Systematic review and meta-analysis of randomised control trials on mindfulness training and mindful eating for emotional eating in adults

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Systematic Review

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Abstract

Introduction

This research investigates the role mindfulness and mindful eating programs play concerning emotional eating in adults. As disordered eating studies have extensively focused on younger-aged/student populations, the pervasiveness of emotional eating patterns in other age groups is comparatively under-examined. Hence, this study seeks to answer the research question of whether mindfulness or mindful eating is associated with a reduction in emotional eating.

Method

This study is a systematic review and meta-analysis of randomised control trial. The researcher performed searches on MEDLINE (OVID), Embase (OVID), PsycINFO (OVID), Web of Science Core Collection, and Google Scholar to identify studies evaluating mindfulness and mindful eating training as a predictor of reduction in emotional eating. This study assessed the effectiveness of mindfulness interventions or mindful eating in reducing emotional eating behaviour. Search terms focused on mindfulness training and its effect on emotional eating. Standardized mean differences and 95% confidence interval were retrieved and analysed by pooled estimates according to Cochrane Handbook.

Result

From 326 identified records, the result included a total of 9 articles. The standardised mean difference estimate was -0.29 (95% CI: -0.43 to -0.15) for reducing emotional eating behaviour after mindful eating or mindfulness training. There was no substantial heterogeneity for the aggregated estimates. Hence, mindfulness training and mindful eating effectively decrease emotional eating in populations engaging in this behaviour among adults.

Conclusion

The reduction in emotional eating behaviour among adults indicates the necessity of health promotion programs to increase mindfulness and mindful eating in this age group. Health professionals should implement behavioural modification programs to reduce emotional eating behaviours before the onset of advanced non-communicable diseases, particularly in those at high risk for poorer mental health.

Introduction

Unhealthy eating behaviour is a leading global risk of obesity and many non-communicable diseases (NCDs). (Micha et al., 2017) Eating habits have been evolving alongside a range of socio-economic, demographic, and lifestyle factors around this topic, for example, globalisation, the form of the workforce,
age, gender, and quality of life. Health-related stakeholders are experiencing ever-changing challenges with habitual diet-related eating patterns and detrimental psychological harm. 11 million deaths and 255 million disability-adjusted life years were attributable to poor diet in the global population. That was even higher than tobacco (8.0 million deaths) and high blood pressure (10.4 million deaths). (Afshin et al., 2019) Research has estimated that promoting a healthy diet could reduce approximately $50 billion in healthcare costs. (Jardim et al., 2019) Thereby, to incorporate healthy diets as a basic tenet in the healthcare system and to attain Good Health and Well-being as one of the Sustainable Development Goals, WHO established a "Global strategy for diet, physical activity, and health" in 2004. (World Health Organization, 2004)

Although patients with disordered eating or weight problems are usually given medical advice for weight management through exercise and dietary consultation, eating is not a singular behavioural. (McMaster et al., 2021, Johns et al., 2014) The evidence showing that eating habits represent a wide range of food consumption patterns may have multiple root causes. (Gerbens-Leenes et al., 2010, Musaiger et al., 1993) Healthcare professionals, therefore, adopted interventional approaches for varying disordered eating. For instance, mindfulness or mindful eating intervention refers to maintaining awareness of physical and emotional sensations with food and eating for disordered eating and weight reduction. (Lofgren, 2015) The concepts of mindful eating and mindfulness have been discussed interchangeably because of their similar principles and values of being present, non-judgemental, and accepting. They are drawing increasing attention because of their physical and psychological benefits on health, such as improved awareness of food cues, reduced symptoms of negative emotions, and promoted weight loss. (Miller et al., 2014) Previous research suggested that mindfulness conveys significant improvement in life satisfaction and resilience. (Bajaj et al., 2016)

