caesar, thousand island, etc.) can double, or even triple the calorie count!*

Homework

This week, I want you to become mindfully aware of your portion sizes. Eating smaller portions is crucial for weight loss. To help you get started, use the three tips reviewed in session (e.g. using a smaller plate, decreasing your carb intake, and choosing to eat a low-calorie soup or salad before your main course). To help you remember, use the check list provided in your session handout. Which technique did you find most helpful and why?

Session 7: Mindful awareness of meal frequency

Objective: *Discuss the importance of meal frequency.*

Homework: *Practice eating 3 small meals and 2 snacks per day.*

Last session, we discussed the importance of increasing your awareness of daily food choices and portion sizes as a way to reduce overeating and to lose weight. *Quickly ask participants how their week went eating wise. Were they able to decrease their portion sizes using the 3 techniques you reviewed last session? Which technique(s) worked best for them?* This week, we are going to turn our attention to the importance of increasing your awareness of meal frequency. **A regular pattern of meals and snacks is important for maintaining good energy levels,**

curbing overeating, and gradual weight loss. One way to prevent overeating is to spread your calories throughout the day so that you eat every few hours. This will help keep your hunger in-check in between meals and prevent insulin spikes that lead to weight gain. Rather than eating 3 large meals per day, eat 3 small meals and 2 snacks instead. This will help you sustain a healthy blood sugar level and will prevent weight gain. By spreading your meals throughout the day, you will be more in control of your hunger and will be less likely to overeat. *Ask participants to describe their current eating patterns. How many meals and snacks do they eat per day?*

Homework

This week, I want you to be mindfully aware of your daily meal frequency. **Aim to eat 3 small meals (breakfast, lunch, dinner) per day with a snack in between each meal. Remember that these 5 meals/snacks need to be small!** If they are not, you will be more likely to overeat and gain weight. To help you reduce your portion sizes, **eat only half of what you would normally eat at any given meal or snack**.
Whenever you eat a meal or snack, make a note of it on your session handout. As you start to distribute your small meals and snacks equally throughout the day, use the belly scan, reviewed in session 1, to tune into your stomach's natural hunger and fullness cues. How does changing your meal frequency affect your hunger? Do you find that you are less physically hungry when you spread your meals throughout the day?

Session 8: Establishing Habits

Objective: *Review the skills taught throughout the program to help reduce overeating and promote long term weight loss.*

Homework: *Identifying which exercises or techniques worked best.*

All of the homework that has been given up to this point will be most effective if it is practiced regularly such that it becomes **a habit.** Decreasing the tendency to overeat and improving weight extends beyond this program. The skills that you have learned here can be used indefinitely. There is no quick fix, or easy solution to weight loss. Since weight loss takes time and effort, it is important that you focus on applying these skills consistently over the long term to help you change your eating behaviours and to be more in tune with your body's physical needs. This way, these skills will continue to help you eat less and lose weight.

Let's quickly review some of the skills that we covered over the past several weeks. First, we discussed the **belly scan exercise**. I asked you to routinely practice this belly scan as an exercise to help you begin tuning into your stomach signals. We then reviewed mindful eating and I taught you the importance of slowing down and being consciously aware of our entire eating experience. In session 3 we reviewed **STOP** (Stop-Take a breath-Observe-Proceed) to help reduce automatic eating and to help you decide whether your urge to eat is a psychological or physical urge. In sessions 4 and 5, we discussed the importance of tuning-in and listening to our body's physical cues of hunger and fullness. Again, I emphasized the importance of slowing down when eating in order to recognize and identify these subtle shifts in your body signals. An

eating belly scan was introduced to help you do this. In session 6 we discussed portion sizes, specifically, the importance of paying attention to HOW MUCH you eat. Because eating smaller portions is so crucial for weight loss, we reviewed three techniques to help you do just that. These techniques included:
using a **dessert plate** when dishing your meal, **decreasing your daily carb intake**, and **choosing to eat a low-calorie soup or salad before your main course**. In session 7, we discussed the importance of increasing your awareness of meal frequency as a way to prevent insulin spikes that lead to weight gain. Rather than eating 3 large meals per day, we asked you to **eat 3 small meals and 2 snacks** instead. To help you continue to reduce your portion sizes, I asked you to **only eat half of what you would normally eat at any given meal or snack**.

