AUTHORIZATION TO LEND AND REPRODUCE THE THESIS

As the sole author of this thesis, I authorize Brown University to lend it to other institutions or individuals for the purpose of scholarly research.

Date ________________ ____________________________________
Carin Northuis, Author

I further authorize Brown University to reproduce this thesis by photocopying or other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

Date ________________ ____________________________________
Carin Northuis, Author

The impact of self-regulatory processes on dietary intake and behavior change

By

Carin Northuis

B.S., B.A., Wheaton College, 2014

Thesis

Submitted in partial fulfillment of the requirements for the
Degree of Master of Public Health in the Brown University School of Public Health

PROVIDENCE, RHODE ISLAND
MAY 2017

This thesis by *Student Name* is accepted in its present form
by the Brown University School of Public Health as satisfying the
thesis requirements for the degree of Master of Public Health.

Date ________________ ______________________________
Eric Loucks, PhD, Advisor

Date ________________ ______________________________
Alison Field, ScD, Reader

Date ________________ ______________________________
Patrick M. Vivier, MD, PhD
Director, Master of Public Health Program

Approved by the Graduate Council

Date ________________ ________________________________
Andrew G. Campbell, Dean of the Graduate School

VITA

Carin A. Northuis was born September 24, 1991, in Muskegon, MI, to Rich and Tresa Northuis. Carin attended Mona Shores High School in Norton Shores, Michigan, and Wheaton College in Wheaton, Illinois, where she completed a Bachelor of Science degree in the biological sciences and a Bachelor of Arts degree in Spanish Language and Culture. At Wheaton, Carin explored her curiosity for cellular and molecular biology while conducting cellular experiments that tested the relationships between environment and translational changes, learning important mechanism in the development of cardiovascular disease and cancer. Carin went on to work in the quality assurance division of the research and development branch of Amway Corporation in Grand Rapids, Michigan testing products that went into home products, food, and health products. In September 2015, she entered Brown University's School of Public Health to pursue her Master of Public Health with a focus in Epidemiology. Carin's interest lie in the study of cardiovascular disease and health outcomes. She looks forward to continuing her doctoral training in the area of Cardiovascular Disease Epidemiology at the University of Minnesota in the Fall 2017.

Preface and Acknowledgements

The data that supported this thesis came from the Mindfulness-Base Blood Pressure Reduction Pilot Clinical Trial conducted by Dr. Eric Loucks at Brown University from October 2015 to October 2016.

First, I would like to thank all who assisted with my education at Brown. Thank you for instilling in me the confidence and desire to pursue my educational and research interests over the last two years and for supporting each step of the way.

This thesis would not have been possible without the guidance and support of my thesis advisor, Dr. Eric Loucks and reader Dr. Alison Field. Thank you for allowing me to participate in the Mindfulness and Cardiovascular Disease Lab and continue my interests in cardiovascular disease and health outcomes. In addition, I would like to thank Erika Sevetson for her assistance in finalizing my search terms for the many databases I used in my systematic review.

Lastly, I would like to thank my parents, brother, and sister. Without your constant support, love, and confidence in me, my pursuit of this degree and the completion of this thesis would not have been possible. Thank you for always reading my work and providing constructive and positive feedback.

This thesis is dedicated to my grandmother Dorothy Harrison, who was the first in her family of 10 to graduate from high school. Thank you for telling me I can do all things I set my mind to and that I should never back down from an educational pursuit. And for teaching me that coffee is the only thing that matters each morning and every day is better with chocolate.

Table of Contents

The impact of self-regulation processes on evidence-based dietary patterns: A systematic review

Abstract

Objectives: The present study aimed to systematically evaluate the state of the evidence on the relationship of self-regulation (specifically self-related processing, cognitive processes, and emotion regulation) with heart healthy, evidence-based dietary patterns. A further aim is to determine if there are specific self-regulation processes that when modified in a randomized controlled trial, are associated with changes in dietary patterns.

Methods: PubMed, EMBASE, CINAHL, and PsycInfo databases were systematically searched to identify randomized controlled trials published between January 1, 1995 and June 1, 2016. Studies with adult participants that displayed significant changes in a validated measure of self-regulation and analyzed one of four evidence-based diets associated with decreased heart disease risk (low-salt, low-calorie, Mediterranean Diet, or Dietary Approaches to Stop Hypertension Diet) were included for the review. Studies that were single armed, quasi-experimental, analyzed only components of the evidence-based diets (e.g. only fruits and vegetable consumption) were excluded from the review.

Results: Of the 1,721 studies retrieved and screened in duplicate, 29 full-text articles were reviewed for inclusion. Of these, five studies with a combined total of 973 participants were included. In all five studies, a form of dietary self-efficacy was evaluated and found positive changes over the course of the intervention and follow-up. Only one study evaluated emotional eating and revealed nonsignificant differences between groups. Two studies evaluated low-caloric diets and three studies analyzed the Dietary Approaches to Stop Hypertension diet. All studies showed improvements in dietary patterns or components of diets. Associations between change in self-regulatory skills and change in dietary patterns were assessed in four of the five studies, with three finding significant positive associations.

Conclusions: Although not all studies found associations between changes in all self-regulation skills and all evidence-based dietary pattern measures, each study revealed positive changes in dietary self-efficacy and diet. Results from the few studies that did incorporate self-regulatory skills into the intervention suggest that improving self-efficacy may mediate changes in dietary patterns.

Keywords dietary behavior, self-regulation, diet

Background

Dietary patterns are prominent determinants of a range of chronic diseases, including cardiovascular disease, diabetes, and cancers.[1-11] Four evidence-based diets have consistently be found in randomized controlled trials to reduce cardiovascular disease risk.[11-17] These diets are the Dietary Approaches to Stop Hypertension (DASH) diet, the Mediterranean Diet, low-calorie diet, and low-salt diet.[12-15, 18] Although serving and content recommendations somewhat vary in each, the general dietary guidelines for Americans include the following: 2.5 cups/day of vegetables, 2 cups/day of fruits, 6 oz/day of grains, 3 cups/day of dairy, 8 oz/wk of seafood, 26 oz/wk of meat, poultry, and eggs, 5 oz/week of nuts, seeds, and soy products, 27 g/day of oil and 270 kcal or less/day of added sugars, fats, and nutrient-dense foods.[19]

Although one study, surveying a nationally representative sample of 3,000 Americans aged 18+, found that approximately 75% of their sample claimed to consume a healthy diet[20], results from the 2009-2010 NHANES sample revealed that a majority have difficulty maintaining or adhering to the dietary guidelines, with 0.5% and 27.0% of Americans meeting ideal (4-5 food groups) and intermediate (2-3 food groups) dietary recommendations, respectively.[1] Specifically, in a systematic review on cardiovascular disease patients and the evidence-based DASH diet, adherence and compliance to dietary recommendations were poor over the long-term follow-ups, with most studies reporting a mean DASH score of between 6/10 to as low as 2/9,[21] where higher scores represent greater adherence. Similar findings were found for the Mediterranean Diet, cognitive function, and the risk of dementia.[22] In this review, most studies had a mean adherence scores of around 50%, with the range being from 4.3/9 to 28.2/45.[22] Therefore, with the multitude of dietary interventions tested, many fail to alter to the dietary recommendations in the long-term.

One method that may be effective in changing dietary patterns is based on the Science of Behavior Change framework. Many advancing approaches in behavioral medicine research advocate for Science of Behavior Change methods that incorporate an experimental medicine approach that involves 4 steps, being 1.) Identifying an intervention target (i.e. a factor hypothesized to involved in the health behavior/outcome), 2.) Developing valid and reliable assays (i.e. measures) of the target, 3.) Engaging the target through experimental manipulations or interventions, and 4.) Testing the degree to which the target is engaged and determining the degree to which this engagement produces the desired behavior/health change.[23-24] The mechanism for how the intervention affects the dietary change endpoint through these methods can be seen in Figure 1.

While many approaches promote dietary changes, there has been very little systematic evidence on which intervention target mechanisms (shown in Figure 1) influence evidence-based dietary patterns, and are modified by specific behavioral interventions. Understanding these targets would have several benefits, including 1.) Elucidating mechanisms helps to determine whether observed associations between psychosocial factors and disease outcomes are causal; 2.) allowing for early detection of changes in people's disease risk, often well before clinical endpoints (such as mortality and morbidity) can detect a change; this can foster cost- and time-efficient evaluation of intervention effectiveness; and 3.) Identifying mechanisms that may be particularly amenable to modification.

Self-regulation is one target mechanism that is currently receiving substantial attention among behavior change researchers. Much of the research is within the area of medical regimen adherence,[25-28] but could be applied to other areas. The process of self-regulation involves three domains: cognitive processes, emotion regulation, and self-related processing.[27-29] Cognitive processes involve attention control, impulsivity, and metacognitive awareness. Emotion regulation is the ability to manage and respond to emotional experiences, such as through navigating stressful situations, or engaging in coping strategies such as acceptance or nonjudgmentalness of emotional experiences, to alter emotional responses to internal or external cues.[29] Lastly, Christoff *et al*. states that self-related processing describes "the processing requiring one to evaluate or judge some feature in relation to one's perceptual image or mental concept of oneself", such as self-efficacy, self-compassion, or interoceptive awareness.[30-32] Through the utilization and regulation of these three domains, self-regulation may be key in initiating and maintaining goal-oriented behaviors. Therefore, a person with strong self-regulation abilities may be able to align those skills with behaviors needed to meet a behavior change and inhibit those that hinder it.

While the concept of self-regulation has gained significant popularity, and remains an important hypothesized pathway to initiate dietary change, to our knowledge, a systematic review evaluating the state of the literature on this topic has not yet been conducted. Therefore, the objectives of this study were to evaluate the state of the literature on whether self-regulation measures may be mechanisms through which behavioral interventions influence the four evidence-based dietary patterns. Secondly, knowing both what areas studies have been done in, and not done in, is important to not only understand potentially important mechanisms but also understand where there are opportunities for further research.

Methods

The Cochrane Handbook of Systematic Reviews[33] and PRISMA guidelines[34] were used to guide and conduct this review. A protocol for the systematic review was submitted on PROSPERO on February 6, 2017 (CRD42017056766; Available from http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42017056766).

An evidence map was developed and provides an overview of the current literature on whether alterations in established self-regulation domains (i.e. self-related processes, emotion regulation, and cognitive processes) may influence evidence-based dietary patterns, using methods consistent with those performed elsewhere[35]. The evidence map depicts the number of randomized controlled trials that evaluated whether observed changes in specific measures of self-regulation are associated with changes in particular dietary patterns. This approach provides a scoping overview of the state of the field in terms of what is known, and not known, about impacts of established domains of self-regulation on dietary patterns.

Study Selection

Systematic searches were conducted in the following electronic databases: CINAHL, The Cochrane Library, Embase, PsycInfo and PubMed for studies published between January 1, 1995, and June 1, 2016. The PubMed search strategy is shown in Appendix A. Briefly, the Medical Subject Headings (MeSH) terms for the four evidence-based diets were utilized with the exception of the DASH diet which was searched in quotations. Additionally, terms and concepts related to the three self-regulation domains were used. Specifically, the following terms represent the designated domains of self-regulation:

(1) emotion regulation: acceptance, affect, amygdala, anger, anxiety, arousal, autonomic, avoidance, compassion, coping, decentering, depression, distress tolerance, emotion, equanimity, experiential avoidance, exposure, expression, fear, habituation, kindness, limbic, motivation, neuroticism, nonattachment, nonjudgment, nonreactivity, positive psychology, reappraisal, reconsolidation, resilience, reperceiving, reward, rumination, stress, suppression, sympathetic, threat;

(2) cognitive processes: achievement, alerting, orienting, attention, cognitive, concentration, control, conflict monitoring, decision making, delay discounting, discrimination, distraction, dot probe, efficiency, executive function, impulsivity,

intelligence, learning, memory, meta-awareness, metacognition, mind wandering, performance, resource depletion, Sustained Attention to Response Task, selective stopping, stimulus prioritization, stop signal, Stroop, top-down, task switching, vigilance;

(3) self-related processing: agency, body awareness, detach, misidentification, dissociation, default mode network, ego, embodiment, empathy, identity, identification, insula, interoceptive, meta-cognitive, psychological distance, posterior cingulate cortex, perspective, prosocial, self, ownership, theory of mind.

Truncation with an asterisk (*) was utilized where necessary in order to capture all possible terms with the designated root. The search was restricted to studies among humans and adults. In addition, only randomized controlled trials were included. There was no language restriction. The literature search design was created in collaboration with a medical librarian at Brown University (E.S.).

Eligibility of studies were determined by screening titles, abstracts, keywords, and full-text in duplicate by two independent reviewers (C.A.N. and E.B.S.) (95.6% agreement). Prior to evaluating eligibility of studies, several practice extractions were completed and reviewed by the extraction team (C.A.N. and E.B.S.) and the senior scientist (E.B.L.) to ensure agreement in the process and clarify inclusion/exclusion criteria. Once consistency was achieved, the full double screening of all abstracts commenced. Abstrackr[41] was used to assess study titles and abstracts for inclusion. A PhD-level scientist (E.B.L.) with expertise in self-regulation, health, and systematic review methods resolved any disagreement. Any citation that was presented in Abstrackr with no abstract and only a title and key words was retrieved for a full-text review.

Studies that were published between January 1, 1995 and June 1, 2016, and met all the following criteria were eligible for inclusion: 1.) was a randomized controlled trial design; 2.) had adult participants (age ≥ 19 years old); 3.) tested an intervention which induced a significant change in a validated measure of self-regulation; and 4.) analyzed a dietary behavior change among one of four evidence based diets: low-calorie, low-sodium, DASH diet, or Mediterranean Diet. Reasons for exclusion included 1.) quasi-experimental studies or single arm clinical trials; 2.) studies that analyze components of a diet (e.g. fruit and vegetable consumption) but not the entire diet.

Data collection process

Each eligible study for inclusion was entered into pre-made Excel forms for data extraction. Quality and accuracy of the data entry was assessed by a second member of the review team and entries were corrected if necessary. Data that was extracted included items regarding the study population; intervention descriptions; diet and self-regulation variables; descriptions of experimental and control arms; results pertaining to diet and self-regulation; and questions related to risk of bias. The Cochrane Risk of Bias tool was utilized to assess each study.[33] Seven bias questions were asked regarding selection, performance, detection, attrition, reporting, and other biases.

Data synthesis

Study characteristics and descriptive results for each study were summarized from the Excel form as seen in Tables 1-3. Statistically significant findings were considered as analyses demonstrating p-values less than 0.05. Results of the individual risk analysis questions can be seen in Figure 2.

Results

The databases returned 2,241 papers. Of these, 520 duplicates were removed, resulting in 1,721 papers. Abstract screening removed 1,692 papers that did not meet inclusion criteria, resulting in 29 articles that had the full-text screened. Twenty-four articles were excluded due to not meeting the complete inclusion criteria (Figure 2), leaving five studies included.

Characteristics of the five studies with the diet, self-regulation domain, and participant information are shown in Table 1. Sample sizes ranged from 35 to 537 (median: 107) with the intervention arm sample size ranging from 19 to 537 (median: 53). Trial duration ranged from six weeks to 18 months (median: 6 months). One study was male-only[36] while 2 studies were female-only.[37-38] Four of the studies were conducted in the United States.[36-39] Race was predominantly white in all studies (range: 54% - 77%). One study did not report race/ethnicity.[40] Mean ages ranged from 44 to 57 years. All but one study[38] reported baseline self-regulation scores and dietary habits. The population clinical characteristics included hypertensive patients (3 studies),[38-40] overweight/obese patients (1 study),[36] and healthy participants (1 study).[37] Of the eligible evidence-based dietary patterns (i.e. DASH, Mediterranean, low-calorie, and low-salt diets) only the DASH and the low-calorie diets were addressed in the studies.

Strategies to changing behavior

All five studies performed interventions that focused on altering dietary behavior patterns. The control groups varied between studies, where two studies utilized waitlist control groups that only received the baseline measurements and no intervention.[36-37] The remaining three control groups received either information on lifestyle change and usual care,[40] advice only,[39] or no treatment of any kind without being on a waitlist.[38] The advice-only control group was not included in analysis of the self-regulation processes on dietary patterns as the authors stated they did not receive the behavioral intervention.[39] Instead the authors pooled the intervention arms together and analyzed categorized participants baseline DSE into tertiles.[39] Analysis was performed on those who had low baseline DSE versus those who had high baseline DSE.[39]

Table 3 contains the general contents of the group and individual in-person intervention sessions. The overall intervention type varied as well ranging from lifestyle modification,[39] health promotion programs,[40] and weight-gain prevention/weight loss interventions.[36-37] Four of the studies were based on theoretical models including: Social Cognitive Theory,[36, 39-40] Behavior of Self-Management Theory,[39] the Stages of Change Model,[39] Health Behavior Model,[40] Theory of Planned Behavior (Theory of Reasoned Action),[40] Decisional Balance,[40] Health Promotion Model,[37] or Self-Determination Theory.[36] Four studies had intervention groups that received at least one group and/or individual in-person intervention session. Types of session included educational-based group;[36] individual counseling[40] or guidance;[39] group workshops;[40] lifestyle educational modules;[40] interactive group activities;[37,39] and interactive online modules.[36] One study was a text messaging intervention and did not have in-person group or individual sessions.[38] Only one study's specific aim was to improve dietary adherence.[38] The content of the intervention sessions included behavioral skill development and maintenance;[39] problem solving;[39] motivation;[39] weight loss encouragement through food and nutrient education;[40] stress management;[40] meditation;[37,40] exercise strategies and tips;[40] goal setting;[36-40] and, dietary education/introduction.[36-40] Group sessions ranged from one to two hours. Only one study reported individual group session lengths, which were between 30 – 60 minutes. One study did not define the intervention dietary recommendation.[37]

Change in Self-Regulation

All studies reported significant changes in the self-related processing domain variables at some follow-up time point. No significant findings were found within the emotion regulation domain. No variables from the cognitive domain were studied. All scales for measurement in all domains assessed were different between studies.