However, limited research focused on measuring the effectiveness of mindfulness intervention or mindful eating with eating disordered or disordered eating such as anorexia nervosa, bulimia nervosa, binge eating disorder, and lesser-known behaviours such as night eating syndrome, emotional eating, and restricted eating. (Dunne, 2018, Moradi and Samari, 2017, Vander, 2012) Emotional eating, eating in response to a range of emotions such as stress, is one of the phenotypes of disordered eating that do not meet the strict criteria for inclusion in the Diagnostic and Statistical Manual of Mental Disorders V but is associated with weight fluctuations, poor nutritional status, emotional distress, and psychiatric co-morbidities. (Frayn and Knäuper, 2018, American Psychiatric Association, 2013, Keller and Siegrist, 2015, Dweck et al., 2014, Bemanian et al., 2021) Instruments were developed and used to measure facets of emotional eating because the intervention has a profound effect on changing patients’ health and well-being. For example, researchers developed Emotional Eating Scale (EES) (Arnow et al., 1985) to measure emotional eating. Three-Factor Eating Questionnaire-emotional eating (TFEQ) (Stunkard et al., 1985) and Dutch Eating Behaviour Questionnaire-emotional eating (DEBQ) (Van Strien et al., 1986) are subscales of a disordered eating questionnaire for similar use.

Optimising eating behaviour does not merely benefit individuals by modifying the risk of a spectrum of NCDs. It also creates positive outcomes for holistic welling. (Gidugu and Jacobs, 2019) Traditional healthy eating behaviours promote the prevention of diet-related diseases such as cardiovascular disease, diabetes, musculoskeletal disorders, and gastrointestinal conditions. (Micha et al., 2017, Chen et al., 2005, Satherley
et al., 2015) Yet the relationship between eating behaviour and mental wellness is a comparatively new research area that warrants epidemiological scrutiny. A broader perspective involves the complexity of the interplay between individuals and healthy development across the lifespan, the reciprocal influence between health system dynamics, and individual health. (Lehman, 2017) Investigators examine multiple risk factors as confounding variables for emotional eating, including age, gender, and socioeconomic status. (Sze et al., 2021) Ecological worldviews suggested that transformational changes were brought to the consumption habits in individuals over decades due to globalisation by investing in high quantity, low cost but obesogenic food in multinational fast-food and supermarket chains. (Fox et al., 2019) Thereby, a transition of sole reliance on clinical management towards a proactive health promotion approach or interventional trial in levels of social determinants cannot address eating behaviour. Expanding knowledge for education on the social and economic dimensions can impact the obesity epidemic in trials to alter public awareness to elucidate the patterns of globalisation and overeating habits.

Despite nearly 20 years of implementation of the action plan by WHO, health systems face challenges in validating the outcomes in ascertaining eating behaviour. (Delormier et al., 2009) Many developing and developed countries are still conquering obesity, overeating, or an imbalanced diet. (Caballero, 2007) Therefore, dietary habits and their relationship with obesity are crucial, provoking, and contentious public health issues in contemporary society. (Wyatt et al., 2006) There were measurements used in interventional trials for eating phenotype, especially for emotional eating, and the result and outcome are often unorganised. (Kristeller, and Hallett, 1999) It is unclear if mindfulness intervention and mindful eating are associated with reducing Emotional Eating behaviour. There is a need for health systems to focus on achieving a healthy diet to improve health outcomes. (Mitchell et al., 2017) There is a gap in knowledge studying mindful eating and assessing the effectiveness of mindfulness interventions in reducing emotional eating behaviour. This systematic review and meta-analysis imply public health significance for the epidemiology of mindfulness and mindful eating and future screening of non-mindful eaters to engage in mindfulness for reduced emotional eating. This research aims to answer whether mindfulness intervention or mindful eating is associated with reduced emotional eating among adults. As a primary objective, this study will assess the effectiveness of mindfulness interventions or mindful eating by comparing the reduction in Emotional Eating behaviour. This study hypothesises that mindfulness intervention or mindful eating can reduce emotional eating behaviour.