Out of the techniques we reviewed, which techniques worked best for you? *Encourage the participants to continue practicing these techniques, especially the techniques that they identified as being effective.* ***Be sure to emphasize that although some techniques may seem more effective than others, all of the techniques reviewed in the program work together****. You cannot have one technique without the other. To lose weight and eat less, it is always important to choose the right combinations of foods, in the right amount, in response to their body's natural hunger and fullness cues.*

Like I previously said, the techniques reviewed in this program are skills that you can use for the rest of your life. With consistent practice, these skills will become easier and more automatic, until at one point, you may no longer realize that you are using them.

Homework

Encourage the participant to revisit their homework sheets from previous sessions and to identify which techniques are most effective in managing their tendency to overeat. Every session, we discussed a specific technique or exercise to help you begin tuning in and listening to your body's physical cues of hunger and fullness. Now that you are more familiar with these techniques, I want to you to review your homework sheets and choose the ones that worked best for you. When you have done this, write these techniques down on *this session's handout.* We will review these techniques again next week so that you can continue to use them in the future.

Session 9: Commitment to Values

Objective: *Discuss setbacks, loss of motivation, and ways to stay committed to weight loss by not overeating.*

Homework: *Make a summary card with participants in-session.*

Setbacks and loss of motivation are normal. They happen to everyone and are an inevitable part of behaviour changes and weight loss. In a way, weight loss is like hiking a mountain. For a while, it feels like the hike is never going to end and there is no way that you will make it to the

top. But once you get out of the trees, you can see a clear path to the summit and know that you are going in the right direction. If you have not yet reached your weight loss goal, it is important to remember that eating behaviours are complex and require a great deal of time and effort to change. These changes are necessary to implement over time before sustained weight loss can occur. Success is not only about the final outcome (in this case, making it to the top of the mountain). You can also achieve success along the way. It's like the old saying, "it's not about the destination, it's about the journey." Weight loss won't always be easy, or smooth, but that doesn't mean that one cannot achieve their eventual goal if they set their mind to it.

Losing weight is about progress and not perfection. **Immediate results do not exist.** True weight loss takes time and effort. In order to stay motivated and on the right track, it is important to identify and celebrate every bit of progress that you have made thus far. *Brainstorm and identify this progress with the participants. What changes are they most proud of? Even the smallest of changes (e.g. drinking water instead of juice at dinner time) should be praised.* When you catch yourself being critical or judgmental towards yourself, always remember that changing old habits and losing weight is a process. It doesn't happen overnight. Dwelling on negative thoughts only hinders this process (e.g. "I cheated", "I'm a pig", "I'm such a failure"). Instead, focus on the positives (e.g. "I stopped eating when I felt comfortably satisfied," "I only ate when I was truly hungry", "I didn't eat that cupcake that my colleague offered me at lunch"). Remember, no one is ever perfect, so every bit of progress is a step in the right direction!

Setbacks

Briefly discuss any setbacks that participant have had, or think that they think might have, in regards to their weight and tendency to overeat. Depending on their answers, remind the participant of the various strategies learnt in session (belly scan, STOP, Stop-Bite-Breath, rating hunger and fullness cues, belly scan while eating etc.) to help manage their overeating. ***Overall, it is important to emphasize that setbacks are normal and are an inevitable part of losing weight. The key to success is how one reacts to these inevitable setbacks or slips.*** *Participants must understand that it is important to react proactively when setbacks occur in order to prevent more slips from happening in the future. When the participant experiences a slip, they should use the skills that they learnt in the program to help them get back on track.*

Ways to stay committed

When you feel your motivation slipping, it always helps to remember the goals and values that initially led you to want to lose weight and then to use the skills and techniques that you learnt in this program to stay true to these objectives. *Briefly brainstorm these goals and values with the patient (i.e. Why do they want to lose weight? Why is weight loss so important to them?). Make sure to emphasize values related to health (e.g., lowering blood pressure, risk of heart disease, risk of diabetes, etc.), especially the health concerns that led to want to join this program.*

Once the participant has identified their reasons for losing weight and why this is important to them, discuss how this relates to overeating. Ask questions like:

- How is overeating related to your weight loss?

- Does it help or hinder your progress?
- Is overeating in line with your weight loss values, or not? Why?