Each study analyzing dietary self-efficacy (DSE) had statistically significant changes at one or both follow-up assessments (Table 3). The REFIT study found the DSE score changes from 127 to 132 to be significant within group at the follow-up assessment at 3 months (n=107, $p<0.001$),[36] while the Mindful Restaurant Eating and PREMIER interventions had significant between-group DSE score findings at 6 weeks (n=35, intervention: 195.8, control: 174.1, $p<0.05$), 6 months (n=537, mean difference in lower tertile: 2.1±13.6, in upper tertile: -8.9±12.5, $p<0.001$) and 18 months (n=537, mean difference: lower tertile: 0.7±15.9, upper tertile: -10.1±13.3, $p<0.001$), respectively.[37,39] The PREMIER trial analyzed those with lower baseline DSE against those with higher baseline DSE[39] while the other studies were compared to a waitlist control group. Conversely, the ADAPT study revealed DSE changes that were small, but significant (program: 11.2 (SEM 0.1), usual care: 10.8 (SEM 0.1); $p=0.007$) at 4 months but not at 12 months follow-up (program: 11.2 (SEM 0.1), usual care: 10.7 (SEM 0.1); $p=0.087$)[40] (Table 3).

Also within the self-related processing domain, The Manage Associated Perceptions (MAP) study found Cognitive Representations of the DASH Diet (CRDD) scores to be significantly different between groups at 60 (Experimental mean: 76.16, SD: 10.20; Control mean: 63.70, SD: 15.05, $p<0.003$) and 90 (Experimental mean: 75.80, SD: 8.81; Control mean: 61.32, SD: 18.07, $p<0.001$) days follow-up but not 30 (Experimental mean: 76.70, SD: 10.77; Control mean: 56.21, SD: 21.92, $p<0.08$) days.[38] Specifically, the three CRDD domains of knowledge (Experimental mean: 22.54, SD: 3.66; Control mean: 17.44, SD: 5.87, $p<0.001$), skills (Experimental mean: 26.75, SD: 3.40; Control mean: 21.80, SD: 6.70, $p<0.003$), and attitudes (Experimental mean: 26.75, SD: 3.96; Control mean: 22.08, SD: 7.54, $p<0.009$) changed significantly overall (Table 3).[38]

Only the Mindful Restaurant Eating intervention analyzed the emotion regulation domain (37). This study found no statistically significant changes at 6 weeks follow-up for emotional eating, measured with the Emotional Eating Scale, between the intervention arm and the waitlist control (Table 3).[37]

Change in Dietary Patterns

All studies reported means and/or changes in diet, three of which contained significant changes in overall and/or components of the diets. One study did not report the between or within group differences, although caloric intake did decrease from baseline to 18 months follow-up.[39] Caloric intake decreased significantly in two studies either within group or between groups at either 6 weeks[37] or 6 months follow-up.[36] Reducing caloric intake was a goal in both studies. In the MAP study, dietary compliance to the DASH diet was consistent across program group and control group through follow-up.[38] The ADAPT study found significant changes or improvements in energy, fat (total, saturated, and monosaturated), cholesterol, protein, carbohydrates, sodium, high fat dairy, fish, meat, vegetables, and takeways servings at 4 months relative to the control group.[42] At 12 months, fat intake (total, saturated, and monosaturated), protein, carbohydrates, fiber, sodium, high fat dairy, fish, vegetables, takeaways, and spreads servings improved significantly changed relative to the control group.[42] The Mindful Restaurant Eating Study also found significant decreases in average fat intake 6 weeks post intervention.[37]

Self-Regulation Impact on Dietary Behavior Change

Four of the five studies performed analyses on the relationship of the intervention-induced changes in a self-regulation variable with dietary behavior change.[36, 38-40] Three studies found elements of the self-domain to be associated with a component of dietary behavior.[38-40] Specifically, the PREMIER trial found that change in DSE and change in fruit and vegetable intake was significantly correlated at 6 (r=-0.17) and 18 months (r=0.13) follow-up.[39] Additionally, both the PREMIER and ADAPT studies found an inverse relationship between change in DSE and change in percent fat intake.[40] The PREMIER trial observed a significant association at 6 months (r=-0.11), which was no longer significant at 18 months (r=-0.05).[39] The ADAPT study also observed a decrease in the magnitude of the association over time. They observed that change in DSE predicted a negative percent change in fat at the 4 months, but not significantly at the 12 month assessments.[40] Lastly, the MAP study found an association between the combined domains of CRDDs and dietary compliance at each follow-up measurements of 30, 60, and 90 days.[38] Specifically, among the three domains, only two domains had significant associations. The CRDD knowledge domain was significantly correlated at all follow-up measurements and the CRDD attitudes domain was significantly correlated at 30 and 90 days.[38]

Three studies also found no association between the self-domain and diet.[36,38-39] In the MAP study, the CRDD skills domain was not correlated with dietary compliance at any of the follow-up points[38] and the PREMIER trial found no significant correlation between change in DSE and change in caloric intake post-baseline.[39] Finally, while the REFIT intervention showed significantly decreased caloric intake and increased dietary self-efficacy. However, the mediation analysis revealed the change in the self-regulation measure did not significantly mediate the change in caloric intake.[40]

Analysis of Bias

Overall, no study was considered to have consistently high bias, as shown in Figure 2. Only the REFIT study was classified as medium risk of bias due to lack of blinding and the outcomes being of knowledge among participants in both arms.[36] All studies took steps to ensure low risk of selection bias through randomization and allocation concealment; however, two studies did not report how allocation was concealed from participants and investigators. The PREMIER trial was considered high risk for reporting bias as the control group was excluded from analysis.[39] Analysis was conducted between the pooled intervention arms and differences were detected by analyzing high versus low baseline DSE. Finally, the ADAPT and REFIT studies were high for other bias.[36,40] In the REFIT study, the author hypothesized that interaction with the interventionist and the waitlist control may have resulted in improvements in the outcomes for this group.[36] The ADAPT study was considered at a high risk of bias due to the potential for a healthy worker effect (Hawthorne Effect).[40]

Discussion

This systematic review supports the relationship between self-regulation and improvements in dietary patterns of evidence-based diets. Specifically, there were a variety of interventions that utilize self-regulatory various measures to change dietary behavior. It also demonstrated that self-efficacy was the primary self-regulatory skill employed in these diet-related interventions. Among these studies, results showed significant improvements in both diet and DSE. Furthermore, improvements in diet were found to be associated with changes in DSE, but the strength of the association weakened over the follow-up period. The emotion regulation domain was minimally studied to date, and the one finding was null.

While the involved studies support the relationship between the self-related processing domain, specifically self-efficacy, and dietary patterns, the vast differences in dietary and self-regulatory outcomes and the diversity of assessments makes it difficult to determine if there is a common effect on dietary changes. For example, no single RCT included in this study utilized the same DSE measure. Additionally, the variability in intervention components makes it difficult to determine which aspect is most advantageous in changing self-regulatory processes and thereby changing a dietary pattern.

The maintenance and continued improvement of a healthier diet varied throughout the five studies. More specifically, the association between diet and dietary components and the skills of the self-related processing domain varied. All studies found improvements in the self-regulatory skills at some follow-up time point, with the exception of emotional eating. However, the strength of association varied by dietary component or was not similar within a specific overall diet. For example, among dietary components, associations were found between change in DSE and change in dietary fat intake in the short-term (4 and 6 months) within the ADAPT study and the PREMIER trial. However, at the long-term follow-up (12 and 18 months), the associations were no longer significant. Additionally, no associations were found between change in DSE and change in fruit and vegetable consumption at any follow-up point. In regards to overall diet, the REFIT study found no significant associations between change in diet and change in DSE by 6 months, even though both diet and self-regulation individually improved. Conversely, the PREMIER trial found a correlation between change in DSE and change in caloric intake through the final follow-up at 18 months.

A possible explanation for the diversity in results and the opposite outcomes may point to the delivery of the intervention and the number of contacts participants had with interventionists. For example, those in the PREMIER trial had a total of 26 group sessions and 7 individual in-person intervention sessions throughout the 18 months and found prolonged association between change in DSE and change in caloric intake. In contrast, the REFIT study had 2 in-person group intervention sessions and 10 online contact sessions via a survey link, and found no association between change in the self-related processing domain and change in diet. Another possible explanation may be the population and clinical condition each study assessed. Using the PREMIER and REFIT studies, the populations varied in both areas. While the PREMIER trial was among hypertensive individuals and a mixture of male and female, the REFIT study was an all-male intervention among overweight and obese individuals. This may be a plausible explanation as the ADAPT study, which found similar findings to the PREMIER study in the area of dietary fat intake was also a mixed gender hypertensive population but only had 6 group in-person intervention sessions.

One major limitation of the present review was the scarcity of eligible studies. Studies for review were limited due to the inclusion criteria, which included only four evidence-based diets and required reported measures of self-regulation. Among the eligible studies, there were differences in interventions, measures, and outcomes, and therefore the lack of homogeneity between the studies made it very difficult to assess meaningful comparisons.

Conclusion

This study aimed to present the current evidence on the impact of self-regulation on dietary behavior. Although very few studies were identified, these five RCTs revealed that when interventions incorporate strengthening of self-regulatory skills, improvements in dietary compliance and patterns follow. More specifically, building self-efficacy should be a focal point of future interventions aiming to improve dietary patterns. The lack of RCT studies evaluating the role of change in self-regulation on dietary patterns demonstrates a distinct gap in the literature, for which there are opportunities to contribute.

Acknowledgements

We would like to express gratitude to Brown University medical librarian Erika Sevetson for her assistance with the search strategy and search method for this review.

References

1. Go SA, Mozaffarian D, Roger VL, et al. Heart disease and stroke statistics—2014 update: A report from the American Heart Association. Circulation. 2014;129(3):e28-e292.
2. Fung TT, Chiuve SE, McCullough ML, Rexrode KM, Logroscino G, Hu FB. Adherence to a DASH-style diet and risk of coronary heart disease and stroke in women. Arch Intern Med. 2008;168(7):713-720.
3. Fung TT, Rexrode KM, Mantzoros CS, Manson JE, Willett WC, Hu FB. Mediterranean Diet and incidence of and mortality from coronary heart disease and stroke in women. Circulation. 2009;119:1093-1100.
4. Osler M, Heitmann BL, Hoidrup S, Jorgensen LM, Schroll M. Food intake patterns, self rated health and mortality in Danish men and women: A prospective observational study. Journal of Epidemiology and Community Health. 55(6):399-403.
5. van Dam RM, Rimm EB, Willett WC, Stampfer MJ, Hu FB. 2002. Dietary patterns and risk for Type 2 Diabetes Mellitus in U.S. Men. Ann Intern Med. 2001;136(3): 201-209.
6. Heidemann C, Hoffmann K, Spranger J, Klipstein-Grobusch K, Mohlig M, Pfeiffer AFH, Boeing H. A dietary pattern protective against type 2 diabetes in the European Prospective Investigation into Cancer and Nutrition (EPIC) — Potsdam Study cohort. Diabetologia. 2005;48(6):1126-1134.
7. Brunner EJ, Mosdol A, Witte DR, Martikainen P, Stafford M, Shipley MJ, Marmot MG. Dietary patterns and 15-y risks of major coronary events, diabetes, and mortality. Am J Clin Nutr. 2008;87(5):1414-1421.
8. Lutsey PL, Steffen LM, Stevens J. Dietary intake and the development of the metabolic syndrome: The Atherosclerosis Risk in Communities Study. Circulation. 2008;117:754-761.
9. Fitzgerald KC, Chiuve SE, Buring JE, Ridker PM, Glynn RJ. Comparison of associations of adherence to a DASH-style diet with risks of cardiovascular disease and venous thromboembolism. J Thromb Haemost, 2012;10(2):189-198.
10. Williams CD, Satia JA, Adair LS, Stevens J, Galanko J, Keku TO, Sandler RS. Dietary patterns, food groups, and rectal cancer risk in Whites and African-Americans. Cancer Epidemiol Biomarkers. 2009;18(5): 1552-61.
11. Micha R, Wallac SK, Mozaffarian D. Red and processed meat consumption and risk of incident coronary heart disease, stroke, and diabetes: A systematic review and meta-analysis. Circulation. 2010;121(21):2271-2283.
12. Gay HC, Rao SG, Vaccarino V, Ali MK. Effects of different dietary interventions on blood pressure: Systematic review and meta-analysis of randomized controlled trials. Hypertension. 2016;67:733-739.
13. Strazzullo P, D'Elia L, Kandala N, Cappuccio FP. Salt intake, stroke, and cardiovascular disease: Meta-analysis of prospective studies. BMJ. 2009;339:b4567.
14. Di Daniele N, Noce A, Vidiri MF, Moriconi E, Marrone G, Annicchiarico-Petruzzelli M, D'Urso G, Tesauro M, Rovella V, De Lorenzo A. Impact of Mediterranean diet on metabolic syndrome, cancer, and longevity. Oncotarget. 2017;8(5):8947-8979.
15. Bloomfield HE, Koeller E, Greer N, MacDonald R, Kane R, Wilt TJ. Effects on health outcomes of a Mediterranean Diet with no restriction on fat intake: A systematic review and meta-analysis. Ann Intern Med. 2016;165(7):491-500.
16. Danaei G, Ding EL, Mozaffarian D, Taylor B rehm J, Murray CJL, Ezzati M. The preventable causes of death in the United States: Comparative risk assessment of dietary, lifestyle, and metabolic risk factors. PLoS Med. 2009;6(4):e1000058.
17. Liyanage T, Ninomiya T, Wang A, Neal B, Jun M, Wong MG, Jardine M, Hillis GS, Perkovic V. Effects of the Mediterranean Diet on cardiovascular outcomes — A systematic review and meta-analysis. PLoS One. 2016;11(8):e0159252.
18. Bibbings-Domingo K, Chertow GM, Coxson PG, Moran AE, Lightwood JM, Pletcher MJ, Goldman L. Reductions in cardiovascular disease projected from modest reductions in dietary salt. N Engl J Med. 2010;362(7):590-599.
19. U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015-2020 Dietary Guidelines for Americans. 8th Edition. 2015.
20. Truven Health Analytics. Health Poll: Diet and Nutrition. IBM: Truven Health Analytics. 2016.

21. Kwan MW, Wong MC, Wang HH, Liu KQ, Lee CL, Yan BP, Yu CM, Griffiths SM. Compliance with the dietary approaches to stop hypertension (DASH) diet: A systematic review. PLOS One. 2013;8(10):e78412.
22. Lourida I, Soni M, Thompson-Coon J, Purandare N, Lang IA, Ukoumunne OC, Llewellyn DJ. Mediterranean Diet, cognitive function, and dementia: A systematic review. Epidemiology. 2013;24(4):479-89.
23. Onken L, Carroll K, Shoham V, Cuthbert B, Riddle M. Reenvisioning clinical science: Unifying the discipline to improve the public health. Clinical Psychological Science. 2014;2(2):22-34.
24. Riddle M, Ferrer R. The science of behavior change. Assoc Psychol Sci. 2015. Available from: https://www.psychologicalscience.org/observer/the-science-of-behavior-change#.WNG8HBLyvow
25. Murphy MJ, Mermelstein LC, Edwards KM, Gidycz CA. The benefits of dispositional mindfulness in physical health: a longitudinal study of female college students. Journal of American college health: J of ACH. 2012;60(5):341-8. doi: 10.1080/07448481.2011.629260. PubMed PMID: 22686356.
26. Jordan CH, Wang W, Donatoni L, Meier BP. Mindful eating: Trait and state mindfulness predict healthier eating behavior. Personality and Individual Differences 2014;68:107-11.
27. Ouwens MA, Schiffer AA, Visser LI, Raeijmaekers NJ, Nyklicek I. Mindfulness and eating behaviour styles in morbidly obese males and females. Appetite. 2015;87:62-7.
28. Roberts KC, Danoff-Burg S. Mindfulness and health behaviors: is paying attention good for you? Journal of American college health : J of ACH. 2010;59(3):165-73.
29. Gross JJ. The emerging field of emotion regulation: An integrative review. Review of General Psychology. 1998;2:271-99.
30. Carver CS, Scheier M. Attention and self-regulation: a control-theory approach to human behavior: Springer-Verlag; 1981. 403- p.
31. Carver CS, Scheier MF. On the Self-Regulation of Behavior: Cambridge University Press; 2001. 460- p.
32. Vohs KD, Baumeister RF. Handbook of Self-Regulation, Second Edition: Research, Theory, and Applications2010:592..
33. Higgins JPT, Green S (editors). *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from http://handbook.cochrane.org.
34. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Ann Intern Med. 2009;151:264–9, W64.
35. Terasaw T, Dvorak T, Ip S, Raman G, Lau J, Trikalinos TA. Systematic review: charged-particle radiation therapy for cancer. Ann Intern Med. 2009;151(8):556-565.
36. Crane MM, Ward DS, Lutes LD, Bowling JM, Tate DF. Theoretical and behavioral mediators of a weight loss intervention for men. Ann Behav med. 2016;50:460-470.
37. Timmerman GM. Brown A. The effect of a Mindful Restaurant Eating intervention on weight management in women. Nutr Educ Behav. 2012;44:22-28.
38. Scisney-Matlock M, Glazewki L, McClerking C, Lachorek L. Development and evaluation of DASH diet tailored messages for hypertension treatment. Applied Nursing Research. 2006;19:78-87.
39. Wingo BC, Desmond RA, Brantley P, Appel L, Svetkey L, Stevens VJ, Ard JD. Self-efficacy as a predictor of weight change and behavior change in the PREMIER trial. J Nutr Educ Behav. 2013;45:314-321.
40. Burke V, Mansour J, Mori TA, Beilin LJ. Cutt HE, Wilson A. Changes in cognitive measures associated with a lifestyle program for treated hypertensives: a randomized controlled trial (ADAPT). Health Education Research. 2008;23(2):202-217.
41. Wallace BC, Small K, Brodley CE, Lau J, Trikalinos TA. Deploying an interactive machine learning system in an evidence-based practice center: abstrackr. Proc of the ACM International Health Informatics Symposium (IHI). 2012;p.819-824.