**Method**

A meta-analysis approach is adopted to systematically review the broad nature of mindfulness intervention and mindful eating in emotional eating reduction. This study uses The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework (Moher et al., 2009) for synthesising evidence of literature, and Cochrane Reviewer’s Handbook was adopted to develop the framework of this review. The researcher searched five databases, including MEDLINE (OVID), Embase (OVID), PsycINFO (OVID), Web of Science Core Collection, and Google Scholar, to identify studies evaluating mindfulness training or mindful eating as a predictor of reduced emotional eating. The previous evidence suggested combination of Embase, MEDLINE (PubMed), Web of Science Core Collection, and Google Scholar (the 200 first relevant
references) generate decent biomedical systematic reviews. (Bramer et al., 2017) The researcher added PsycINFO because this review touches on behavioural sciences and mental health.

Systematic scientific literature searches included RCT studies that reported a mean reduction in emotional eating behaviour after mindfulness or mindful eating interventions (using the terms Mindfulness, Mindful eating, Adults, and Trials). The researcher conducted a boolean search strategy with wildcard characters to ensure adequate search coverage. The Cochrane library enabled MeSH terms searches and search terms focused on mindfulness training and its effect on emotional eating. (Huang et al., 2016) The appendix 1 outlined the search strategy, MeSH terms, and keywords of concepts used.

The included publications were mindful eating or mindfulness intervention with a reduction of emotional eating as the outcome. Randomised control trial (RCT) is the only study design included, and the review excluded studies with non-English language. The inclusion criteria are adults aged 18+ who attended mindfulness or mindful eating interventions with or without a reduction in emotional eating compared to control according to the PICO framework (P-population, I-intervention, C-comparison, O-Outcome). (Schardt et al., 2007) The review also excluded Animal studies, editorial articles, case reports, newspaper articles, or other inapplicable study designs. The research conducted quality appraisal according to guidelines for reporting systematic reviews to avoid the risk of bias using the Cochrane Risk of Bias tool. (Higgins et al., 2011) Selection bias, performance bias, detection bias, attrition bias, reporting bias, and other biases are six domains of biases covered in this risk of bias tool.

Inclusion criteria

Eligible RCTs met the following eight criteria:

1. Participants: adults aged 18 years or over
2. Recruitment: no restrictions
3. Intervention: any intervention of mindfulness or mindful eating, with the primary stated goal was to decrease self-reported emotional eating levels in participants
4. Comparator characteristics: no restrictions
5. Outcome: emotional eating
6. Design: randomised controlled trial
7. Follow-up: no restrictions
8. Analysis: intention to treat analysis

The researcher imported eligible articles into Endnote X9 software removed duplicates and conducted title and abstract screening on all literature to identify eligible studies for full-text review. Additional relevant literature was hand-searched through snowball in the reference lists. This review used terms such as ‘mindful’ and ‘emotional eating’ to obtain grey literature. The researched also searched related international and non-governmental organisations on websites to ensure the quality of review syntheses, including the Cochrane Trials Register, the World Health Organisation, The National Eating Disorders Association, the American Psychological Association, Global Mindfulness Collaborative, and other international or regional
eating behaviour and trial institutes. (Cochrane Controlled Register of Trials, 2022, World Health Organization, 2022, the National Eating Disorders Association, 2022, American Psychological Association, 2022, Global Mindfulness Collaborative, 2022) The researchers searched the websites, engaged with librarians, and contacted the authors to obtain full texts of eligible articles. The researcher conducted a risk of bias assessment, used a funnel plot to evaluate publication bias, and used the Egger test to test for minimal study bias.