Homework (done in-session)

This week, as we as we finish off, I want you to write these specific weight loss values and goals on a summary card *(See session handout. Get the participants to write down their key goals and values on this summary card*). Refer back to this card when you are feeling a lack of motivation, or have experienced a setback. This summary card will help you stay on track by reminding you why you want to lose weight, and why overeating is inconsistent with your weight loss values. Throughout the program, you have learnt skills to help you stick to your values of eating less to lose weight. In order to stay true to these values, you can use the techniques that you chose as being most effective in managing your tendency to overeat. Keep this card where you can see it, so that it acts as a constant reminder of your values to reduce your overeating and to lose weight. When a setback occurs, refer back to this summary card and use it as a source of motivation to keep heading towards your values of losing weight and eating less.

Sources

The rationales and supporting empirical evidence for justifying the program decisions are provided below:

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Mindful Eating Pilot Project – Participant Handouts

Session 1- Hunger and Fullness

Learning to listen to your body's natural hunger and fullness cues is an important step towards successful weight loss. *When we ignore or are unaware of these natural cues, we tend to eat more than we need. By learning to tune in and to listen to our body's natural hunger and fullness signals, we can eat less and lose weight.*

Homework: To help you start tuning into your body's natural hunger and fullness cues, we will practice a belly scan exercise. **This exercise will help you to start turning your attention inwards, that is, towards your belly and its many sensations.** By practicing this exercise every day, you will become more aware of your natural stomach signals, which will make it easier for you to recognize when to eat, when not to eat, and when to stop eating before eating too much.

Belly Scan Exercise

This belly scan should take **2 minutes** to complete. When practicing this scan, set an alarm to help you keep track of the time. If at any point during this exercise you find yourself distracted, or lost in thought, gently bring your attention back to your belly and its many sensations.

Please read the following instructions before attempting the belly scan.

1) Sit.
2) Close your eyes and take three deep breaths.
3) When you are relaxed, turn your attention towards your belly.
4) How does it feel? What sensations do you notice? Pay close attention to these feelings and sensations.
    - Is it empty, hallow, hungry?
    - Is it full, bloated, uncomfortable?
    - Is it tense, tight?
    - Is it neutral, happy, content?

When it has been 2 minutes, open your eyes. Make note of what you felt in the table on page 2.

Whenever you are about to eat, or have an urge to eat, mentally scan your stomach. When you perform this scan, you do not need to close your eyes. Just focus your attention on your stomach. How does it feel? What sensations do you notice? **This mental belly scan will help you eat less by making you aware of how your belly feels when it is hungry or full.**

Belly Scan Exercise: Tracking Sheet

Date/time	**How did your stomach feel? What sensations did you notice**? (*Was it tense, tight, uncomfortable, bloated, empty, hungry, happy, or content?*)

Session 2 - Mindful Eating

Mindful eating will help you become more aware of your body's natural fullness cues (i.e. when you have consumed enough food and should stop eating), which will help you eat less and lose weight.

Homework 1: Practice mindful eating at home: **Mindfully choose what to eat**: Eat non-greasy, low sugar foods. Do not eat when you are distracted (e.g., watching television, working on the computer, etc.). **When you are eating, slow down and eat with all of your senses**. Pay close attention to the smell, taste, and texture of your food. Use the belly scan to stay in-tune with your stomach cues. How does your stomach enjoy its food? Is the sugar, fat and calorie content of the food worth its pleasure? **Mindful eating will help you eat less because you will have the time to weigh the pros and cons of what you are eating**.

Whenever you eat a high calorie food, ask yourself whether or not it is worth it. Does the pleasure you receive from eating this food warrant its calories, sugar, or fat intake? Most of the time, it does not. When we become fully aware of what we are eating, especially when eating "bad" foods, we tend to enjoy these foods less, or even dislike them.

Homework 2: To help you slow down and eat less, I want you to use an exercise called: **Stop-Bite-Breath**: That is, before eating a meal or snack, take a moment to ***Stop***: Examine your food; what does it look like? What does it smell like? Is this food a non-greasy, low sugar, low fat food? Then, take a ***Bite:*** Pay close attention to the food's taste and texture. Finally, after swallowing your mouthful of food, take one deep ***Breath*** and savor the experience. Make sure to scan your belly between breaths. Pay close attention to your stomach cues. How does your stomach feel after every bite? Is it becoming less hungry and more full? Continue this sequence of stopping-biting-and breathing until you are done eating. **Make sure to stop eating when you feel full**, even if your meal or snack is not completely finished.