42. Burke V, Beilin LJ, Cutt HE, Mansour J, Williams A, Mori TA. A lifestyle program for treated hypertensives improved health-related behaviors and cardiovascular risk factors, a randomized controlled trial. Journal of Clinical Epidemiology. 2007;60:133-141.

Figures and Tables

Figure 1. The Science of Behavioral Change Mechanistic framework.

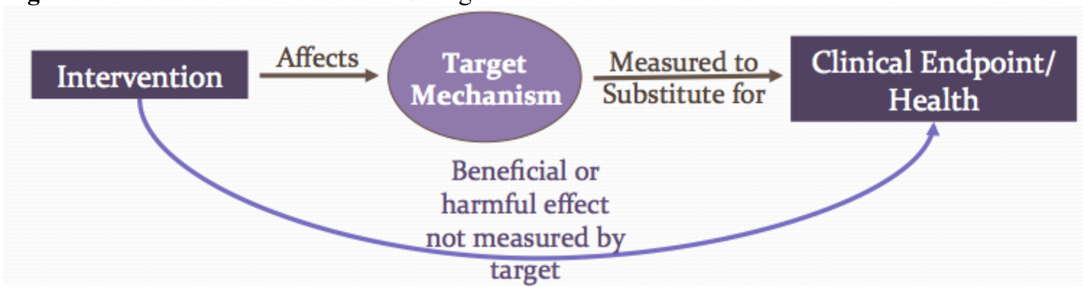


Figure 2. Risk of bias summary; L = Low Risk, H = High Risk, UR = Unknown/Unclear Risk

	Crane *et al*	Timmerman *et al*	Scisney-Matley *et al*	Wingo *et al*	Burke *et al*
Random Sequence Generation (Selection Bias)	L	L	L	L	L
Allocation Concealment (Selection Bias)	UR	L	L	UR	L
Blinding of Participants & Personnel (Performance Bias)	H	L	L	L	L
Blinding of Outcome Assessment (Detection Bias)	H	L		L	H
Incomplete Outcome Data (Attrition Bias)	L	L	L	L	L
Selective Reporting (Reporting Bias)	L	L	L	H	L
Other Bias	H	UR	UR	UR	H

Figure 3. Process of study selection for systematic review (PRISMA flowchart)

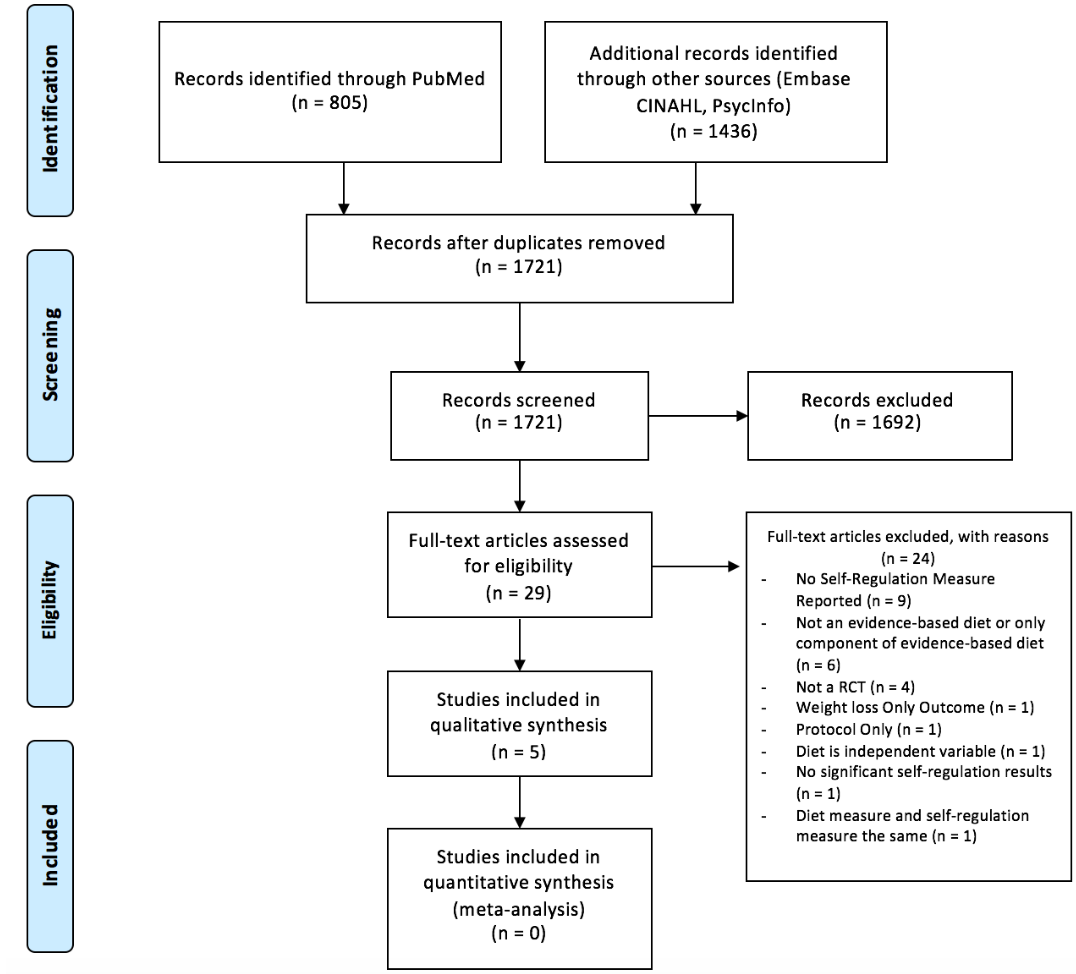
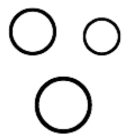
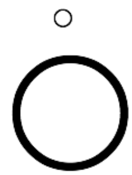


Figure 4. Current clinical evidence for self-regulation on dietary behavior change.

	DASH Diet	Mediterranean Diet	Low-Calorie Diet	Low-Salt Diet
SELF-PROCESSING				
Self-Referential Processing	0	0	0	0
Self-Related Rumination	0	0	0	0
Interoception	0	0	0	0
Self-Compassion	0	0	0	0
Self-Efficacy	 3	0	 2	0
EMOTION REGULATION				
Emotion Regulation	0	0	 1	0
Acceptance / Nonjudgment	0	0	0	0
Experiential Avoidance	0	0	0	0
Other	0	0	0	0
COGNITIVE PROCESSING				
Vigilance*	0	0	0	0
Inhibitory Control	0	0	0	0
Executive Function & Impulsivity	0	0	0	0
Memory	0	0	0	0
Meta-Cognitive Awareness	0	0	0	0

*Includes sustained, attention, wakefulness, engagement
Each circle represents 1 study. The size of the circle is proportional to the study sample size. The number in the bottom corner of each cell represents the number of studies within the category.

Table 1. Study design and baseline characteristics of randomized controlled trials of self-regulatory skills for dietary behavior change.

Study	Year	Country	N (control / Intervention)	Follow-up Time	Age (y), mean	Male (%)	Race	Clinical Status	Self-Regulation	Diet Intervention
REFIT: Crane *et al*	2016	USA	107 (54 / 53)	6 mos	44.2	100	76.6% Non-Hispanic White 15.9% African American 7.5% Other	Overweight/Obese	Self Domain, Self-Regulation Overall	Low Calorie
PREMIER Trial: Wingo *et al*	2013	USA	537*	18 mos	50	39	66% Non-Hispanic White	Pre-Hypertension / Hypertension	Self Domain	DASH
Mindful Restaurant Eating: Timmerman *et al*	2012	USA	35 (16 / 19)	6 weeks	49.6	0	54% White, 29% Hispanic/Latino; 17% African American	Healthy Perimenopausal women who eat out frequently	Emotion Domain, Self Domain	Low Calorie
MAP: Scisney-Matlock *et al*	2005	USA	53 (26 / 27)	3 mo	NA	0	56.6% White; 43.4% Minority	Hypertension	Cognitive Domain	DASH
ADAPT: Burke *et al*	2008	Australia	241 (118 / 123	12 mo	C:55.3 I: 57.1	44.4	NR	Hypertension	Self Domain	DASH

*Analysis done only on intervention arms (combined)
C = control arm; I = Intervention arm

Table 2. Description of Intervention and Control Group Sessions.

	Intervention Group					Control Group	
Study	**Intervention Session Types**	**Content of Group Sessions**	**Content for Individual Sessions**	**Session Duration**	**Number of Sessions**	**Type**	**Control Group Intervention**
REFIT: Crane *et al*	In-person group interactions & individual online contacts via survey link	Recommendations on dietary and physical activity change and self-monitoring behavior	Interactive Survey on behaviors and tailored feedback	Group: 1 h Online: 15 – 30 min	2 Group; 10 Online Contacts	Waitlist Control	1 group session for allocation; received feedback report but no treatment
PREMIER Trial: Wingo *et al*	In-person group and individual interactions	Interactive with problem solving, social support, ownership, and behavior change techniques	Establishing diet, weight loss, and physical activity goals; strengthening behaviors and problem solving, individualized graphics to assist in motivation and goals	Group: 1.5 – 2 h Individual: 0.5 – 1 h	26 Group; 7 Individual	Advice only	Control group was not analyzed for the study component on self-efficacy and diet
Mindful Restaurant Eating: Timmerman *et al*	In-person group interactions	Topics include weight management, interactive skill building activities to address strategies and barriers, and mindful eating behavior; Personalized goals	NA	NA	6 Group	Waitlist Control	No treatment and no contact post-randomization until follow-up time
MAP: Scisney-Matlock *et al*	Text Message or no contact intervention	NA	NA	NA	Daily text messages for 30 days	Control Group	No intervention or treatment; took baseline assessments or monthly assessment
ADAPT: Burke *et al*	In-person group and individual interactions	Interactive with demonstrations, discussion, and practicing behavioral techniques in physical activity and nutrition	Risk factors discussed, specifically cholesterol, blood pressure, weight, and diet	Group: 1.5 h; Individual: NR	6 Group; 4 Individual; 5 Printed Modules	Usual Care	Given material with information on lifestyle changes and attended four seminar sessions that were not related to the intervention program topics

Table 3. Intervention outcomes for each self-regulation domain and dietary behavior change.

	Study	Control	Intervention	Dietary Outcome Measure	Self-Regulation Outcome Measure	Within Arm	Between Arm
Self-Related Processing	REFIT: Crane *et al*	Waitlist	REFIT	Caloric Intake via 24h recall	Weight Efficacy Lifestyle Questionnaire [Dietary Self-Efficacy (DSE)]	• Change in DSE *REFIT Arm* (p=0.009) Baseline: 126.59±32.16 3 months: 132.03±30.00 *Waitlist* (p=0.12) Baseline: 122.01±31.48 3 months: 118.72±35.01	• Change in DSE β: 12.17 (se:4.01), p<0.01 • Change in DSE on change in diet β: -3.95 (se:2.90), p>0.05 • Indirect effect of REFIT on diet β: -48.13 (95%CI: -161.54, 27.82), p>0.05 • Direct effect of REFIT on diet β: -363.56 (se:115.82), p<0.01
	PREMIER Trial: Wingo *et al*	Lowest Tertile of DSE	Highest Tertile of DSE	24h Dietary Recall	Eating Habits Confidence Questionnaire	• DSE and daily caloric intake 6mo: r=-0.17, p=0.001 18mo: r=0.13, p=0.0007 • DSE and percent calories from fat 6mo: r=-0.11, p=0.02 18mo: r=-0.05, p>0.05 • DSE and fruit & vegetable intake 6mo: r=-0.02, p>0.05 18mo: r=0.04, p>0.05 • Change in DSE and change in percent dietary fat intake β: -0.07, p>0.05 • Change in total sample DSE Baseline: 119.7 ±12.5 6 mo: 115.2 ± 15.0 18mo: 114.6 ±15.1	NA

						• Change in High Tertile DSE Baseline: 132.1 ±2.5 6 mo: 123.2 ± 13.2 18 mo: 122.0 ±13.7 • Change in Middle Tertile DSE Baseline: 122.5 ± 3.3 6 mo: 115.2 ±14.8 18 mo: 115.3 ± 12.9 • Change in Low Tertile DSE Baseline: 106.0 ± 9.3 6 mo:108.3 ± 13.3 18 mo: 107.1 ±14.6	
	MAP: Scisney-Matlock *et al*	No Treatment	CRDD Experimental Group	Health Promotion Lifestyle Profile	Cognitive Representations of the DASH Diet	NA	• CRDD scores 30d: t = 1.84, p<0.08 60d: t = 3.12, p<0.003 90d: t = 1.84, p<0.001 • CRDD knowledge scores 60d: t = 2.53, p<0.021 90d: t = 3.74, p<0.001 • CRDD attitude scores 60d: t = 2.16, p<0.037 90d: t = 2.78, p<0.009 • CRDD skills scores 60d: t = 2.62, p<0.012 90d: t = 3.17, p<0.003 • CRDD knowledge score and compliant behavior 30d: r=0.66, p<0.05 60d: r=0.57, p<0.05 90d: r=0.70, p<0.05 • CRDD attitude score and compliant behavior 30d: r=0.38, p<0.05

							90d: r=0.46, p<0.05
	Mindful Restaurant Eating: Timmerman *et al*	Waitlist	Intervention	Caloric Intake via 24 hour recall	Self-Efficacy for Eating Behavior Scale	• Change in DSE *Intervention Arm* Baseline: 177.3 ± 20.2 6 weeks: 174.1 ± 24.8 *Waitlist* Baseline: 182.8 ± 19.7 6 weeks: 195.8 ± 22.5	• DSE score change β: 0.36 (se: 7.16; 95%CI: 3.58, 32.78), t=2.54, p=0.02
	ADAPT: Burke *et al*	Usual Care	Program	3 day food and drink diaries	Low Fat Diet Scale	NA	• Change in DSE on change in percent energy from saturated fat 4mo: β: -0.92 (se: 0.26), p<0.001 12mo: β: -0.76 (se: 0.41), p=0.068 • Change in DSE on change in percent energy from saturated fat adjusted for sex 4mo: β: -0.89 (se: 0.26), p=0.001
Emotion Regulation	Mindful Restaurant Eating: Timmerman *et al*	Waitlist	Intervention	Caloric Intake via 24 hour recall	Emotional Eating Scale	• Change in EES *Intervention Arm* Baseline: 53.2 ± 16.5 6 weeks: 53.1 ±15.0 *Waitlist* Baseline: 47.9 ± 17.9 6 weeks: 62.7 ± 60.4	• Total emotional eating score β: -0.073 (se: 4.17; 95%CI: -10.80, 6.22), t=-0.55, p=0.59
Dietary Intake	REFIT: Crane *et al*	Waitlist	REFIT	Caloric Intake via 24h recall	-	• Change in Caloric Intake *REFIT Arm* (p<0.001) Baseline: 2333±665 6 mo: 1890±468 *Waitlist* (p=0.17) Baseline: 2460±619 6 mo: 2286±693	• Impact of intervention on caloric intake (6mo) β: -353.50 (se: 111.75), p<0.001
	MAP: Scisney-Matlock *et al*	No Treatment	CRDD Experimental Group	Health Promotion Lifestyle Profile	-	NA	• Compliance with diet 30 Days: t=0.18, p<0.086 60 Days: t=1.95, p<0.057 90 Days: t=1.58, p<0.009

	Mindful Restaurant Eating: Timmerman *et al*	Waitlist	Intervention	Caloric Intake via 24 hour recall	-		• Average calories consumed β: -0.44 (se: 101.08; 95%CI: -552.76, -140.99), t=-3.43, p=0.002 • Average fat intake β: -0.45 (se: 4.65; 95%CI: -26.46, -7.56), t=-3.66, p=0.001 • Caloric intake/restaurant eating episode β: -0.28 (se: 88.74; 95%CI: -346.84, 14.68), t=-1.87, p=0.07 • Fat intake/restaurant eating episode β: -0.27 (se: 5.04; 95%CI: -18.27, 12.27), t=-1.59, p=0.12
	PREMIER Trial: Wingo *et al*	Lowest Tertile of DSE	Highest Tertile of DSE	24h Dietary Recall		• Change in Caloric Intake Baseline: 1957.0±638.0 6 mo: 1687.4 ± 526.2 18mo: 1679.9 ± 522.5 • Change in Daily servings of fruit & vegetables Baseline: 4.6 ± 2.4 6 mo: 6.5 ± 3.2 18mo: 6.1 ± 3.3 • Change in Percent of calories from fat Baseline: 33.4 ± 7.8 6 mo: 26.6 ± 9.0 18mo: 28.2 ± 8.7	NA