The researcher used Microsoft Excel for Office 365 to record essential information, including authors, publication year, randomisation method, intervention and duration, controlled arm, handling of dropouts and withdrawals, finding, and limitation. This review used Stata for data synthesis and conducted a pre-specified meta-analysis using a random effects model. This review calculated Pooled estimates for emotional eating on the subset of mindfulness or mindful eating trials. Mean differences and standard deviation were extracted and analysed by forest plots. This research used standardised mean differences with 95% confidence intervals using Stata for continuous outcome data and calculated the $I^2$ statistic to determine the presence of heterogeneity and to estimate the observed variance in effects across studies with 95% confidence intervals. Since the $I^2$ statistic was robust for small sample sizes, the review selected it for the measure of variance. (Cohen, 2013.) This review used Intention-to-treat analysis if the study showed results from a trial completers’ analysis. For studies that reported more than one variable for self-reported emotional eating, this review included all variables that reflected emotional eating in the synthesis.

**Result**

The researcher searched in May 2022 and yielded 326 records, of which 48 were duplicates. This review removed 253 of the remaining 278 articles that did not meet the inclusion criteria after the title and abstract screening. The final procedure included 25 literature and excluded 16 papers because they were not RCT (N=5), not emotional eating outcome (N=8), and not mindfulness or mindful eating intervention (N=3). This review included nine studies that met the inclusion criteria. Additionally, two articles were included through hand searches as mentioned in the Prisma Diagram (Figure. 1). Table 1 gives an overview of descriptive characteristics of the studies, and table 2 summarises the study detail and effect sizes.

Table 1 provides an overview of publication years, randomisation method, intervention arm and duration, controlled arm, handling of dropouts, and limitation relevant to the review. Researchers from the United States (n=6) developed the most RCTs, while only a few from the Netherlands (n=1), United Kingdom (n=1), and Portugal (n=1). The authors published the included articles included between 2009 and 2020. However, it has to be conscious that the year published does not reflect the year when the researcher conducted the RCTs. The investigators randomised all of the participants of the RCTs in either the intervention or the controlled arm. The mindfulness interventions included mindfulness-based cognitive therapy-based eating intervention, mindfulness-based weight loss intervention, mindful restaurant eating intervention, and mindfulness-based intervention dialectical behaviour therapy. The intervention period ranged from 4 weeks to 20 weeks, the controlled arm was waitlist (n=4), active control (n=2) or treatment as usual (n=3), and dropouts were handled by intention-to-treat analysis (n=6) while the remaining RCTs had no dropouts.
Some shared limitations of the studies include a relatively small sample size, no long-term follow-up, and the results were not generalizable due to non-representative samples.