Fill in the following chart to reflect on your mindful eating experience using **Stop-Bite-Breath.**

Date	What did I eat?	How did it smell?	How did it feel?	How did it taste?	How long did it take to eat?

Please answer the following questions.

1) How did mindful eating differ from mindless eating?

2) How did the taste and pleasure of your food warrant its calories, or not?

3) When you mindfully ate your favorite "bad" foods (e.g. chips, chocolate, crackers, etc.) how did they taste? Did they taste better or worse than before?

Session 3 – Emotional Eating

If you realize why you have the urge to eat and choose to eat only when you are physically hungry, you will eat less and you will lose weight.

Homework: Use STOP to help reduce emotional eating. If you are not an emotional eater, use STOP whenever you experience an urge to eat. When you use STOP, please go through the checklist in this handout and make sure that you are using all four steps correctly (**S**top, **T**ake a breath, **O**bserve, and **P**roceed).

STOP stands for:

- ✤**S** – Stop! Do not immediately act on your urge to eat.
- ✤**T** – Take a breath— Slow down!
- ✤**O** - Observe—Look inwards. Do a belly scan. How are you feeling? Is this urge to eat physical or emotional? Are you perhaps feeling bored, tense, or sad?
- ✤**P –** Proceed. Decide to eat or not to eat based on your observations. If you are physically hungry, eat (but be mindful about what you eat and eat it slowly). If you are emotionally hungry, do not eat; instead, take the time to really understand your emotions. Ask yourself what you are feeling and why?

When you use STOP, please go through the checklist and make sure that you are using all four steps correctly (**S**top, **T**ake a breath, **O**bserve, and **P**roceed).

My STOP Checklist:

1) Did I **STOP**?
   - ❑ Yes
   - ❑ No
2) Did I **TAKE A BREATH**?
   - ❑ Yes
   - ❑ No
3) Did I **OBSERV**E and listen to my body? How do I feel? Am I physically or emotionally hungry?
   - ❑ Yes
   - ❑ No
   - ❑ I feel…_____
   - ❑ Am I physically or emotionally hungry?…_____

4) Did I **PROCEED**? (What did I decide?)
   - ❑ I chose to eat
   - ❑ I chose not to eat

Please answer the following questions.

1) How useful did you find STOP in reducing your urges to eat?

2) Did STOP help you slow down enough to figure out whether your urges to eat were emotional or physical (i.e. true hunger)?

Session 4 – Identifying Hunger Cues

In order to lose weight, it is important that you learn to recognize and distinguish true hunger from psychological hunger, and to eat only when you are truly hungry.

Homework: This week, I want you to practice to **only eat when you are physically hungry.** Every time you have an urge to eat, use your belly scan and the STOP technique to rate your level of hunger on a scale from 1 (*starving; feeling weak, dizzy*) to 10 (stuffed; *so full you feel sick*). **Postpone eating if your fullness score is 4 or higher.**

Use the following scale to track your level of hunger on page 2.

Hunger and Fullness Scale

1. **Starving** – Urgent and unbearable feeling of extreme hunger, "I want to eat everything in sight."
   Physical sensations: *Severe hunger pangs, feeling extremely irritable, shaky, lightheaded, weak*.
2. **Extreme hunger**– Feeling overly hungry but the feeling is still bearable.
   Physical sensations: Cranky, low energy, a lot of stomach growling, hunger pangs, difficulty concentrating.
3. **Rather hungry** – I am hungry, "I want to eat now, but am still in control of my hunger."
   Physical sensations: Slight hunger pangs, mild stomach growling and/or discomfort.

******* If your fullness is 4 or higher, postpone eating *******

4. **Peckish** – I am starting to feel a little bit hungry, "I will want to eat soon, but not now."
   Physical sensations: *Very mild sensations of gnawing, churning or growling in stomach.*
5. **Neutral** –I am neither hungry nor full.
   Physical sensations: No sensations. Stomach feels neutral. It is at rest.
6. **Nearly satisfied** – Starting to feel content but could eat a couple more bits before feeling comfortably satisfied.
   Physical sensations: A gentle pressure or sensation is beginning to build.
7. **Comfortably satisfied** – I have eaten enough. I could continue to eat, but I am no longer physically hungry. **** **This is where you should stop eating *****
   Physical sensations: A gentle pressure or sensation is felt, usually at the upper or top part of the stomach. Stomach is satisfied. Hunger pangs have disappeared.
8. **Slightly too full –** I have eaten a bit too much, "I probably should have stopped eating a couple of bits ago"
   Physical sensations: A slightly uncomfortable feeling or pressure in your stomach. You may feel the slight pressure of your stomach against your clothes, especially the waist of your pants.
9. **Stuffed (overfull) –**I have eaten way too much. I am overfull, "Why did I eat that much?"
   Physical sensations: Physically uncomfortable, stomach feels bloated or inflated; clothes feel tight and uncomfortable around stomach region.
10. **So full you feel sick -** I am beyond stuffed.
    Physical sensations: *Feelings of physical illness, or nausea; extreme discomfort. No energy, lethargic.*