Appendix A. Search term strategy

<u>PubMed</u>

("Diet, Mediterranean"[Mesh] OR "Diet, Sodium-Restricted"[Mesh] OR "Caloric Restriction"[Mesh] OR "Dietary Approaches to Stop Hypertension") AND ((achievement) OR (alert*) OR (orienting) OR (attention) OR (cogniti*) OR (concentration) OR (control) OR ("conflict monitoring") OR ("decision making" OR decision-making) OR ("delay discounting") OR (discrimination) OR (distraction) OR ("dot probe") OR (efficiency) OR ("executive function") OR (impulsiv*) OR (intelligence) OR (learning) OR (memory) OR (meta-awareness) OR (metacogniti*) OR ("mind wandering") OR (performance) OR (resource deplet*) OR ("Sustained Attention to Response Task" OR sart) OR ("selective stopping") OR ("stimulus prioritization") OR (stop signal) OR (stroop) OR (top-down) OR ("task switching") OR (vigilance) OR (acceptance) OR (affect*) OR (amygdala) OR (anger) OR (anxiety) OR (arousal) OR (autonomic) OR (avoidance) OR (compassion) OR (coping) OR (decentering OR de-centering) OR (depression) OR ("distress tolerance") OR (emotion*) OR (equanimity) OR ("experiential avoidance") OR (exposure) OR ("expression"[all fields]) OR (fear) OR ("habituation"[all fields]) OR (kindness) OR (limbic) OR (motivation) OR (neuroticism) OR (nonattachment OR non-attachment) OR (nonjudgment OR non-judgment) OR (nonreactivity OR non-reactivity) OR ("positive psychology") OR (reappraisal) OR (reconsolidation) OR (resilience) OR (reperceiving OR re-perceiving) OR (reward) OR ("rumination"[all fields]) OR (stress) OR (suppression) OR (sympathetic) OR (threat) OR (agency) OR ("body awareness") OR (detach*) OR (misidentification OR dis-identification) OR (dissociati*) OR ("default mode network" OR DMN) OR (ego) OR (embodiment) OR (empathy) OR ("identity"[all fields]) OR (identification) OR (insula) OR (interocept*) OR (meta-cogniti*) OR ("psychological distance") OR ("posterior cingulate cortex" OR PCC[all fields]) OR (perspective*) OR (prosocial) OR (self) OR (ownership) OR (theory AND mind)) AND (randomized controlled trial[Publication Type] OR (randomized[Title/Abstract] AND controlled[Title/Abstract] AND trial[Title/Abstract]) OR (randomised controlled trial)) NOT (("addresses"[pt] OR "autobiography"[pt] OR "bibliography"[pt] OR "biography"[pt] OR "case reports"[pt] OR "comment"[pt] OR "congresses"[pt] OR "dictionary"[pt] OR "directory"[pt] OR "editorial"[pt] OR "festschrift"[pt] OR "government publications"[pt] OR "historical article"[pt] OR "interview"[pt] OR "lectures"[pt] OR "legal cases"[pt] OR "legislation"[pt] OR "letter"[pt] OR "news"[pt] OR "newspaper article"[pt] OR "patient education handout"[pt] OR "periodical index"[pt] OR "comment on" OR (child NOT adult))

- Selected criteria: Date range: 01 January 1995 to 01 June 2016; adults (19+); and humans

<u>CINAHL</u>

((MH "Diet, Reducing") OR (MH "DASH Diet") OR (MH "Diet, Sodium-Restricted") OR (MH "Mediterranean Diet")) AND ((achievement) OR (alert*) OR (orienting) OR (attention) OR (cogniti*) OR (concentration) OR (control) OR ("conflict monitoring") OR ("decision making" OR decision-making) OR ("delay discounting") OR (discrimination) OR (distraction) OR ("dot probe") OR (efficiency) OR ("executive function") OR (impulsiv*) OR (intelligence) OR (learning) OR (memory) OR (meta-awareness) OR (metacogniti*) OR ("mind wandering") OR (performance) OR (resource deplet*) OR ("Sustained Attention to Response Task" OR sart) OR ("selective stopping") OR ("stimulus prioritization") OR (stop signal) OR (stroop) OR (top-down) OR ("task switching") OR (vigilance) OR (acceptance) OR (affect*) OR (amygdala) OR (anger) OR (anxiety) OR (arousal) OR (autonomic) OR (avoidance) OR (compassion) OR (coping) OR (decentering OR de-centering) OR (depression) OR ("distress tolerance") OR (emotion*) OR (equanimity) OR ("experiential avoidance") OR (exposure) OR ("expression") OR (fear) OR ("habituation") OR (kindness) OR (limbic) OR (motivation) OR (neuroticism) OR (nonattachment OR non-attachment) OR (nonjudgment OR non-judgment) OR (nonreactivity OR non-reactivity) OR ("positive psychology") OR (reappraisal) OR (reconsolidation) OR (resilience) OR (reperceiving OR re-perceiving) OR (reward) OR ("rumination") OR (stress) OR (suppression) OR (sympathetic) OR (threat) OR (agency) OR ("body awareness") OR (detach*) OR (misidentification OR dis-identification) OR (dissociati*) OR ("default mode network" OR DMN) OR (ego) OR (embodiment) OR (empathy) OR ("identity") OR (identification) OR (insula) OR (interocept*) OR (meta-cogniti*) OR ("psychological distance") OR ("posterior cingulate cortex" OR PCC) OR (perspective*) OR (prosocial) OR (self) OR (ownership) OR (theory AND mind))

- Under advanced search: humans only selected; date range 01 January 1995 to 01 June 2016 was selected; randomized controlled trial was selected; all adults was selected

PsycInfo
((diet AND (calor* OR (sodium OR salt))) OR ("Mediterranean diet") OR ("dietary approaches to stop hypertension")) AND ((achievement) OR (alert*) OR (orienting) OR (attention) OR (cogniti*) OR (concentration) OR (control) OR ("conflict monitoring") OR ("decision making" OR decision-making) OR ("delay discounting") OR (discrimination) OR (distraction) OR ("dot probe") OR (efficiency) OR ("executive function") OR (impulsiv*) OR (intelligence) OR (learning) OR (memory) OR (meta-awareness) OR (metacogniti*) OR ("mind wandering") OR (performance) OR (resource deplet*) OR ("Sustained Attention to Response Task" OR sart) OR ("selective stopping") OR ("stimulus prioritization") OR (stop signal) OR (stroop) OR (top-down) OR ("task switching") OR (vigilance) OR (acceptance) OR (affect*) OR (amygdala) OR (anger) OR (anxiety) OR (arousal) OR (autonomic) OR (avoidance) OR (compassion) OR (coping) OR (decentering OR de-centering) OR (depression) OR ("distress tolerance") OR (emotion*) OR (equanimity) OR ("experiential avoidance") OR (exposure) OR ("expression") OR (fear) OR ("habituation") OR (kindness) OR (limbic) OR (motivation) OR (neuroticism) OR (nonattachment OR non-attachment) OR (nonjudgment OR non-judgment) OR (nonreactivity OR non-reactivity) OR ("positive psychology") OR (reappraisal) OR (reconsolidation) OR (resilience) OR (reperceiving OR re-perceiving) OR (reward) OR ("rumination") OR (stress) OR (suppression) OR (sympathetic) OR (threat) OR (agency) OR ("body awareness") OR (detach*) OR (misidentification OR dis-identification) OR (dissociati*) OR ("default mode network" OR DMN) OR (ego) OR (embodiment) OR (empathy) OR ("identity") OR (identification) OR (insula) OR (interocept*) OR (meta-cogniti*) OR ("psychological distance") OR ("posterior cingulate cortex" OR PCC) OR (perspective*) OR (prosocial) OR (self) OR (ownership) OR (theory AND mind)) AND (SU ("Treatment Effectiveness Evaluation") OR SU ("Treatment Outcomes") OR SU ("Psychotherapeutic Outcomes") OR SU ("Placebo") OR SU ("Followup Studies") OR placebo* OR random* OR "comparative stud*" OR clinical NEAR/3 trial* OR research NEAR/3 design OR evaluat* NEAR/3 stud* OR prospectiv* NEAR/3 stud* OR (singl* OR doubl* OR trebl* OR tripl*) NEAR/3 (blind* OR mask*))

- Under advanced search: humans only selected; date range 01 January 1995 to 01 June 2016 was selected; all adults was selected

Embase
'low calory diet'/exp OR 'low calory diet' OR 'mediterranean diet'/exp OR 'mediterranean diet' OR 'caloric restriction'/exp OR 'caloric restriction' OR 'sodium restriction'/exp OR 'sodium restriction' OR 'dietary approaches to stop hypertension'/exp OR 'dietary approaches to stop hypertension' AND ('achievement' OR 'achievement'/exp OR achievement OR alert* OR orienting OR 'attention' OR 'attention'/exp OR attention OR cogniti* OR 'concentration'/exp OR concentration OR 'control' OR 'control'/exp OR control OR 'conflict monitoring'/exp OR 'conflict monitoring' OR 'decision making'/exp OR 'decision making' OR 'delay discounting'/exp OR 'delay discounting' OR 'discrimination'/exp OR discrimination OR 'distraction'/exp OR distraction OR 'dot probe' OR 'efficiency' OR 'efficiency'/exp OR efficiency OR 'executive function'/exp OR 'executive function' OR impulsiv* OR 'intelligence' OR 'intelligence'/exp OR intelligence OR 'learning' OR 'learning'/exp OR learning OR 'memory' OR 'memory'/exp OR memory OR 'meta awareness' OR metacogniti* OR 'mind wandering'/exp OR 'mind wandering' OR 'performance' OR 'performance'/exp OR performance OR (resource AND deplet*) OR 'sustained attention to response task'/exp OR 'sustained attention to response task' OR sart OR 'selective stopping' OR 'stimulus prioritization' OR (stop AND ('signal'/exp OR signal)) OR stroop OR 'top down' OR 'task switching'/exp OR 'task switching' OR 'vigilance' OR 'vigilance'/exp OR vigilance OR 'acceptance'/exp OR acceptance OR affect* OR 'amygdala' OR 'amygdala'/exp OR amygdala OR 'anger' OR 'anger'/exp OR anger OR 'anxiety' OR 'anxiety'/exp OR anxiety OR 'arousal' OR 'arousal'/exp OR arousal OR autonomic OR 'avoidance' OR 'avoidance'/exp OR avoidance OR 'compassion'/exp OR compassion OR 'coping' OR 'coping'/exp OR coping OR 'decentering'/exp OR decentering OR 'de-centering' OR decentring OR 'de-centring' OR 'depression' OR 'depression'/exp OR depression OR 'distress tolerance'/exp OR 'distress tolerance' OR emotion* OR equanimity OR 'experiential avoidance'/exp OR 'experiential avoidance' OR 'exposure' OR 'exposure'/exp OR exposure OR 'expression'/exp OR expression OR 'fear' OR 'fear'/exp OR fear OR 'habituation' OR 'habituation'/exp OR habituation OR 'kindness'/exp OR kindness OR limbic OR 'motivation' OR 'motivation'/exp OR motivation OR 'neuroticism' OR 'neuroticism'/exp OR neuroticism OR nonattachment OR 'non attachment' OR nonjudgment OR 'non judgment' OR nonreactivity OR 'non reactivity' OR 'positive psychology'/exp OR 'positive psychology' OR 'reappraisal'/exp OR reappraisal OR reconsolidation OR 'resilience'/exp OR resilience OR reperceiving OR 're-perceiving' OR 'reward' OR

'reward'/exp OR reward OR 'rumination' OR 'rumination'/exp OR rumination OR 'stress' OR 'stress'/exp OR stress OR 'suppression'/exp OR suppression OR sympathetic OR 'threat' OR 'threat'/exp OR threat OR 'agency'/exp OR agency OR 'body awareness' OR detach* OR misidentification OR 'dis-identification' OR dissociati* OR 'default mode network'/exp OR 'default mode network' OR dmn OR 'ego' OR 'ego'/exp OR ego OR 'embodiment'/exp OR embodiment OR 'empathy' OR 'empathy'/exp OR empathy OR 'identity' OR 'identity'/exp OR identity OR 'identification'/exp OR identification OR 'insula' OR 'insula'/exp OR insula OR interocept* OR 'meta cogniti*' OR 'psychological distance' OR 'posterior cingulate cortex'/exp OR 'posterior cingulate cortex' OR pcc OR perspective* OR prosocial OR 'self' OR 'self'/exp OR self OR 'ownership' OR 'ownership'/exp OR ownership OR ('theory' OR 'theory'/exp OR theory AND ('mind'/exp OR mind))) AND ([young adult]/lim OR [adult]/lim OR [middle aged]/lim OR [aged]/lim OR [very elderly]/lim) AND [randomized controlled trial]/lim AND ([adolescent]/lim OR [young adult]/lim OR [adult]/lim OR [middle aged]/lim OR [aged]/lim OR [very elderly]/lim) AND [humans]/lim AND [1995-2016]/py

<u>Conchrane</u>

1. ((achievement) OR (alert*) OR (orienting) OR (attention) OR (cogniti*) OR (concentration) OR (control) OR ("conflict monitoring") OR ("decision making" OR decision-making) OR ("delay discounting") OR (discrimination) OR (distraction) OR ("dot probe") OR (efficiency) OR ("executive function") OR (impulsiv*) OR (intelligence) OR (learning) OR (memory) OR (meta-awareness) OR (metacogniti*) OR ("mind wandering") OR (performance) OR (resource deplet*) OR ("Sustained Attention to Response Task" OR sart) OR ("selective stopping") OR ("stimulus prioritization") OR (stop signal) OR (stroop) OR (top-down) OR ("task switching") OR (vigilance) OR (acceptance) OR (affect*) OR (amygdala) OR (anger) OR (anxiety) OR (arousal) OR (autonomic) OR (avoidance) OR (compassion) OR (coping) OR (decentering OR de-centering) OR (depression) OR ("distress tolerance") OR (emotion*) OR (equanimity) OR ("experiential avoidance") OR (exposure) OR ("expression") OR (fear) OR ("habituation") OR (kindness) OR (limbic) OR (motivation) OR (neuroticism) OR (nonattachment OR non-attachment) OR (nonjudgment OR non-judgment) OR (nonreactivity OR non-reactivity) OR ("positive psychology") OR (reappraisal) OR (reconsolidation) OR (resilience) OR (reperceiving OR re-perceiving) OR (reward) OR ("rumination") OR (stress) OR (suppression) OR (sympathetic) OR (threat) OR (agency) OR ("body awareness") OR (detach*) OR (misidentification OR dis-identification) OR (dissociati*) OR ("default mode network" OR DMN) OR (ego) OR (embodiment) OR (empathy) OR ("identity") OR (identification) OR (insula) OR (interocept*) OR (meta-cogniti*) OR ("psychological distance") OR ("posterior cingulate cortex" OR PCC) OR (perspective*) OR (prosocial) OR (self) OR (ownership) OR (theory AND mind))
2. MeSH descriptor: [Diet, Mediterranean]
3. MeSH descriptor: [Diet, Sodium-Restricted]
4. MeSH descriptor: [Caloric Restriction]
5. "Dietary Approaches to Stop Hypertension"
6. (#2 OR #3 OR #4 OR #5)
7. (#6) AND (#1)

A mindfulness-based intervention customized to changing self-regulation for hypertensive participants may alter dietary patterns: a pilot study

Abstract

Title: A mindfulness-based intervention customized to changing self-regulation for hypertensive participants may alter dietary patterns: a pilot study

Author: Carin A. Northuis

Objectives: The primary aim of this study was to investigate whether the Mindfulness-Based Blood Pressure Reduction (MB-BP) intervention influenced blood pressure-relevant dietary patterns, including the Dietary Approaches to Stop Hypertension (DASH) diet and the Mediterranean diet. Secondary aims were to determine if self-regulatory processes, evaluated through the Difficulties in Emotion Regulation Scale (DERS) and the Multidimensional Assessment of Interoceptive Awareness (MAIA), were mechanisms by which MB-BP could alter dietary patterns. A further secondary aim was to investigate if those who were confident or motivated to change dietary patterns, versus those who were not, made more changes to their diet at 10-weeks follow-up. This study served as a pilot for a randomized control trial.

Methods: Data were collected from eligible and consenting participants at baseline and 10 weeks from in-person interviews and at-home questionnaires. Student's paired t-tests were used to assess the effects of the intervention on dietary patterns and self-regulation. Regression analyses evaluated if self-regulation measures were mediators for the change in dietary patterns. Subgroup analyses were performed on motivation and confidence to change diet and among those who had baseline controlled versus uncontrolled blood pressure.

Results: A total of 49 participants consented and enrolled in the study. Mean age was 59.5 (SD: 13.3) years. A majority of the participants were white (95.9%), and 61% were female. Compared to baseline, following completion of the MB-BP intervention, MAIA total scores increased by a mean of 3.90 ($p<0.001$). The mean difference in the DERS total score (-3.19, $p=0.19$) and most component scores, in addition to overall diet scores for either Mediterranean diet (0.53; 95%CI: -0.07, 1.13; $p=0.08$) or DASH diet (0.25; 95%CI: -0.06, 0.56; $p= 0.1$) did not change significantly. Among the components of each diet, sweets, eggs, and legumes dietary components changed significantly at follow-up ($p<0.05$). Those who were motivated and confident to change had no significant changes in their diet while those who were less confident or motivated to change had significant changes in overall DASH diet score and the sweets and egg dietary components ($p<0.05$). In mediation models, evidence suggested the self-processing domain assessed by MAIA, mediated the relationship between MB-BP and several diet outcomes including DASH diet sweets and Mediterranean diet egg components.

Conclusions: Findings suggest that MB-BP may decrease the consumption of sweets, and eggs, and increase the consumption of legumes components. Furthermore, it may be successful in engaging and improving self-regulation among participants, specifically for those who are not very motivated or not very confident to change their diet. This change in self-regulation may be a useful method to improve the dietary intake of hypertensive participants.