**Table 1.** Overview of descriptive characteristics on studies included
<table>
<thead>
<tr>
<th>Study</th>
<th>Publication Years</th>
<th>Randomisation method</th>
<th>Intervention arm and duration</th>
<th>Controlled arm</th>
<th>Handling of drop-outs</th>
<th>Limitation</th>
</tr>
</thead>
</table>
| Alberts et al. Netherland | 2012              | Randomly assigned to the treatment group or waiting-list control group                 | Mindfulness-Based Cognitive Therapy-based eating intervention (n=12) 8 weeks | Wait-list (n = 14)                                 | No dropouts          | 1. Relatively small sample size  
2. Potential biases from self-report measures  
3. No follow-up                                                                                                                       |
| Chacko et al. United States | 2016              | Randomised to receive the mindfulness-based intervention or the standard intervention. | Mindfulness-based intervention (n=9), 10 weeks | Normal lessons (n = 9)                             | No dropouts          | 1. Relatively small sample size  
2. The results are not generalizable because the study sample was women and Caucasian  
3. No well-organized control group intervention                                                                                       |
| Timmerman and Brown United States | 2012              | Randomly assigned to the intervention or the wait list control group using a computer-generated table of random numbers | Mindful Restaurant Eating intervention (n = 19), 6 weeks | Wait-list (n = 16)                                 | Intention to treat analysis | 1. Relatively small sample size  
2. No long-term follow-up  
3. Rely on self-report measures                                                                                                         |
| Daubenmier et al. United States | 2011              | Randomly assigned to a 4-month intervention or waitlist group                           | Mindfulness-based intervention (n = 24), 4 months | Wait-list (n = 23)                                 | Included in intention-to-treat analyses but excluded from secondary analyses | 1. Small sample size and some lost to follow-up  
2. Great differences in the predictor variables                                                                                         |
<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Randomisation</th>
<th>Intervention</th>
<th>Control</th>
<th>Analysis</th>
<th>Notes</th>
</tr>
</thead>
</table>
| Tapper, et al. | 2009 | Randomised to an intervention or control condition | Mindfulness-based weight loss intervention (n=31), 6 months | Normal diet (n=31) | Intention to treat analysis | 1. Exploratory trial only  
2. No treatment control |
| Radin, et al. | 2020 | Randomised to the mindfulness (vs. control) intervention | Mindfulness-Based Weight Loss Intervention (n=100), 18 weeks | Active control (n=94) | No dropouts | 1. No treatment control |
| Palmeira, et al. Portugal | 2017 | Randomly assigned to intervention or control groups | Kg-Free intervention (n = 27), 10 weeks | Treatment as Usual (TAU) (n = 32) | Intention to treat analysis | 1. Sample comprised only adult women  
2. Control group remained with TAU, which did not include any psychological intervention |
| Hill, et al. | 2011 | Randomly assigned to intervention or control groups | Dialectical behavior therapy, entitled appetite focused (DBT-AF) (n = 18), 12 weeks | Waitlist (n=14) | Intention to treat analysis | 1. Small pilot study only  
2. Did not control for nonspecific factors or allow for a follow-up comparison |
| Safer, et al. | 2010 | Randomly assigned to intervention or control groups | Dialectical Behavior Therapy for Binge Eating Disorder (DBT-BED) (n= 50), 20 weeks | Active control (n= 51) | Intention to treat analysis 1. High dropout rates |

Table 2 tabulated the description of the study detail, such as study design, subject characteristics, measurement, and assessment points. Seven studies included were RCTs, and two were pilot RCTs. People who were overweight/obese or women comprised a considerable percentage of participants, and one study only involved people with binge eating disorders. Target populations for the studies varied and included
people with disordered eating behaviour, bariatric patients and people who eat out, and people attempting to lose weight. Participants were adults, and the mean age for most RTCs fell between 21.08 and 53.4 years. Emotional eating was measured in four studies using DEBQ-emotional eating, three studies using EES, and two studies using TFEQ R18/R21-emotional eating. The scales used to assess emotional eating are different, with lower scores being less emotional eating than high or vice versa. The assessment points were preintervention versus postintervention or six months/twelve months follow-up.