Tracking My Level of Hunger and Urges to Eat

Date/Time	Did I scan my belly using STOP? *(yes/no)*	What is my current level of hunger? *1 (starving; weak; dizzy) to 10 (stuffed; so full I feel sick)* **If your fullness score is 4 or higher, postpone eating**

Session 5 –Identifying Fullness Cues

When your stomach is truly satisfied, a light, almost gentle pressure will appear in your abdomen.

Homework 1: This week, I want to you to practice recognizing and identifying the feelings in your stomach when you eat and after you eat. Before taking a bite of food, rank your hunger or fullness on a scale from 1 (*starving*) to 10 (*so full you feel sick*). Use the hunger and fullness scale we reviewed last session. **Make sure to stop eating when you feel *comfortably satisfied* (scale point 7)**.

Homework 2: As you eat, **use the belly scan to help you recognize and identify when you are feeling *comfortably satisfied***. Pay special attention to how your stomach feels after every bite of food. Notice how the empty sensation in your stomach is slowly replaced by a gentle pressure. Remember to **stop eating once you feel this gentle pressure**, **even if food is still left on your plate.** When practicing identifying these fullness cues, use **STOP***).* This exercise will help slow you down between bites, making it easier to recognize when you should stop eating.

IMPORTANT: Please use the following frequency chart to record how often you used the belly scan and the hunger/fullness scale to help you recognize when feeling "comfortably satisfied." Check-off the appropriate box after using either of the two techniques.

Monday	**Tuesday**	**Wednesday**	**Sunday**
❑ Bfast	❑ Bfast	❑ Bfast	❑ Bfast
❑ Snack	❑ Snack	❑ Snack	❑ Snack
❑ Lunch	❑ Lunch	❑ Lunch	❑ Lunch
❑ Snack	❑ Snack	❑ Snack	❑ Snack
❑ Dinner	❑ Dinner	❑ Dinner	❑ Dinner
Thursday	**Friday**	**Saturday**	
❑ Bfast	❑ Bfast	❑ Bfast	
❑ Snack	❑ Snack	❑ Snack	
❑ Lunch	❑ Lunch	❑ Lunch	
❑ Snack	❑ Snack	❑ Snack	
❑ Dinner	❑ Dinner	❑ Dinner	

Session 6 – Mindful Awareness of Food Choices and Portion Sizes

Homework: This week, I want you to become mindfully aware of your portion sizes. **Eating smaller portions is crucial for weight loss**. To help you get started, use the three tips reviewed in session (e.g. using a smaller plate, limit your carb intake, and choosing to eat a low-calorie soup or salad before your main course). To help you remember, use the check list provided below.

TODAY, did I decrease my portion sizes by…

1) **Using a smaller plate**
   - ❑ Yes
   - ❑ No
2) **Moderating my carbohydrates**

(e.g. Trading my breakfast, lunch and dinner carbs with a high protein alternative, doubling up on my vegetables, eating only ½ cup of low carb pasta ,like egg noodles, and avoiding sugary drinks, etc.)
   - ❑ Yes
   - ❑ No
3) **Eating a low calorie soup or salad before my meal**

(Note: The soup must be broth-based and avoid using any cream-based salad dressings)
   - ❑ Yes
   - ❑ No

Please answer the following questions.

1) Which technique(s) did you find most helpful? Why?

_____
_____
_____
_____

2) How (else) will you decrease your portion sizes in the future?

_____
_____
_____

Session 7- Mindful Awareness of Meal Frequency

Rather than eating 2 or 3 large meals per day, reduce these meals into 4 or 5 smaller portions. By spreading your meals throughout the day, you will improve your metabolism, you will be more in control and will be less likely to overeat due to extreme hunger.