Keywords: hypertension, self-regulation, diet, dietary pattern

Background

In 2012, over half (117 million) of the United States adult population had at least one chronic health condition[†], and over a quarter had two or more.[1] By 2020, it is estimated that 157 million adults will have at least one chronic condition.[2] One of the most common chronic diseases in the US and the world is cardiovascular disease. A major risk factor for cardiovascular disease is hypertension, which plagues over one-third of the American population.[7] An important predictor of hypertension and numerous chronic diseases such as cardiovascular disease, diabetes and cancer, is diet.[8]

Two dietary patterns, demonstrated in a recent systematic review and meta-analysis, to exert the largest reductions in blood pressure are the Mediterranean Diet (MedDiet)[9,10] and the Dietary Approaches to Stop Hypertension (DASH).[10,11] Unfortunately, few people are able to make sustained changes to their dietary intake[11,12] and failure to adhere to recommended changes is common among patients with chronic disease. Therefore, chronic disease prevention and management programs must address ways for patients to effectively care for their health conditions.[13] Self-management programs and interventions that improve a person's ability to self-regulate may also improve adherence to treatment and reduce health risk behaviors.[14-26]

The process of self-regulation involves three domains: cognitive processes, emotion regulation, and self-related processing.[27-29] Cognitive processes involve attention control, impulsivity, and metacognitive awareness. Emotion regulation is the ability to manage and respond to emotional experiences, such as through navigating stressful situations, or engaging in coping strategies such as acceptance or nonjudgmentalness of

---

[†] Includes: hypertension, coronary heart disease, stroke, diabetes, cancer, arthritis, hepatitis, weak or failing kidneys, current asthma, or chronic obstructive pulmonary disease

emotional experiences, to alter emotional responses to internal or external cues.[30] With regard to self-related processing, Christoff *et al*. states that self-related processing describes "processing requiring one to evaluate or judge some feature in relation to one's perceptual image or mental concept of oneself", such as self-efficacy, self-compassion, or interoceptive awareness.[31] Through the utilization and regulation of these three domains, self-regulation may be key in initiating and maintaining goal-oriented behaviors. Therefore, a person with strong self-regulation abilities may be able to align those skills with behaviors needed to meet a behavior change and inhibit those that hinder change.[32-35] While many behavioral interventions focus on systems of rewards extrinsic to the person,[36] interventions incorporating self-regulation, like mindfulness based interventions (MBIs), focus on the intrinsic motivation of the person through attention control and inhibition in addition to the emotional and motivational components already provided in the current behavioral interventions.[36-38] By strengthening self-regulation, it is theorized that a person is able to initiate and maintain the desired change in health behavior.

Self-regulatory skills were found in one study to play a role in initiating, adopting, and maintaining changes in eating behavior.[39] By providing patients at risk for chronic disease with the skills necessary to improve their healthy behaviors and reduce their health risk behaviors, patients should be able to change and continue to maintain changes resulting in improved chronic disease prevention and management.[40] Currently, there is limited research regarding interventions that engage self-regulatory skills to change evidence-based diets like low-salt, low-calorie, Mediterranean Diet, or DASH diet. Further, while there is vast research pertaining to interventions related to eating behavior,[41-43] it is unclear which domains of self-regulation are being engaged in the area of dietary intake and behavior change.

Mindfulness-based interventions (MBIs) have been associated with engaging and strengthening the self-regulatory skills necessary to initiate and maintain a behavioral change.[44-47] In several studies directed at those with aberrant eating, a positive association between the intervention and improved symptoms were observed.[41,48,49] Additionally, mindful eating interventions have produced positive results in reducing binge eating, emotional eating, and uncontrolled eating.[41,50,51] While there is a plethora of evidence supporting the association between MBIs and eating behavior, a limited amount of the research has delved into how self-regulation may mediate the change. As well, there are conflicting results regarding dietary intake among MBIs. For example, one study has found mindfulness to engage changes in emotion regulation domain and engage changes in diet[52] while another found no significant changes in either variable.[53] Furthermore, it is not clear which domains of self-regulation should be focused on to enact the most effective dietary change or treatment.

The Mindfulness-Based Blood Pressure Reduction Study (MB-BP) was designed to focus on engagement with self-regulation targets and skills among adults with pre-hypertension and hypertension. MB-BP aimed to build and improve the foundations of mindfulness skills and then direct attention toward the various hypertension risk factors and health effects. As depicted in Figure 1, it is hypothesized that MB-BP promotes self-regulatory processes and that those processes will mediate positive dietary behavior change. The primary aim of the present paper is to investigate whether self-regulatory processes promoted dietary awareness and resulted in dietary patterns at 10-weeks follow-up. Additionally, participants were asked at baseline if they were motivated or confident to change their current diet to adhere with the Dietary Approaches to Stop Hypertension (DASH) diet guidelines.[54] Thus, a second aim is to investigate if those who were confident or motivated to change versus those who were not had made more changes to their diet at 10-weeks follow-up.

Methods

Trial Design

Patients were screened for pre-hypertension and hypertension to be eligible for participation. Data collection occurred at baseline and 10 weeks follow-up. The primary outcome was change in medical regimen adherence (i.e. dietary behavior, etc.) and changes related to self-regulatory skills. The secondary outcome was change in blood pressure or blood pressure reduction.

Participants and Procedures

Participants were recruited in three cycles between September 2015 and September 2016 from Rhode Island and surrounding states. Eligible participants were adults (aged ≥ 18 years) and were pre-hypertensive or hypertensive (systolic blood pressure >120 mmHg and diastolic blood pressure > 80 mmHg at time of screening). Approval from Brown University's Institutional Review Board was obtained for the study. After screening, eligible participants signed informed consent and entered the pilot 8-week Mindfulness-Based Blood Pressure Reduction (MB-BP) Study Clinical Trial, registered on www.clinicaltrials.gov (NCT02702258).

Participants completed at-home and in-person questionnaires for self-reported measures on risk factors, health behaviors, and psychosocial variables. Self-regulation and biometric measures were assessed in-person through validated measures by trained research assistants. The same procedures were used during follow-up assessments at 10 weeks.

Intervention

MB-BP is adapted from, and time matched to, the standardized MBSR program developed by Jon Kabat-Zinn, Saki Santorelli, and colleagues at the University of Massachusetts. MB-BP is designed to systematically meet the unique needs of individuals with prehypertension and hypertension through the incorporation of cardiovascular health education. MB-BP emphasizes formal and informal mindfulness meditation practices as a foundation for the cultivation of positive health behaviors that are associated with healthy and stable blood pressure levels. The MB-BP course is taught over the course of nine weekly two and a half hour sessions (one orientation session, and 8 class sessions), in addition to a 7.5-hour retreat between the sixth and seventh weeks of the program. Participants are instructed to complete 30-60 minutes per day of home mindfulness practice six days a week throughout the course. Upon graduation from MB-BP, participants are invited to participate in 1-hour instructor-led community sessions that are available to graduates twice per month, and can be attended live in-person or accessed via videoconference or phone. Sessions include formal mindfulness practices, a didactic talk, and group sharing between participants on how they are using tools learned in the course applied to their lives. All community session instructor-led meditations and talks are recorded, and posted on a website (mindfulhearthealth.org) where graduates have access to download or stream the recordings. All graduates are invited to future all-day mindfulness retreats, which occur on average three times per year. A qualified MBSR instructor trained at the University of Massachusetts Center for Mindfulness who is also a cardiovascular physiologist and epidemiologist both designed and facilitated the MB-BP program. MB-BP course sessions were held at the Brown University School of Public Health in Providence, Rhode Island.

Outcome Measures

Physiological Measurements

Blood pressure readings were taken at baseline and 10 weeks follow-up. Readings were standardized for all participants and for all time points. Blood pressure was assessed by trained research technicians by use of an Omron automatic blood pressure machine validated for epidemiologic research (model HEM-705-CP, Omron, Kyoto, Japan).[55] Readings were taken with participants seated, arm at heart level, and after participant rested for 5 minutes. Three readings were taken with one minute of rest between each assessment. In accordance to the American Heart Association guidelines, the second and third readings were averaged and used as the participant's blood pressure.[56] Participants' height and weight without shoes were recorded using a standiometer and electronic scale (SECA 813, Hamburg, Germany). Scales were calibrated using calibration weights to ensure accuracy. Body mass index was calculated for each individual as kg/m^2.

Health behaviors

Dietary behavior was assessed using a validated 80-item Food Frequency Questionnaire created by Harvard,[74] which assessed fruit and vegetable intake in addition to other foods commonly consumed in the American diet. Participants answered each food item as never eating, 1-3 times per month, once per week, 2-4 times per week, 5-6 times per week, once per day, 2-3 times per day, 4-5 times per day, or six or more times per day. These responses were computed into servings per day as zero servings/day, 0.08 servings/day, 0.14 servings/day, 0.43 servings/day, 0.8 servings/day, 1 serving/day, 2.5 servings/day, 4.5 servings/day, and 6 servings/day, respectively. Each food item in the food group (i.e. fruits, vegetables, dairy, etc.) were summed into total servings per day for each food group. For example, each individual daily serving for fruits (i.e. apples, oranges, other fruit, etc.) were combined to total fruit servings/day. The total serving/day for each food category was then converted to a Dietary Approaches to Stop Hypertension (DASH) diet score and Mediterranean Diet (MedDiet) score, adopted from the methods described in Folsom *et al*. (2007) for the DASH Diet, and Monteagudo *et al*. (2015) for the MedDiet.[57,58] The selection of the scoring criteria is based on the daily serving recommendations for both diets.

For the DASH diet, each food group was given a score of 0-1 and summed for an overall diet score. Those meeting the recommendations received full points while those not meeting the recommendations received zero points. For participants within one or two serving of the recommendation, partial credit awarded (0.5). If the participant was not within 1 serving size of the recommendation, he or she received a score of zero.

For the MedDiet, the Mediterranean Dietary Serving Score, scores were awarded on a 0-1, 0-2, or 0-3 basis, depending on the Mediterranean Diet Pyramid recommendations.[59] Therefore, more important foods like fruits and vegetables, are given higher points than foods that should be eaten weekly or in moderation like sweets and red meat. Foods were given a score of zero if the serving was lower or exceeded the recommendation size. A partial score credit was given to those who were within one serving size of the recommended amount as to prevent an all-or-nothing scoring approach.

Scores ranged from 0-9 for the DASH diet and 0-24 for the MedDiet. A higher total DASH diet or total MedDiet Score reflected a higher compliance with the given diet type or the given food category.

Self-Regulation

Self-regulation skills were measured using two validated and reliable assessments.[60,61] The first assessment was in the Difficulties in Emotion Regulation Scale (DERS) which assesses components of the emotion-regulation domain through 36-items.[60] The DERS assessment is scored on a five-point Likert scale and totaled into five component scores and an overall score. The components include non-acceptance of emotional responses, difficulties in engaging in goal directed behavior, impulse control of difficulties lack of emotional awareness, limited access to emotion regulation strategies, and lack of emotional clarity.[60] Problems with emotion regulation were associated with higher scores.

The second measurement used was the Multidimensional Assessment of Interoceptive Awareness (MAIA) assessment. This measure contains 32 items that assess components of the self-processing domain.[61] Scoring occurs on a six-point scale with 0 being 'Never' and 5 being 'Always'. The scores are totaled into overall and eight scale scores that represent five different domains of the assessment. The domains and scales include: 1) awareness of body sensations (Noticing); 2) Emotional reaction and attentional response to sensations (Not Distracting and Not Worrying); 3) Capacity to regulate attention (Attention Regulation); 4) Awareness of mind-body integration (Emotional Awareness and Self-Regulation) and 5) Trusting body sensations (Trusting).[61] Higher scores represented better interoceptive awareness.

Clinical Data and Psychosocial Variables

Self-reported personal and familial hypertension history and self-reported demographic data including age, gender, and education level were obtained.

Subgroup Analysis

Three subgroup categories were analyzed: motivation to change diet, confidence to change diet, and blood pressure control. At baseline, participants responded to how confident and how motivated they were to changing their diet on a scale from 1 to 10 with a higher ranking representing more confidence or motivation to change. Those ranking their confidence at a 9 or 10 were considered very confident to change their diet, while those who answered 8 or below were considered less confident. The same scaling system was used for the motivation to change analyses. Uncontrolled hypertension is defined as systolic/diastolic blood pressure ≥140/90 mmHg. Prehypertension/controlled hypertension was defined as those who were not uncontrolled hypertensive, and had systolic blood pressure between 120-140 mmHg or diastolic blood pressure between 80-90 mmHg, per American Heart Association guidelines.[62]

Statistical analysis

Data were analyzed using Rstudio for Macintosh, version 3.3.2.[63] Prior to analysis, the assumptions for linear regression, including normality, were assessed. Changes in diet and self-regulation skills were calculated from baseline to 10 weeks using a Student's paired t test. Due to the small sample size, mediation was assessed via two Student's paired t test (Figure 1: path a and path c') and then linear regression (Figure 1: path b). The mediation analysis allowed for an estimated indirect effect of the mediator on the outcome of dietary behavior change. All participants enrolled in the study were attempted to be followed up for assessments. Of the five participants who began the intervention and dropped out, one agreed to participate in follow-up assessments. Intention-to-treat analyses were performed including this participant.

All continuous data are reported as mean ± standard deviation. All categorical data are reported as counts and percentages. Forty-nine participants enrolled at baseline. For all missing MAIA and DERS variables, mean imputation was performed if less than 20% of the data for the variable was missing.

Results

Participant Flow

A total of 64 participants were screened for the MBBP intervention. A flow diagram is displayed in Figure 2. Of the 64 participants screened, 53 were eligible for the study. Those who were ineligible were excluded due to having blood pressure within normal range (SBP < 120 mmHg and DBP < 80). Two eligible participants did not enroll in the study due to time burden reasons. In addition, two eligible participants enrolled but withdrew during baseline assessments. Demographic information and clinical baseline characteristics were collected for 49 participants and are displayed in Table 1.

Health Behavior Change

MedDiet and DASH diet scores at baseline and 10 weeks follow-up are displayed in Tables 2-4. At baseline, MedDiet scores ranged from 4.0 to 13.0 and DASH diet scores ranged from 1.0 to 6.0. Five participants dropped out of the study, and of these, only one returned the 10 week diet data. Using intention-to-treat analyses for the 44 participants with complete data, 27 participants (61.4%) improved their original MedDiet score, 3 participants (6.8%) did not change, and 14 participants (31.8%) worsened their score at 10 weeks follow-up. Under the DASH diet scoring method, 22 participants (50.0%) improved their original diet score, 10 participants did not change (22.7%), and 12 participants (27.3%) worsened their score from baseline to 10 weeks follow-up. Student's paired t-test showed that overall, diet scores did not change significantly for either MedDiet (0.53 (95%CI: -0.07, 1.13), p=0.08) or DASH diet (0.25 (95%CI: -0.06, 0.56), p= 0.1). Among the components of each diet, the sweets component of the DASH diet (0.13 (95% CI: 0.00, 0.25), p=0.047) and the egg (-0.21 (95% CI: -0.37, 0.04), p=0.02) and legumes (0.16 (95% CI: 0.01, 0.31), p=0.03) components of the MedDiet had significantly changed mean scores from baseline to 10 weeks follow-up.

Three subgroup analyses were performed: (1) prehypertension/controlled hypertension (n=23) versus uncontrolled hypertension (n=21), (2) baseline motivation to change diet (very motivated (n=20) versus less motivated (n=23)), and (3) baseline confidence (very confident (n=17) versus less confident (n=26)). Tables 5-10 display the results of Student's paired t-tests for each subgroup in self-regulation scores and diet scores.

Among those who ranked their confidence to change their diet high with values of 9 or 10 (n=17), there were no significant changes in diet scores (Table 5). For those who were not as confident to change their diet, ranking their confidence at an 8 or lower (n=26), the change in DASH overall score was significant (p=0.045) with a mean difference of 0.38 (95% CI: 0.01, 0.76) points (Table 6). Components of DASH sweets (p=0.03) and MedDiet egg (p=0.008) were also significantly altered following MB-BP, with mean differences of 0.17 (95% CI: 0.02, 0.32) points and -0.31 (95% CI: -0.53, -0.09) points, respectively (Table 6).

For those who ranked their motivation to change their diet very high with scores of 9 or 10 (n=20), no significant changes were found in the overall diet or component scores (Table 7). For those who were less motivated, or ranked their motivation at an 8 or lower (n=23), the DASH overall score changed significantly (p=0.049) with a mean difference of 0.41 (95% CI: 0.00, 0.82) points (Table 8). Component scores of DASH sweets score (p=0.04) and MedDiet egg score (p= 0.008) changed significantly with a mean difference of 0.17 (95%CI: 0.01, 0.34) and -0.35 (95% CI: -0.60, -0.10) points, respectively.

Among those who had controlled blood pressure at baseline, the DASH diet nuts component score (p=0.0497) and the MedDiet legumes component score (p=0.002) changed significantly with a mean difference of 0.15 (95% CI: 0.00, 0.30) points and 0.35 (95% CI: 0.14, 0.56) points, respectively (Table 9). There were no other significant changes in the overall diet scores or components of either diets, including dairy, fruits, vegetables, grains, sweets, and eggs.

Self-Regulation Skills

At 10 weeks, the self-regulation skills changed significantly in the MAIA overall category (p=<0.0001) and several subcategories (noticing, attention, emotion, self-regulation, body, and trust). Results of the mean differences can be seen in Table 11. There was no significant change in the DERS test overall (p=0.211), but there were significant differences in the DERS goals category, with a mean change of -1.33 (p= 0.0096; 95% CI: -2.31, -0.34).

Among the confidence subgroups, those who were confident to change their diet had a significant change in MAIA self-regulation score (0.64 (95%CI: 0.21, 1.06), p=0.006; Table 12), while those who were less confident to change their diet had significant changes in the overall MAIA score and six components of the MAIA score: attention, body, emotion, noticing, self-regulation, and trust (p's<0.01; Table 13).

For those who were very motivated to change their diet (motivation to change score >8; range 0-10), the mean difference for the MAIA overall score and component scores of attention, body, noticing, self-regulation, and trust improved from baseline to 10 weeks follow-up, and were statistically significant (p's<0.05; Table 14). Generally similar findings were found in those who were less motivated to change (p's<0.01; motivation to change score ≤8; range 0-10; Table 15).