**Table 2.** Description of study detail
<table>
<thead>
<tr>
<th>Authors</th>
<th>Study design</th>
<th>Subject characteristics</th>
<th>Measurement</th>
<th>Assessment point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberts et al.</td>
<td>RCT</td>
<td>Women with disordered eating behavior (n = 26)</td>
<td>DEBQ-emotional eating</td>
<td>Preintervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean age = 48.5, SD = 7.9</td>
<td>(5-point Likert scale)</td>
<td></td>
</tr>
<tr>
<td>Chacko et al.</td>
<td>Pilot RCT</td>
<td>Bariatric patients 1-5 year Postsurgery (n = 18)</td>
<td>TFEQ R18-emotional eating</td>
<td>Preintervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean age = 53.4, SD = 5.6</td>
<td>(Scores 0–100)</td>
<td>6-month follow-up</td>
</tr>
<tr>
<td>Timmerman and Brown</td>
<td>RCT</td>
<td>Women who eat out at least 3 times per week (n = 35)</td>
<td>EES-Emotional Eating Scale</td>
<td>Preintervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean age = 49.6, SD = 6.8</td>
<td>(25 item 5-point Likert scale)</td>
<td></td>
</tr>
<tr>
<td>Daubenmier et al.</td>
<td>Pilot RCT</td>
<td>Overweight/obese women (n=47)</td>
<td>DEBQ-emotional eating</td>
<td>Preintervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean age = 40.42, SD = 8.0</td>
<td>(5-point Likert scale)</td>
<td>12-month follow-up</td>
</tr>
<tr>
<td>Tapper, et al.</td>
<td>RCT</td>
<td>Women who were attempting to lose weight (n=62)</td>
<td>DEBQ-Emotional eating</td>
<td>Preintervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean age = 41, SD = 13</td>
<td>(5-point Likert scale)</td>
<td>6-month follow-up</td>
</tr>
<tr>
<td>Radin, et al.</td>
<td>RCT</td>
<td>People with obesity (n=194)</td>
<td>DEBQ-Emotional eating</td>
<td>Preintervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean age = 46.98, SD = 12.71</td>
<td>(5-point Likert scale)</td>
<td>12-month follow-up</td>
</tr>
<tr>
<td>Palmeira, et al.</td>
<td>RCT</td>
<td>Women with overweight or obesity (n=73)</td>
<td>TFEQ R21-emotional eating</td>
<td>Preintervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kg-Free: Mean age = 46.98, SD = 8.79</td>
<td>(4-point Likert scale and 8-point Likert scale)</td>
<td>Postintervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TAU: Mean age = 42.73, SD = 8.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hill, et al.</td>
<td>RCT</td>
<td>Women with binge/purge episodes at least one time per week (n=32)</td>
<td>EES-Emotional Eating Scale</td>
<td>Preintervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment: Mean age = 22.67, SD = 5.86</td>
<td>(5-point Likert scale)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Waitlist: Mean age = 21.08, SD = 2.93</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safer, et al.</td>
<td>RCT</td>
<td>Individuals with binge eating disorder (n= 101)</td>
<td>EES-Emotional Eating Scale</td>
<td>Preintervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(5-point Likert scale)</td>
<td>12-month follow-up</td>
</tr>
</tbody>
</table>
As described in Cochrane Handbook for Systematic Reviews of Interventions, the researcher assessed the risk of bias by domains, including random sequence generation, allocation concealment, blinding of participants and personnel, incomplete outcome data, selective reporting, and other bias. These domains were low risk, unclear risk, and high risk. Table 3 tabulated that most studies have a low risk of bias for random sequence generation and selective reporting in the risk of bias assessment. However, blinding of participants and personnel and incomplete outcome data have a comparatively high risk of bias. Moreover, there was an unclear risk of bias for allocation concealment and other bias for the included studies.

### Table 3. Risk of bias assessments

<table>
<thead>
<tr>
<th></th>
<th>Random sequence generation</th>
<th>Allocation concealment</th>
<th>Binding of participants and personnel</th>
<th>Incomplete outcome data</th>
<th>Selective reporting</th>
<th>Other bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberts et al.</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>?</td>
</tr>
<tr>
<td>Chacko et al.</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Timmerman and Brown</td>
<td>?</td>
<td>?</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Daubenmier et al.</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Tapper K, Shaw C, Ilsley J, et al.</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>?</td>
</tr>
<tr>
<td>Radin RM, Epel ES, Daubenmier J, et al.</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Palmeira L, Pinto-Gouveia J, Cunha M</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>?</td>
</tr>
<tr>
<td>Hill DM, Craighead LW, Safer DL</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Safer DL, Jo B</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

Remarks: +: low risk of bias; -: high risk of bias; ?: unclear risk of bias

The researcher retrieved 12 results from the nine articles and used the ‘metan’ command of Stata to generate standardised mean difference (SMD) with the method of Cohen. (Figure 2) The below ‘metan’ plot
showed a statistically significant difference between the diamond shape in the pooled estimate and its corresponding confidence interval (CI). The diamond does not cross the vertical line of no effect and lies to the left of the line. The result confirmed a statistically significant difference by the CI around the pooled estimated (-0.43 to -0.15) that does not include 0. Hence, there is a reduction in emotional eating behaviour after mindful eating or mindfulness training (-0.29). Furthermore, the test of heterogeneity suggested no evidence for statistical heterogeneity with a p-value of 0.824.