Homework: This week I want you to increase your mindful awareness of your daily meal frequency. **Aim to eat 3 small meals and 2 snacks** each day. Whenever you eat a small meal or snack, please check off the appropriate box below.

My Weekly Meal Frequency Chart

Monday	Tuesday	Wednesday	Sunday
❑ Bfast ❑ Snack ❑ Lunch ❑ Snack ❑ Dinner	❑ Bfast ❑ Snack ❑ Lunch ❑ Snack ❑ Dinner	❑ Bfast ❑ Snack ❑ Lunch ❑ Snack ❑ Dinner	❑ Bfast ❑ Snack ❑ Lunch ❑ Snack ❑ Dinner
Thursday	Friday	Saturday	
❑ Bfast ❑ Snack ❑ Lunch ❑ Snack ❑ Dinner	❑ Bfast ❑ Snack ❑ Lunch ❑ Snack ❑ Dinner	❑ Bfast ❑ Snack ❑ Lunch ❑ Snack ❑ Dinner	

Please answer the following questions.

1) How did changing your meal frequency affect your hunger?

_____
_____
_____

2) When you felt that you were hungry or not satisfied, how did you deal with it?

_____
_____
_____

Session 8 – **Establishing Habits**

All of the homework that has been given up to this point will be most effective if it is practiced regularly so that it becomes a habit. The skills that you have learned here can be used indefinitely. ***There is no quick fix, or easy solution to weight loss****. Because weight loss takes time and effort, it is important that you focus on applying these skills consistently over the long term. This way, these skills will continue to help you eat less and lose weight.*

Homework: Every session, we discussed a specific technique or exercise to help you start tuning in and listening to your body's physical cues of hunger and fullness. Below is a list of these techniques.

1. Belly scan exercise
2. STOP (Stop, Take a breath, Observe, Proceed)
3. **S**top-**B**ite-**B**reath; helps slow your eating down
4. Rating your hunger and fullness cues
5. Belly scan while eating
6. Tracking your portion sizes
7. Tracking your meal frequency

Please answer the following questions.

1) Which of these have helped you the most in reducing your tendency to overeat?

_____
_____
_____
_____
_____

2) How will you combine them to further lose weight?

_____
_____
_____
_____
_____

Session 9 – Commitment to Values

Setbacks and loss of motivation are normal. *They happen to everyone and are an inevitable part of weight loss. In a way, weight loss is like hiking a mountain. For a while, it feels like the hike is never going to end and there is no way that you will make it to the top. But once you get out of the trees, you can see a clear path to the summit and know that you are going in the right direction. Success is not only about the final outcome (in this case, making it to the top of the mountain). You can also achieve success along the way. It's like the old saying, "it's not about the destination, it's about the journey." Weight loss won't always be easy, or smooth, but that doesn't mean that one cannot achieve one's eventual goal if one set one's mind to it.*

Losing weight is about progress and not perfection. Immediate results do not exist. *True weight loss takes time and effort. In order to stay motivated and on the right track, it is important that you identify and celebrate every bit of progress that you have made thus far. When you catch yourself being critical or judgmental towards yourself, always remember that changing old habits and losing weight is a process. It doesn't happen overnight. Dwelling on negative thoughts only hinders this process (e.g. "I cheated", "I'm a pig", "I'm such a failure"). Instead, focus on the positives (e.g. "I stopped eating when I felt comfortably satisfied," "I only ate when I was truly hungry," "I didn't eat that cupcake that my colleague offered me at lunch"). Remember, no one is ever perfect, so every bit of progress is a step in the right direction!*

<u>Homework</u> (done in-session): Make a summary card. **<u>Summary Card</u>**
My Weight Loss Goals and Values: Why is Losing Weight so Important to me?

1.

2.

3.

4.

5.

6.

When you are feeling a lack of motivation, or have experienced a setback, ***always refer back to this card****. This summary card will help you stay on track by reminding you why you want to lose weight, and why overeating is inconsistent with your weight loss values.*
Throughout the program, you have learnt skills to help you stick to your values of eating less to lose weight. In order to stay true to these values, you can use the techniques that you chose as being most effective in managing your tendency to overeat. ***Keep this card where you can see it, so that it acts as a constant reminder of your values to reduce your overeating and to lose weight****. When a setback occurs, refer back to this summary card and use it as a source of motivation to keep heading towards your values of losing weight and eating less.*