The subgroup of prehypertension/controlled hypertension demonstrated significant improvements in the MAIA overall score and MAIA subcomponent scores, specifically for attention, body, emotion, noticing, self-regulation, and trust subcomponent scores (p's<0.05; Table 16). Additionally, the DERS strategy component score was significantly improved in those with controlled hypertension following the MB-BP intervention (-1.22 (95%CI: -2.42, -0.02), p=0.047). For participants with uncontrolled hypertension, there were significant improvements in the MAIA overall score, and MAIA subscores for attention, body, noticing, and self-regulation scores (p's<0.05; Table 17). No significant changes in uncontrolled hypertensive participants were observed in the DERS scores.

Mediation Analysis

Mediation analyses were only performed on variables where the Student's paired t-test demonstrated significant changes for both the proposed mediator (i.e. self-regulation measures) and the outcome (i.e. dietary pattern) in response to MB-BP (Table 18). Regression analysis displayed evidence that the MAIA attention subscore may be a mediator between MB-BP and MedDiet Egg (0.25 (SE: 0.11), p=0.03). However, once controlling for age and gender, the mediation was no longer statistically significant (0.2 (SE:0.12), p=0.07). Therefore, higher changes in self-regulation attention scores were associated with a greater change in egg consumption, but the association was attenuated and no longer significant after controlling for age and gender. The mediation analyses were not statistically significant for MedDiet legumes or DASH diet sweets component.

Among those who were less motivated to change diet, no mediation was found for the overall DASH score and the MAIA variables. For the component of MedDiet egg, mediation among MAIA overall (0.08 (SE: 0.03), p=0.01) and MAIA attention (0.41 (SE: 0.13), p=0.005) were found. After controlling for age and gender, the mediation remained and the effect size did not change (0.07 (SE: 0.03), p=0.04; 0.37 (SE: 0.15), p=0.02). The MAIA variables of self-regulation (-0.19 (SE: 0.07), p=0.02) and trust (-0.27 (SE: 0.10), p=0.01) mediated the change in DASH diet sweets component significantly and remained a significant mediator after controlling for covariates (-0.18 (SE: 0.08) p=0.03; -0.25 (SE: 0.11) p=0.03).

For those who were not confident, the change in the overall DASH score was not mediated by any MAIA measure of self-regulation, but mediation was found among the MedDiet egg component with MAIA attention (0.42 (SE: 0.12), p=0.002) and MAIA overall (0.08 (SE: 0.03), p=0.02) and DASH diet sweet component with MAIA self-regulation (-0.16 (SE: 0.07), p=0.02) and MAIA trust (-0.24 (SE: 0.09), p=0.01). After controlling for age and gender, the attention (0.38 (SE: 0.13), p=0.008) and overall MAIA (0.07 (SE: 0.03), p=0.04) for MedDiet Egg mediation, and the MAIA trust (-0.23 (SE: 0.09), p=0.019) for the DASH sweets mediation remained significant. The mediation by MAIA self-regulation for the change in DASH diet sweets component did not remain statistically significant after controlling for age and gender (-0.15 (SE: 0.07), p=0.055).

No mediation was found to be significant among those who had controlled blood pressure.

Among all mediation analyses, once controlling for covariates, the effect size did not change while the variance (R^2) improved for each model.

It should be noted with the mediation analyses that 82 test for mediation were performed, of which 5 were statistically significant at $p<0.01$. Findings should be interpreted with the consideration that issues of multiple statistical testing would suggest 1 tests would be significant due to chance.

Discussion

Overall, findings in this study showed associations between the MB-BP intervention and a change in participants' diet, specifically within the sweets, egg, and legumes components of the DASH and MedDiet; however, the changes were only a beneficial improvement in the sweets and legumes components. Associations were also found between the MB-BP intervention and changes in self-related processing domain, specifically interoceptive awareness assessed using the MAIA. This domain was found to be a mediator between the intervention and the dietary change in the diet components of eggs and sweets. While not all changes were statistically significant, almost all self-regulation scores improved with the exception of the DERS clarity score. These changes reveal that participants were making more moves towards improving their capacity for interceptive awareness and emotional regulation.

In addition to the change in self-regulation, there were also several significant changes in diet and diet components among participants. Mixed results were found among both diets. Under the MedDiet guidelines, all mean diet scores improved with the exception of eggs, oil, and cereal components, which worsened slightly. Alcohol consumption did not change through 10 weeks follow-up. Among the DASH diet guidelines, all scores improved with the exception of dairy and total grains, which did not change, and whole grains and meat scores, which worsened. Significant changes overall were found in DASH sweets and MedDiet legumes which improved and MedDiet egg consumption which decreased.

While current literature in the area of MBIs and impact on eating behavior is vast, the impact of the interventions on dietary intake and dietary patterns are limited.[41,64] Those that report dietary patterns or behavior analyzed fruits and vegetable intake, caloric intake, or percent fat consumed, rather than the overall DASH diet and MedDiet as in the MB-BP study.[32,52,53,65,66] The impacts on overall diet and dietary components vary from positive effects to no significant associations. [32,52-53,65-67] For example, a study done by Salmoirago-Blotcher *et al*. found improvements in overall diet and reductions in sweet consumption when participants followed a MBSR intervention, which is consistent with the MB-BP study findings.[52] Another study done by Timmerman *et al*., following a mindful eating intervention, found a significant change in reducing caloric and fat intake post-intervention.[67] Both studies report that the MBI is positively associated with better dietary behavior; however only one study[67] measured self-regulatory skills. This study found skills within the self-processing domain, specifically on the self-efficacy for eating behavior scale, improved post-intervention, significantly more than waitlist control group.[67]

Several studies also found no significant changes in dietary intake post-intervention, and therefore, no association between the MBI and dietary behavior.[32,53,67] One such study, by Kearney *et al*., analyzed the emotion regulation domain and dietary behavior.[53] This study found no association between dietary components like fruits and vegetables, total energy, or sugar intake through a MBSR intervention using the FFMQ assessment.[53] There was an association between MBSR and emotional eating, however that did not transfer into dietary changes.[53] Similarly, a study by Lucas *et al*. found no association with a mindfulness-based dietary counseling intervention (Mindfulness in Motion) and dietary intake (grains, fruits/vegetables, dairy, meat, fats/oils, other, and overall), nor were the self-regulation measures of FFMQ or MAAS found to be significantly changed[32] The Kearney *et al*. and the Lucas *et al*. studies both support the findings presented in the MB-BP study regarding the emotion regulation domain.

While the study populations differ with the MB-BP study, similar results reveal post-intervention, improvements in the self-domain may potentially mediate the changes in dietary behavior. Although the emotion domain appears to work well for dietary behaviors as displayed in the Salmoirago-Blotcher *et al*. and several other eating disorder studies,[41,52,68] the emotion regulation domain was not supportive of dietary change in the MB-BP study. Furthermore, our results add to the growing literature on the impact of MBIs on healthy behavior changes and how engaging and improving self-regulatory skills through mindfulness can influence dietary intake and improve dietary outcomes.

Other results from the current study demonstrated differences from current literature particularly related to confidence and motivation to change dietary behavior. Interestingly, it was only participants considering themselves less motivated and less confident to change that showed significant improvements in dietary outcomes, while those ranking themselves as very highly motivated or confident to changed, showed no significant dietary improvements. This is opposite of what was hypothesized. Current literature supports that those who have high motivation tend to have more significant and greater changes in their diet or health outcome compared to those who are not. The same goes for those who have higher self-efficacy at the beginning of an intervention.[69] One possible explanation as to why the opposite occurred within the current study is that those who reported high confidence or motivation scores pre-intervention may have decreased in these areas once the actual intervention began.[70] Similar to findings in the present study, another study found that participants who answered higher at baseline on both motivation to change and self-efficacy were actually associated with a greater decrease in overall motivation and self-efficacy post-intervention.[71] This may be due to unrealistic expectations held at baseline,[71] or possibly regression to the mean. Additionally, those who were less motivated and confident may have experienced enough positive qualities of a healthy diet in which their motivation and confidence to change their diet increased enough to allow maintenance through post-intervention. For example, one study revealed those with lower self-efficacy and motivation to change scores at baseline reached their goals or behavior change better than those who answer in the higher category[72] which may support the idea that those in the higher category are overly confident in their ability to change at baseline. It is also possible that current common behavior change approaches are not working for the subset of the population who had lower motivation or confidence to change, potentially leading to learned helplessness. With MBIs focusing on fairly novel approaches in Western society, enhancing nonjudgmental self-awareness (including of how the body and mind feel during and after consumption of healthy and unhealthy foods), as well as attention control training to be able to place the mind on certain meditation objects even if they are difficult (including food cravings, and how the body and mind feel during and after eating), this approach may have accessed new resources these participants did not formerly have. In this way, while those with greater motivation and confidence to change may have had ceiling effects in that greater improvements were not as possible, those with lower levels of motivation and confidence may have been more able to engage these skills through MB-BP to enact a dietary change. A final potential explanation of these findings is that they were significant simply due to chance. Future replication of these analyses in other studies will confirm or refute the findings.

Limitations

There are several limitations to this pilot study. The primary limitation of this single-arm study is the absence of a randomly assigned control group. In addition, the sample size was relatively small which may point to lack of statistically significant findings due to inadequate statistical power.

Another limitation of the study was the FFQ. Beside the fact that the FFQ was created in 1991 and did not contain many currently popular healthy foods, specifically certain vegetables and grains such as kale, zucchini, quinoa, and oats, FFQs are commonly criticized for their underreporting due to social desirability or recall.[73] Therefore, the future RCT of MB-BP is utilizing a more recently developed FFQ. Other approaches, such as 24-hour recalls may increase accuracy in capturing dietary intake.[73] One limitation that may have impacted the overall change in diet score and specific components is the timing of the intervention. For approximately 20 participants, the 10-weeks follow-up assessment was conducted during the holiday season. This may have resulted in decreases in healthy foods or increases in foods that should be taken in moderation. Additionally, baseline confidence and motivation to change responses should be taken both pre-intervention (baseline) and immediately after the start of the intervention. This change in time may reveal if, in fact, participants are overly confident and motivated at baseline, or if the intervention improve the intrinsic motivation and confidence more readily among those who are less ready to change.

There is also the issue of multiple statistical testing. For the overall study, there were 16 self-regulation variables between the DERS and the MAIA assessments, totaling to 112 hypothesis tests performed between the overall study and the three subgroups for self-regulation change. Additionally, there were 23 diet score variables, totaling to 161 hypothesis tests performed between the overall study and the three subgroups for dietary change. Of these two categories, 34 were significant for self-regulation and 3 were significant for diet at a p<0.01. Therefore, these findings should be interpreted with some caution since by chance one would expect 1 tests would be significant for self-regulation and 2 for diet.

Conclusion

Despite the limitations of the study and the lack of overall change among either diet category, the findings of significant mediation between the self-regulatory skills identified in the MAIA assessment and components of the diets necessitate further investigation into the impact of MBIs on dietary intake.

References

1. Ward BW, Schiller JS, Goodman RA. Multiple chronic conditions among US adults: a 2012 update. Prev Chronic Dis. 2014;11:E62.
2. Bodenheimer T, Chen E, Bennett HD. Confronting the growing burden of chronic disease: Can the U.S. health care workforce do the job? Health Affairs. 2009;28(1):64-74.
3. Hoyert DL, Xu J. Deaths: preliminary data for 2011. Natl Vital Stat Rep. 2012;61(6)1-51.
4. Lochner KA, Cox CS. Prevalence of multiple chronic conditions among medicare beneficiaries, United States, 2010. Prev Chronic Dis. 2010;10:E61.
5. Centers for Medicare and Medicaid Services. Chronic conditions among Medicare beneficiaries, Chartbook 2012 Edition. Baltimore, MD. 2012.
6. Gerteis J, Izrael D. Deitz D, LeRoy L, Ricciardi R, Miller T, Basu J. Multiple chronic conditions chartbook. AHRQ Publications No, Q14-0038. Rockville, MD: Agency for Healthcare Research and Quality. 2014.
7. National Center for Health Statistics. Health, United States, 2015: With special feature on racial and ethnic health disparities. Hyattsville, MD. 2016.
8. Bauer UE, Briss PA, Goodman RA, Bowman BA. Prevention of chronic disease in the 21st century: elimination of the leading preventable causes of premature death and disability in the USA. The Lancet. 2014;384(9937):45-52.
9. Aleman JA, Zafrilla Rentero MP, Montoro-Garcia S, Mulero J, Garrido AP, Leal M, Guerrero L, Ramos E, Ruilope LM. Adherence to the "Mediterranean Diet" in Spain and its relationship with cardiovascular risk (DIMERICA Study). Nutrients 2016;8(11):680.
10. Bhupathiraju SN, Tucker KL. Coronary heart disease prevention: Nutrition, foods, and dietary patterns. Clinica Chimica Acta. 2011;412:1493-1514.
11. Gay HC, Rao SG, Vaccarino V, Ali MK. Effects of different dietary interventions on blood pressure: Systematic review and meta-analysis of randomized controlled trials. Hypertension. 2016;67:733-739.
12. Kwan MW, Wong MC, Wang HH, Liu KQ, Lee CL, Yan BP, Yu CM, Griffiths SM. Compliance with the dietary approaches to stop hypertension (DASH) diet: A systematic review. PLOS One. 2013;8(10):e78412.
13. Bodenheimer T, Lorig K, Holman H, Grumbach K. Patient self-management of chronic disease in primary care. JAMA. 2002;288(19):2469-75.
14. Michie S, Abraham C, Whittington C, McAteer J, Gupta S. Effective techniques in healthy eating and physical activity interventions: a meta-regression. Health Psychol. 2009;28(6):690-701.

15. Chase, J.-A. D. Systematic review of physical activity intervention studies after cardiac rehabilitation. The Journal of Cardiovascular Nursing. 2011;26:351–358.
16. Knittle, K, Maes, S, de Gucht V. Psychological interventions for rheumatoid arthritis: Examining the role of self-regulation with a systematic review and meta-analysis of randomized controlled trials. Arthritis Care & Research. 2010;62: 1460–1472.
17. Huisman, SD, De Gucht V, Dusseldorp E, & Maes S. The effect of weight reduction interventions for persons with type 2 diabetes: A meta-analysis from a self-regulation perspective. The Diabetes Educator. 2011;35:818–835.
18. Wing RR, Tate DF, Gorin AA, Raynor HA, Fava JL. A self-regulation program for maintenance of weight loss. The New England Journal of Medicine. 2006;355: 1563–1571.
19. Sniehotta FF, Scholz U, Schwarzer R, Fuhrmann B, Kiwus U, Voller H. Long-term effects of two psychological interventions on physical exercise and self-regulation following coronary rehabilitation. International Journal of Behavioral Medicine. 2005;12:244–255.
20. Conn VS, Hafdahl AR, Moore SM, Nielsen PJ, Brown, LM. Meta-analysis of interventions to increase physical activity among cardiac subjects. International Journal of Cardiology 2009;133:307–320.
21. Smeulders ESTF, van Haastregt JCM, Ambergen T, Janssen-Boyne JJJ, van Eijk JTM, Kempen, GIJM. The impact of a self-management group programme on health behaviour and healthcare utilization among congestive heart failure patients. European Journal of Heart Failure. 2009;11:609–616.
22. Develasco J, Rodriguez JA, Ridocci F, Aznar J. Action to improve secondary prevention in coronary heart disease patients: One-year follow-up of a shared care programme. European Heart Journal Supplements. 2004;6:27–32.
23. Williams GC, Rodin GC, Ryan RM, Grolnick WS, Deci EL. Autonomous regulation and long-term medication adherence in adult outpatients. Health psychology : official journal of the Division of Health Psychology, American Psychological Association. 1998;17(3):269-76.
24. Tucker CM. Self-Regulation Predictors of Medication Adherence Among Ethnically Different Pediatric Patients With Renal Transplants. Journal of Pediatric Psychology. 2001;26(8):455-64.
25. Horne R, Weinman J. Self-regulation and Self-management in Asthma: Exploring The Role of Illness Perceptions and Treatment Beliefs in Explaining Non-adherence to Preventer Medication. Psychology & Health. 2002;17(1):17-32.
26. Bandura A. Perceived self-efficacy in the exercise of control over AIDS infection. Evaluation and Program Planning. 1990;13(1):9-17.
27. Carver CS, Scheier M. Attention and self-regulation: a control-theory approach to human behavior: Springer-Verlag; 1981. 403- p.
28. Carver CS, Scheier MF. On the Self-Regulation of Behavior: Cambridge University Press; 2001. 460- p.
29. Vohs KD, Baumeister RF. Handbook of Self-Regulation, Second Edition: Research, Theory, and Applications; 2010:592. Epub Second.
30. Gross JJ. The emerging field of emotion regulation: An integrative review. Review of General Psychology. 1998;2:271-99.
31. Christoff, K. *et al*. Specifying the self for cognitive neuroscience. Trends Cogn. Sci. 2011;15:104–122
32. Lucas AR, Focht BC, Cohn DE, Buckworth J, Klatt MD. A mindfulness-based lifestyle intervention for obese, inactive endometrial cancer survivors: A feasibility study. Integrative Cancer Therapies. 2016;p. 1-13.
33. Berger A, Kofman O, Livneh U, Henik A. Multidisciplinary perspectives on attention and the development of self-regulation. Progress in Neurobiology. 2007;82:256-286.
34. Kaunhoven RJ, Dorjee D. How does mindfulness modulate self-regulation in pre-adolescent children? An integrative neurocognitive review. Neuroscience and Biobehavioral Reviews. 2017;74(A):163-184.
35. Posner MI, Rothbart MK, Sheese BE, Tang Y. The anterior cingulate gyrus and the mechanism of self-regulation. Cognitive, Affective, and Behavioral Neuroscience. 2007;7(4):391-395.
36. Deci EL, Ryan RM. Intrinsic Motivation and Self-Determination in Human Behavior: Springer Science & Business Media; 1985. 371- p.