As shown in the funnel plot (figure 3), the standardized mean difference against the standard error was not susceptible to distortion. There was no wide scattering of the effect estimates without marked signs of a publication bias. The researcher also performed the Egger test to test the asymmetry of the funnel plot. Although a larger sample size would profoundly increase the power of the result, a p-value of 0.558 suggested no evidence of publication bias.

**Discussion**

This review further deliberated the evidence that mindfulness training and mindful eating are critical to disordered eating behaviours. Evidence from the result suggested that mindfulness-based RCTs interventions are primarily effective treatments for reducing emotional eating symptoms. RCTs interventions significantly reduce emotional eating symptoms from pre- to post-intervention with adequate effect sizes. Hence, mindfulness training and mindful eating are means for treating emotional eating behaviour.

To my understanding, this meta-analysis is the first and only study that assembled the mean difference between reduced emotional eating after mindfulness training and mindful eating. Only one published a systematic review of mindfulness meditation as an intervention for emotional eating that involves nonrandomized trials through 2013. (Katterman et al., 2014) Despite the difference, in comparison with the control, the findings are broadly consistent that both studies reported a significant reduction in emotional eating. This systematic review and meta-analysis added to the growing evidence that mindfulness and mindful eating interventions improve emotional eating behaviours. Most studies have been studying disordered eating behaviours in younger populations. (Limbers et al., 2021, Cella et al., 2021, Hill et al., 2018, Hoerr et al., 2002, Thome et al., 2004) Some previous systematic reviews looked at the association between emotional eating and risk factors such as weight status or emotions but not mindfulness as treatment. (Van Strien, 2018, McAtamney et al., 2022) This review was the first systematic review and meta-analysis to measure the impact of mindfulness or mindful eating-based interventions on emotional eating behaviour in adults. Furthermore, this research has undertaken an extensive search of 5 databases and used the risk of bias assessment and funnel plot to rule out potential bias and to validate the reliability of the size of the effect.

However, this field of research is relatively new and thus has several limitations. A relatively small number of studies met the inclusion criteria, and the intervention lengths were not prolonged. The intervention effect is potentially diluted owing to the minimal or no intervention of control groups. Hence, the confidence interval for the effect size estimate was broadened and thus impeded the result from detecting a significant
effect. Also, the review focused on emotional eating as an outcome, yet research could have applied other crucial consequences to investigate RCTs, such as weight loss and alternative overeating phenotypes. In terms of the included trials, there are limited data by small sample sizes and a lack of an active treatment group. The study subjects and intervention components were also heterogeneous. Future research could add more complete data and involvement of treatment groups to explain the true impact of mindfulness training and mindful eating. As included as part of the risk of bias assessment, loss to follow-up is common in most of the studies. Hence, it is not possible to rule out that this meta-analysis overstates the effect of mindfulness training and mindful eating on emotional eating symptom reduction.

Previous studies pointed out that mindfulness training or intervention could effectively reduce disordered eating, such as binge eating. Similarly, this meta-analysis revealed positive effects on emotional eating. (Katterman et al., 2014, Baer et al., 2005, Wanden-Berghe et al., 2011) Across a range of sample populations, including bariatric patients, individuals who eat out, and people attempting to lose weight, there is an association between mindfulness training and mindful eating and reduced emotional eating episodes. Despite such variability of subjects, they can be effective treatments regardless of comorbidities or diversity in characteristics.