37. Hettema J, Steele J, Miller WR. Motivational interviewing. Annual review of clinical psychology. 2005;1:91-111.
38. Westra HA, Arkowitz H, Dozois DJA. Adding a motivational interviewing pretreatment to cognitive behavioral therapy for generalized anxiety disorder: a preliminary randomized controlled trial. Journal of anxiety disorders. 2009;23(8):1106-17.
39. Crane MM, Ward DS, Lutes LD, Bowling JM, Tate DF. Theoretical and behavioral mediators of a weight loss intervention for men. Ann Behav med. 2016;50:460-470.
40. Janssen V, De Gucht V, van Exel H, Maes S. A self-regulation lifestyle intervention program for post-cardiac rehabilitation patients has long-term effects on exercise adherence. J Behav med. 2014;37:308-321.
41. O'Reilly GA, Cook L, Spruijt-Metz D, Black DS. Mindfulness-based interventions for obesity-related eating behaviors: a literature review. Obesity Reviews. 2014;15(6):453-61.
42. Lara J, Hobbs N, Moynihan PJ, Meyer TD, Adamson AJ, Errington L, Rochester L, Sneihotta FF, White M, Mathers JC. Effectiveness of dietary interventions among adults of retirement age: A systematic review and meta-analysis of randomized controlled trials. BMC Medicine. 2014;12:60.
43. Valdivia Espino JN, Guerrero N, Rhoads N, Simon N, Escaron AL, Meinen A, et al. Community-Based Restaurant Interventions to Promote Healthy Eating: A Systematic Review. Prev Chronic Dis 2015;12:140455
44. Goldin P, Gross J. Effect of mindfulness meditation training on the neural bases of emotion regulation in social anxiety disorder. Emotion. 2010;10:83-91.
45. Chambers R, Gullone E, Allen NB. Mindful emotion regulation: an integrative review. Clin Psychol Rev. 2009;29:560-572.
46. Brown KW, Ryan RM, Creswell JD. Mindfulness: Theoretical foundations and evidence for its salutary effects. Psychological Inquiry. 2007;18(4):211-37.
47. Vago DR. Mapping modalities of self-awareness in mindfulness practice: A potential mechanism for clarifying habits of mind. Ann N Y Acad Sci. 2014;1307:28-42.
48. Kristeller J, Wolever RQ, Sheets V. Mindfulness-based eating awareness training (MB-EAT) for binge eating: A randomized clinical trial. Mindfulness. 2014;5:282-297.
49. Alberts HJEM, Thewissen LR. Dealing with problematic eating behavior: The effects of a mindfulness-based intervention on eating behavior, food cravings, dichotomous thinking and body image concern. Appetite. 2012;58:847-851.
50. Dalen J, Smith BW, Shelley BM, Sloan AL, Leahigh L, Begay D. Pilot study: Mindful eating and living (MEAL): Weight, eating behavior, and psychological outcomes associated with a mindfulness-based intervention for people with obesity. Complementary Therapies in Medicine. 2010;18(6):260-4.
51. Katterman SN, Kleinman BM, Hood MM, Nackers LM, Corisica JA. Mindfulness meditation as an intervention for binge eating, emotional eating, and weight loss: A systematic review. Eating Behaviors. 2014;15:197-204.
52. Salmoirago-Blotcher E, Hunsinger M, Morgan L, Fischer D, Carmody J. Mindfulness-based stress reduction and change in health-related behaviors. Journal of Evidence-Based Complementary and Alternative Medicine. 2013;18:243.
53. Kearney DJ. Milton ML. Malte CA. McDermott KA. Martinez M. Simpson TL. Participation in mindfulness-based stress reduction is not associated with reductions in emotional eating or uncontrolled eating. Nutrition Research. 2012;32:413-420.
54. National Heart, Lung, and Blood Institute. Following the DASH eating plan. NIH: National Heart, Lung, and Blood Institute. 2015.
55. Vera-Cala LM, Orostegui M, Valencia-Angel LI, Lopez N, Bautista LE. Accuracy of the Omron HEM-705 CP for blood pressure measurement in large epidemiologic studies. Arq Bras Cardiol. 2011;96(5):393-8.
56. Pickering TG, Hall JE, Appel LJ, Falkner BE, Graves J, Hill MN, et al. Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. Recommendations for blood pressure measurement in human and experimental animals. Part 1: blood pressure measurement in humans. Hypertension 2005;45:142-61
57. Folsom AR, Parker ED, Harnack LJ. Degree of concordance with DASH Diet guidelines and incidence of hypertension and fatal cardiovascular disease. Am J Hypertens. 2007;20(3):225-232.

58. Monteagudo C, Mariscal-Arcas M, Rivas A, Lorenzo-Tovar ML, Tur JA, Olea-Serrano F. Proposal of a Mediterranean Diet serving score. PLoS One. 2015;10(6):e0128594.
59. Bach-Faig A, Berry EM, Lairon D, Reguant J, Trichopoulou A, Dernini S et al. Mediterranean diet pyramid today. Science and cultural updates. Public Health Nutr. 2011;14:2274–84
60. Gratz KL, Roemer L. Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the Difficulties in Emotion Regulation Scale. Journal of Psychopathology and Behavioral Assessment. 2004;26:41-54.
61. Mehling WE, Wrubel J, Daubenmier JJ, Price CJ, Kerr CE, Silow T, Gopisetty V, Stewart AL. Body Awareness: a phenomenological inquiry into the common ground of mind-body therapies. Philosophy, ethics, and humanities in medicine : PEHM. 2011;6:6.
62. James PA, Oparil S, Carter BL. 2014 Evidence-based guideline for the management of high blood pressure in adults: Report from the panel members appointed to the eighth joint national committee (JNC8). JAMA. 2014;311(5):507-20.
63. RStudio Team (2016). RStudio: Integrated Development for R. RStudio, Inc., Boston, MA.
64. Sopina MB, Bond K, Karkhaneh M, Tjosvold L, Vandermeer B, Liang Y, Bialy L, Hooton N, Buscemi N, Dryden DM, Klassen TP. Meditation practices for health: State of the research. AHRQ Publication. 2007;07-E010.
65. Miller CK, Kristeller JL, Headings A, Nagaraja H. Comparison of a mindful eating intervention to a Diabetes self-management intervention among adults with Type 2 Diabetes: A randomized controlled trial. Health Education and Behavior. 2013;XX(X):1-10.
66. Marchiori D, Papies E. A brief mindfulness intervention reduces unhealthy eating when hungry, but no the portion size effect. Appetite. 2014;75:40-45.
67. Timmerman GM. Brown A. The effect of a Mindful Restaurant Eating intervention on weight management in women. Nutr Educ Behav. 2012;44:22-28.
68. Katterman SN, Kleinman BM, Hood MM, Nackers LM, Corsica JA. Mindfulness meditation as an intervention for binge eating, emotional eating, and weight loss: A systematic review. Eating Behaviors. 2014;15:197-204.
69. Teixeira PJ. Carraca EV, Marques MM, Rutter H, Oppert J, De Bourdeaudhuij I. Lakerveld J. Brug J. Successful behavior change in obesity interventions in adults: A systematic review of self-regulation mediators. BMC Medicine. 2015;13:84.
70. Webber KH, Gabriele JM, Tate DF, Dignan MB. The effect of a motivational intervention on weight loss is moderate by level of baseline controlled motivation. International Journal of Behavioral Nutrition and Physical Activity. 2010;7:4.
71. Teixeira PJ, Silva MN, Mata J, Palmeira AL, Markland D. Motivation, self-determination, and long-term weight control. International Journal of Behavioral Nutrition and Physical Activity. 2012;9:22.
72. Faghri PD, Duffy VB, Benson NR, Cherniack MG. Worksite weight loss intervention for employees in stressful workplace: A pilot study and baseline survey indicators of success. J Obes Weig los Ther. 2012;2:2.
73. Shim J, Oh K, Kim HC. Dietary assessment methods in epidemiologic studies. Epidemiol Health. 2014;36:e2014009.
74. Willett WC, Sampson, L, Stampfer, MJ, Rosner, B., Bain C, Witschi J, Hennekens CH, Speizer, FE. Reproducibility and Validity of a Semiquantitative Food Frequency Questionnaire. Am J. Epidemiol 1985;122: 51-65

Tables and Figures

Figure 1. The effect of the Mindfulness-Base Blood Pressure Reduction (MBBP) intervention trial on dietary pattern with (indirect) and without (direct) the hypothesized mediator.

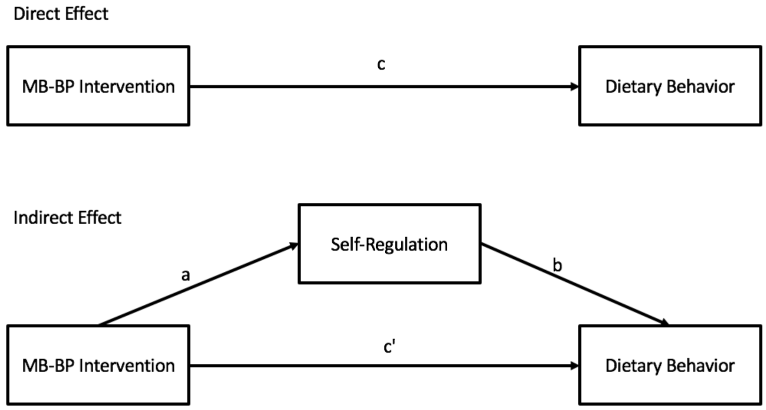


Figure 2. Participant flow for MB-BP intervention

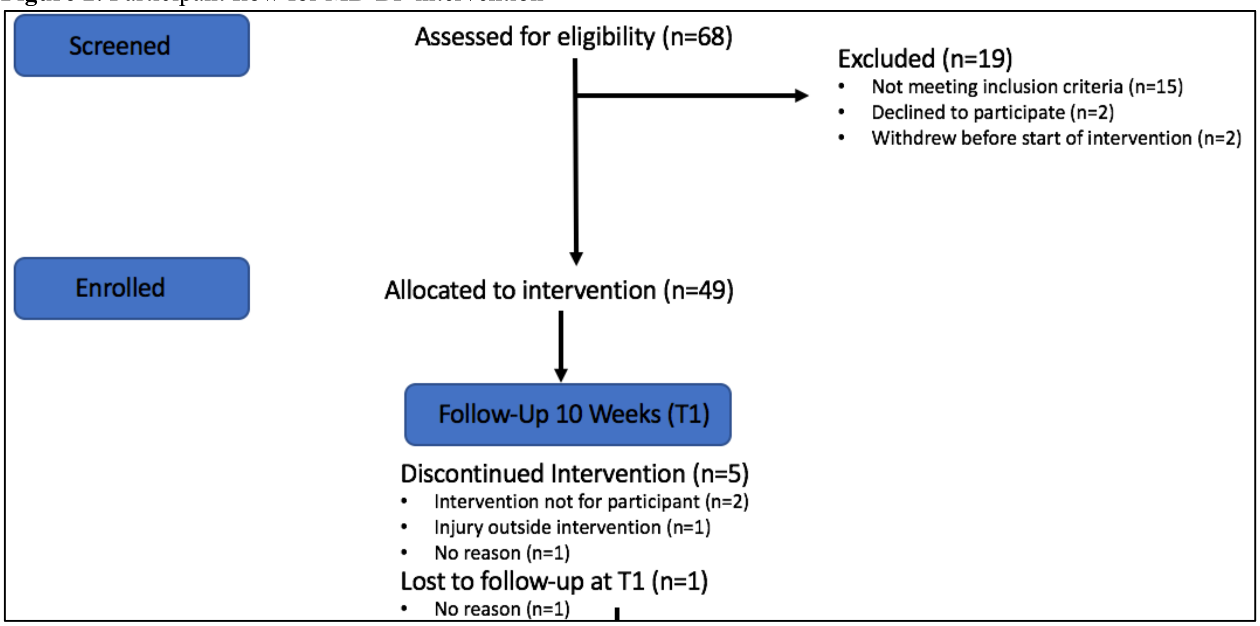


Table 1. Demographic information and clinical characteristics of patients who enrolled in intervention.

	MBBP Intervention (n = 49)[1]
Female, n (%)	30, (61.2%)
Age, m ± sd	59.5 ± 13.3
BMI, m ± sd	28.3 ± 4.6
Race, n (%)	
White	47 (95.9%)
African American	1 (2.0%)
Asian	1 (2.0%)
Education, Highest Degree, n (%)	
High School Degree	4 (8.2%)
Bachelor's Degree	15 (30.6%)
Graduate Degree	30 (61.2%)
Education, Total Years, m ± sd	17.6 ± 2.5
Family History of Hypertension, n (%)	
Yes	28 (57.1%)
No	17 (8.2%)
Unknown	4 (34.7%)
Mean Systolic Blood Pressure, mmHg, m ± sd	140.3 ± 14.3
Diastolic Blood Pressure, m ± sd	81.2 ± 9.2
Taking Prescription/Over-the-Counter Medication, n (%)	41 (83.7%)
Motivated to Change Diet[1], n (%)	
Low Motivation	0 (0.0%)
Some Motivation	12 (25.0%)
High Motivation	36 (75.0%)
Confidence to Change Diet[1], n (%)	
Low Confidence	1 (2.1%)
Some Confidence	17 (35.4%)
High Confidence	30 (62.5%)
DASH Score, m ± sd	3.1 ± 1.1
MedDiet Score, m ± sd	8.5 ± 2.3

[1]Motivation and Confidence Statistic (n=48)
DASH Dietary Approaches to Stop Hypertension
MedDiet Mediterranean Diet

Table 2. Distribution of DASH Diet Component Items at Baseline and 10 Weeks.

DASH Diet Index Item	**Score**	Baseline N	Baseline %	10 Weeks N	10 Weeks %
Total grain intake[‡]					
≥ 7 servings/day	1	0	0	0	0
5-6 servings/day	0.5	0	0	0	0
< 5 servings/day	0	49	100.0	44	100.0
Whole grain intake					
≥ 2 servings/day	1	7	14.3	3	6.8
1 servings/day	0.5	13	26.5	14	31.8
< 1 servings/day	0	29	59.2	27	61.4
Vegetables[§]					
≥ 4 servings/day	1	8	16.3	10	22.7
2-3 servings/day	0.5	24	49.0	23	52.3
< 2 servings/day	0	17	34.7	11	25.0
Fruits[*]					
≥ 4 servings/day	1	4	8.2	4	9.1
2-3 servings/day	0.5	18	36.7	17	38.6
< 2 servings/day	0	27	8.2	23	52.3
Dairy[¶]					
≥ 2 servings/day	1	22	44.9	19	43.2
1 servings/day	0.5	14	28.6	14	31.8
< 1 servings/day	0	13	26.5	11	43.2
Meats, poultry, and fish[#]					
≤ 2 servings/day	1	30	61.2	30	68.2
3 servings/day	0.5	18	36.7	10	22.7
≥ 4 servings/day	0	1	2.0	4	9.1
Nuts, seeds, and dry beans[**]					
≥ 4 servings/week	1	34	69.4	37	84.1
2-3 servings/week	0.5	9	18.4	2	4.5
< 2 servings/week	0	6	12.2	5	11.3
Sweets[$]					
≤ 5 servings/week	1	20	40.8	25	56.8
6-7 servings/week	0.5	6	12.2	2	4.5
≥ 8 servings/week	0	23	46.9	17	38.6
Oils[||]					
≥ 2 servings/day	1	4	8.2	4	9.1
1 servings/day	0.5	14	28.6	14	31.8
< 1 servings/day	0	31	63.3	26	59.1

[‡]Total Grains: cold breakfast cereal, white bread (including pita bread), dark bread (including wheat pita bread), rice, pasta
[§]Vegetables: tomatoes, tomato juice, string beans, broccoli, cabbage, cauliflower, Brussel sprouts, carrots (cooked or raw), corn, peas, lima beans, yams, sweet potatoes, spinach, collard greens, yellow (winter) squash, French fried potatoes, potatoes (baked, boiled, or mashed)
[*]Fruit: fresh apples or pears, oranges, orange juice, grapefruit juice, peaches, apricots, plums, bananas, other fruit (fresh, frozen, or canned)
[¶]Dairy: Skim or low fat milk, whole milk, yogurt, ice cream, cottage or ricotta cheese, other cheese (American, cheddar, etc.)
[#]Meats, poultry, and fish: eggs, chicken or turkey (with or without skin), bacon, hot dogs, processed meats (e.g. sausage, salami, bologna, etc.), liver, hamburger, beef, pork, lamb (as main dish or sandwich), fish
[**]Nuts, seeds, and dry beans: peanut butter, nuts, beans or lentils (baked or dried)
[$]Sweets: Chocolate, candy without chocolate, pie (homemade or ready-made), cake, cookies, carbonated beverage, Hawaiian punch, lemonade, or other fruit drinks
[||]Oil: margarine, butter, oil (any type)

Table 3. Distribution of MedDiet Component Items at Baseline and 10 Weeks.