Taken together, despite the methodological limitation of included trials and compromising internal and external validity, this meta-analysis unravelled that mindfulness training and mindful eating can be effective treatments for reducing emotional eating behaviour across different adult populations. However, this systematic review and meta-analysis highlighted that existing research only carried out a few high-quality RCTs to measure the effectiveness of mindfulness training and mindful eating to emotional eating. Therefore, mindfulness training and mindful eating as a means for problematic consumption behaviours require more clinical and empirical attention. Further studies need to include adequate detail so that results would be more reproducible for advancement in this field of research. For instance, producing longer-lasting effects and sustaining user engagement is noticeable for interventions after the sessions. RCTs could determine the function, feedback, tailored information, and personalised design to improve adherence and retention. (Coo et al., 2018) These would be useful for future intervention design to consider sustainable and long-term engagement strategies. Moreover, future research is needed to examine disordered eating outcomes beyond emotional eating to understand whether emotional eating is a singular behaviour or is associated with other disordered eating behaviours. A comparison of the effectiveness of mindfulness or mindfulness interventions versus other previously supported treatments is required to ascertain evidence of effectiveness in reducing symptoms of eating disorders.

Conclusion

The effectiveness of mindfulness and mindful eating intervention on emotional eating indicates the necessity of health promotion programmes to reduce emotional eating behaviours in adults. Relevant stakeholders can implement mindfulness or mindful eating training to reduce unhealthy overeating behaviours before the onset of advanced non-communicable diseases, particularly in countries with a high burden of disordered eating.
Declarations

Ethical statement

Compliance with Ethical Standards

Not applicable.

Funding

Not applicable.

Conflict of Interest

The author declares that there is no competing interests.

Ethics approval

Ethical approval was obtained from the LSHTM Ethics Online of the The London School of Hygiene & Tropical Medicine. (Review Reference: 27405/RR/27169)

Informed consent

Not applicable.

References


64. World Health Organization (WHO). [online] Available at: <https://www.who.int/> [Accessed 20 September 2022].

Figures

Figure 1

Prisma Diagram
### Figure 2

Result of meta-analysis

<table>
<thead>
<tr>
<th>trial</th>
<th>SMD (95% CI)</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberts</td>
<td>-0.83 (-1.64, -0.02)</td>
<td>2.99</td>
</tr>
<tr>
<td>checko</td>
<td>0.39 (-0.54, 1.33)</td>
<td>2.22</td>
</tr>
<tr>
<td>Timmerman</td>
<td>0.11 (-0.55, 0.78)</td>
<td>4.38</td>
</tr>
<tr>
<td>Daubenmier</td>
<td>-0.52 (-1.11, 0.06)</td>
<td>5.72</td>
</tr>
<tr>
<td>Tapper_DEBQ</td>
<td>-0.16 (-0.74, 0.41)</td>
<td>5.79</td>
</tr>
<tr>
<td>Tapper_EEQ</td>
<td>-0.36 (-0.95, 0.22)</td>
<td>5.71</td>
</tr>
<tr>
<td>Radin</td>
<td>-0.30 (-0.58, -0.02)</td>
<td>24.19</td>
</tr>
<tr>
<td>Palmeira</td>
<td>-0.22 (-0.74, 0.29)</td>
<td>7.35</td>
</tr>
<tr>
<td>Hill</td>
<td>-0.22 (-0.92, 0.49)</td>
<td>3.95</td>
</tr>
<tr>
<td>Safer_ESS-Anger</td>
<td>-0.23 (-0.62, 0.16)</td>
<td>12.67</td>
</tr>
<tr>
<td>Safer_ESS-Anxiety</td>
<td>-0.34 (-0.73, 0.05)</td>
<td>12.56</td>
</tr>
<tr>
<td>Safer_ESS-Depression</td>
<td>-0.41 (-0.81, -0.02)</td>
<td>12.48</td>
</tr>
<tr>
<td>Overall, IV ($I^2 = 0.0%, p = 0.824$)</td>
<td>-0.29 (-0.43, -0.15)</td>
<td>100.00</td>
</tr>
</tbody>
</table>
Figure 3

Funnel plot of included studies with the effect size

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Appendix1.docx