MedDiet Index Item	**Score**	Baseline		10 Weeks	
		N	%	N	%
Total grain intake‡					
≥ 3 servings/day	3	2	4.1	1	2.3
2-3 servings/day	2	6	12.2	5	11.3
1-2 servings/day	1	16	32.7	15	34.1
< 1 servings/day	0	25	51.0	23	52.3
Vegetables§					
≥ 6 servings/day	3	2	4.1	1	2.3
4-6 servings/day	2	3	6.1	7	15.9
2-4 servings/day	1	23	46.9	21	47.7
< 2 servings/day	0	21	42.9	15	34.1
Legumes‡‡					
≥ 2 servings/week	1	18	36.7	24	54.5
1-2 servings/week	0.5	0	0.0	0	0.0
< 1 servings/week	0	31	63.4	20	45.5
Fruits*					
>6 servings/day	0	0	0.0	0	0.0
3-6 servings/day	3	14	28.6	12	27.3
2-3 servings/day	2	8	16.3	9	20.5
1-2 servings/day	1	13	26.5	19	43.2
< 1 servings/day	0	14	28.6	4	9.1
Dairy¶					
> 3 servings/day	0	10	20.4	3	6.8
2-3 servings/day	1	10	20.4	16	36.4
2 servings/day	2	2	4.1	0	0.0
1-2 servings/day	1	14	28.6	14	31.8
< 1 servings/day	0	13	26.5	11	25.0
Red Meat§§					
< 2 servings/week	1	16	32.7	14	31.8
2-3 servings/week	0.5	7	14.3	10	22.7
≥ 3 servings/week	0	26	53.1	20	45.5
White Meat¶¶					
> 3 servings/week	0	31	63.3	28	63.6
2-3 servings/week	0.5	0	0.0	0	0.0
2 servings/week	1	0	0.0	0	0.0
1-2 servings/week	0.5	9	18.4	10	22.7
< 1 servings/week	0	9	18.4	6	13.6
Fish#					
≥ 2 servings/week	1	20	40.8	17	38.6
1-2 servings/week	0.5	0	0.0	0	0.0
< 1 servings/week	0	29	59.2	27	61.4
Egg^					
> 5 servings/week	0	12	24.5	14	31.8
4-5 servings/week	0.5	0	0.0	0	0.0
2-4 servings/week	1	25	51.0	13	29.5
1-2 servings/week	0.5	0	0.0	0	0.0
< 1 servings/week	0	12	24.5	17	38.6
Potato+					
≤ 3 servings/week	1	29	59.2	27	61.4
3-4 servings/week	0.5	7	14.3	5	11.4
> 4 servings/week	0	13	26.5	12	27.3
Nuts**					
≥ 3 servings/day	0	4	8.2	1	2.3

2-3 servings/day	1	5	10.2	2	4.5
1-2 servings/day	2	16	32.7	21	47.7
<1 servings/day	1	21	42.9	17	38.6
0 servings/day	0	3	6.1	3	6.8
Sweets[$]					
≤ 2 servings/week	1	11	22.4	9	20.5
2-3 servings/week	0.5	5	10.2	6	13.6
> 3 servings/week	0	33	67.3	29	65.9
Oils[‖]					
≥ 3 servings/day	3	1	2.0	0	0.0
2 - 3 servings/day	2	0	0.0	0	0.0
1 -2 servings/day	1	5	10.2	6	13.6
< 1 servings/day	0	43	87.8	38	86.4
Alcohol[##]					
≤ 2 servings/day	1	46	93.9	41	93.2
2-3 servings/day	0.5	3	6.1	2	4.5
> 3 servings/day	0	0	0.0	1	2.3

[‡]Total Grains: cold breakfast cereal, white bread (including pita bread), dark bread (including wheat pita bread), rice, pasta

[§]Vegetables: tomatoes, tomato juice, broccoli, cabbage, cauliflower, Brussel sprouts, carrots (cooked or raw), corn, spinach, collard greens, yellow (winter) squash, lima beans, string beans, peas

[‡‡]Legumes: beans (baked or dried), lentils (baked or dried)

[*]Fruit: fresh apples or pears, oranges, orange juice, grapefruit juice, peaches, apricots, plums, bananas, other fruit (fresh, frozen, or canned)

[¶]Dairy: Skim or low fat milk, whole milk, yogurt, ice cream, cottage or ricotta cheese, other cheese (American, cheddar, etc.)

[§§]Red Meat: bacon, hot dogs, processed meats (e.g. sausage, salami, bologna, etc.), liver, hamburger, beef, pork, lamb (as main dish or sandwich)

[¶¶]White Meat: chicken or turkey (with or without skin)

[#]Fish: Fish

[^]Eggs: Eggs

[**]Nuts: peanut butter, nuts

[+]Potatoes: French fried potatoes, potatoes (baked, boiled, or mashed), yams, sweet potatoes

[$]Sweets: Chocolate, candy without chocolate, pie (homemade or ready-made), cake, cookies, carbonated beverage, Hawaiian punch, lemonade, or other fruit drinks

[‖]Oil: margarine, butter, oil (any type)

[##]Alcohol: Beer, wine, liquor

Table 4. Dietary behavior measures at baseline prior to MB-BP intervention, and 10-weeks follow-up at MB-BP intervention completion

Measure	**Baseline (n = 49)**	**10 Weeks (n = 44)**	**P value**	**Cohen's *d* (95%CI)**
DASH Diet, mean ± SD				
Overall	3.8 ± 1.1	4.1 ± 1.0	0.1	0.24 (-0.19, 0.67)
Dairy	0.6 ± 0.4	0.6 ± 0.4	1.0	0 (-0.43, 0.43)
Fruits	0.3 ± 0.3	0.3 ± 0.3	0.5	0.10 (-0.33, 0.53)
Vegetables	0.3 ± 0.3	0.5 ± 0.3	0.2	0.25 (-0.18, 0.68)
Meat	0.8 ± 0.2	0.8 ± 0.3	0.8	-0.03 (-0.46, 0.40)
Total Grains	0.0 ± 0.0	0.0 ± 0.0	NA	NA
Whole Grains	0.3 ± 0.4	0.2 ± 0.3	0.3	-0.17 (-0.60, 0.26)
Nuts	0.8 ± 0.4	0.9 ± 0.3	0.09	0.26 (-0.17, 0.70)
Oil	0.2 ± 0.3	0.2 ± 0.3	0.8	0.04 (-0.39, 0.46)
Sweets	**0.5 ± 0.5**	**0.3 ± 0.4**	**0.047**	**0.31 (-0.12, 0.74)**
MedDiet, mean ± SD				
Overall	8.5 ± 2.3	9.0 ± 2.3	0.08	0.27 (-0.16, 0.70)
Dairy	0.6 ± 0.6	0.7 ± 0.5	0.2	0.19 (-0.24, 0.62)
Fruits	1.4 ± 1.2	1.7 ± 1.0	0.2	0.18 (-0.25, 0.61)
Vegetables	0.7 ± 0.8	0.9 ± 0.8	0.2	0.19 (-0.24, 0.62)
Legumes	**0.4 ± 0.5**	**0.5 ± 0.5**	**0.03**	**0.33 (-0.10, 0.76)**
Grains	0.7 ± 0.8	0.6 ± 0.8	0.6	-0.09 (-0.52, 0.34)
Potatoes	0.7 ± 0.4	0.7 ± 0.4	0.9	0.03 (-0.40, 0.45)
White Meat	0.1 ± 0.2	0.1 ± 0.2	0.3	0.17 (-0.26, 0.60)
Red Meat	0.4 ± 0.5	0.4 ± 0.4	0.6	0.07 (-0.35, 0.50)
Fish	0.4 ± 0.5	0.4 ± 0.5	0.7	0.06 (-0.37, 0.49)
Eggs	**0.5 ± 0.5**	**0.3 ± 0.5**	**0.02**	**-0.34 (-0.80, 0.06)**
Nuts	1.2 ± 0.7	1.4 ± 0.7	0.1	0.23 (-0.20, 0.23)
Oils	0.2 ± 0.5	0.1 ± 0.3	0.5	-0.09 (-0.52, 0.33)
Sweets	0.3 ± 0.4	0.3 ± 0.4	0.8	0.03 (-0.39, 0.46)
Alcohol	1.0 ± 0.1	1.0 ± 0.1	NA	NA
Statistical tests performed were paired t-tests				

Table 5. Dietary behavior measures at baseline prior to MB-BP intervention, and 10-weeks follow-up at MB-BP intervention completion for the very confident to change subgroup

Measure	**Mean Difference (95% CI)**	**P value**	**Cohen's *d* (95%CI)**
DASH Diet Overall (N=17)			
Overall	0.18 (-0.38, 0.73)	0.5	0.16 (-0.56, 0.89)
Dairy	-0.03 (-0.22, 0.16)	0.8	-0.08 (-0.80, 0.64)
Fruits	0.06 (-0.12, 0.24)	0.5	0.17 (-0.55, 0.89)
Vegetables	0.09 (-0.05, 0.22)	0.2	0.33 (-0.39, 1.06)
Meat	-0.03 (-0.22, 0.16)	0.8	-0.08 (-0.80, 0.64)
Total Grains	0 (NA)	NA	NA (NA)
Whole Grains	0 (-0.20, 0.20)	1	0 (-0.72, 0.72)
Nuts	0.06 (-0.10, 0.21)	0.4	0.20 (-0.53, 0.92)
Oil	0.01 (-0.08, 0.11)	0.8	0.04 (-0.39, 0.46)
Sweets	0.06 (-0.18, 0.30)	0.6	0.13 (-0.59, 0.85)
MedDiet (N=17)			
Overall	0.88 (-0.09, 1.86)	0.07	0.46 (-0.27, 1.19)
Dairy	-0.06 (-0.28, 0.16)	0.6	-0.14 (-0.86, 0.58)
Fruits	0.12 (-0.32, 0.56)	0.6	0.14 (-0.58, 0.86)
Vegetables	0.24 (-0.05, 0.52)	0.1	0.42 (-0.31, 1.15)
Legumes	0.24 (-0.05, 0.52)	0.1	0.42 (-0.31, 1.15)
Grains	-0.12 (-0.59, 0.36)	0.6	-0.13 (-0.85, 0.56)
Potatoes	0.06 (-0.18, 0.30)	0.6	0.13 (-0.59, 0.85)
White Meat	0.03 (-0.03, 0.09)	0.3	0.24 (-0.48, 0.97)
Red Meat	-0.06 (-0.26, 0.14)	0.5	-0.15 (-0.87, 0.57)
Fish	0.18 (-0.26, 0.34)	0.08	0.45 (-0.28, 1.18)
Eggs	0 (-0.26, 0.26)	1	0 (-0.72, 0.72)
Nuts	0.35 (-0.15, 0.86)	0.2	0.4 (-0.37, 1.09)
Oils	-0.03 (-0.17, 0.11)	0.7	-0.11 (-0.83, 0.61)
Sweets	-0.09 (-0.30, 0.12)	0.4	-0.22 (-0.94, 0.50)
Alcohol	0 (NA)	NA	NA (NA)
Statistical tests performed were paired t-tests			

Table 6. Dietary behavior measures at baseline prior to MB-BP intervention, and 10-weeks follow-up at MB-BP intervention completion for the less confident to change subgroup

Measure	**Mean Difference (95% CI)**	**P value**	**Cohen's *d* (95%CI)**
DASH Diet (N=17)			
Overall	**0.38 (0.01, 0.76)**	**0.045**	**0.41 (-0.16, 0.99)**
Dairy	0.04 (-0.04, 0.12)	0.3	0.20 (-0.37, 0.77)
Fruits	0.04 (-0.10, 0.18)	0.6	0.11 (-0.46, 0.68)
Vegetables	0.08 (-0.03, 0.19)	0.2	0.28 (-0.29, 0.85)
Meat	0.04 (-0.09, 0.17)	0.5	0.12 (-0.45, 0.69)
Total Grains	0 (NA)	NA	NA (NA)
Whole Grains	-0.10 (-0.21, 0.02)	0.10	-0.34 (-0.91, 0.23)
Nuts	0.10 (-0.03, 0.22)	0.1	0.30 (-0.27, 0.87)
Oil	0.02 (-0.11, 0.15)	0.8	0.06 (-0.51, 0.63)
Sweets	**0.17 (0.02, 0.32)**	**0.03**	**0.46 (-0.11, 1.04)**
MedDiet (N=17)			
Overall	0.46 (-0.31, 1.23)	0.2	0.24 (-0.33, 0.81)
Dairy	0.19 (-0.01, 0.39)	0.06	0.39 (-0.18, 0.97)
Fruits	0.35 (-0.16, 0.86)	0.2	0.27 (-0.30, 0.84)
Vegetables	0.12 (-0.19, 0.42)	0.4	0.15 (-0.42, 0.72)
Legumes	0.12 (-0.06, 0.29)	0.2	0.27 (-0.30, 0.84)
Grains	-0.04 (-0.33, 0.25)	0.8	-0.05 (-0.62, 0.51)
Potatoes	-0.04 (-0.22, 0.14)	0.7	-0.09 (-0.65, 0.48)
White Meat	0.04 (-0.06, 0.14)	0.4	0.16 (-0.41, 0.73)
Red Meat	0.08 (-0.02, 0.17)	0.1	0.33 (-0.24, 0.90)
Fish	-0.08 (-0.24, 0.08)	0.3	-0.20 (-0.77, 0.37)
Eggs	**-0.31 (-0.53, -0.09)**	**0.008**	**-0.56 (-1.14, 0.02)**
Nuts	0.08 (-0.20, 0.35)	0.6	0.11 (-0.46, 0.68)
Oils	-0.08 (-0.27, 0.12)	0.4	-0.16 (-0.73, 0.41)
Sweets	0.08 (-0.03, 0.19)	0.2	0.28 (-0.29, 0.85)
Alcohol	0 (NA)	NA	NA (NA)
Statistical tests performed were paired t-tests			

Table 7. Dietary behavior measures at baseline prior to MB-BP intervention, and 10-weeks follow-up at MB-BP intervention completion for the very motivated to change subgroup

Measure	Mean Difference (95% CI)	P value	Cohen's *d* (95%CI)
DASH Diet			
Overall	0.18 (-0.31, 0.66)	0.5	0.17 (-0.49, 0.83)
Dairy	-0.05 (-0.20, 0.10)	0.5	-0.16 (-0.81, 0.50)
Fruits	0.05 (-0.12, 0.22)	0.5	0.14 (-0.52, 0.80)
Vegetables	0.13 (-0.001, 0.25)	0.06	0.45 (-0.21, 1.12)
Meat	0 (-0.17, 0.17)	1	0 (-0.66, 0.66)
Total Grains	0 (NA)	NA	NA (NA)
Whole Grains	0 (-0.19, 0.19)	1	0 (-0.66, 0.66)
Nuts	0.08 (-0.06, 0.21)	0.3	0.26 (-0.40, 0.92)
Oil	-0.10 (-0.22, 0.02)	0.1	-0.38 (-1.05, 0.28)
Sweets	0.08 (-0.13, 0.28)	0.5	0.17 (-0.49, 0.83)
MedDiet			
Overall	0.85 (-0.09, 1.79)	0.07	0.42 (-0.24, 1.09)
Dairy	0 (-0.21, 0.21)	1	0 (-0.66, 0.66)
Fruits	0.10 (-0.35, 0.55)	0.6	0.10 (-0.55, 0.76)
Vegetables	0.25 (-0.09, 0.59)	0.1	0.35 (-0.31, 1.01)
Legumes	0.15 (-0.08, 0.38)	0.2	0.31 (-0.35, 0.97)
Grains	0.10 (-0.53, 0.33)	0.6	-0.11 (-0.77, 0.55)
Potatoes	0.05 (-0.15, 0.25)	0.6	0.12 (-0.54, 0.77)
White Meat	0.03 (-0.03, 0.08)	0.3	0.22 (-0.43, 0.88)
Red Meat	0.05 (-0.22, 0.12)	0.5	-0.14 (-0.80, 0.52)
Fish	0.15 (-0.02, 0.32)	0.08	0.41 (-0.25, 1.07)
Eggs	0 (-0.21, 0.21)	1	0 (-0.66, 0.66)
Nuts	0.40 (-0.08, 0.88)	0.10	0.39 (-0.28, 1.05)
Oils	-0.05 (-0.23, 0.13)	0.6	-0.13 (-0.78, 0.53)
Sweets	-0.08 (-0.25, 0.10)	0.4	-0.20 (-0.86, 0.46)
Alcohol	0 (NA)	NA	NA (NA)
Statistical tests performed were paired t-tests			

Table 8. Dietary behavior measures at baseline prior to MB-BP intervention, and 10-weeks follow-up at MB-BP intervention completion for the less motivated to change subgroup

Measure	**Mean Difference (95% CI)**	**P value**	**Cohen's *d* (95%CI)**
DASH (N=23)			
Overall	**0.41 (0.002, 0.82)**	**0.049**	**0.44 (-0.18, 1.05)**
Dairy	0.07 (-0.03, 0.16)	0.2	0.28 (-0.33, 0.90)
Fruits	0.04 (-0.10, 0.19)	0.5	0.13 (-0.48, 0.74)
Vegetables	0.04 (-0.07, 0.15)	0.4	0.17 (-0.44, 0.78)
Meat	0.02 (-0.12, 0.16)	0.7	0.07 (-0.54, 0.68)
Total Grains	0 (NA)	NA	NA (NA)
Whole Grains	-0.11 (-0.22, 0.003)	0.06	-0.42 (-1.03, 0.20)
Nuts	0.09 (-0.05, 0.23)	0.2	0.27 (-0.34, 0.88)
Oil	0.09 (-0.05, 0.23)	0.2	0.27 (-0.34, 0.88)
Sweets	**0.17 (0.01, 0.34)**	**0.04**	**0.45 (-0.17, 1.06)**
MedDiet (N=23)			
Overall	0.43 (-0.35, 1.22)	0.3	0.24 (-0.37, 0.85)
Dairy	0.17 (-0.04, 0.39)	0.1	0.35 (-0.26, 0.97)
Fruits	0.39 (-0.14, 0.92)	0.1	0.32 (-0.29, 0.93)
Vegetables	0.09 (-0.20, 0.38)	0.5	0.13 (-0.48, 0.74)
Legumes	0.17 (-0.04, 0.39)	0.1	0.35 (-0.26, 0.97)
Grains	-0.04 (-0.35, 0.26)	0.8	-0.06 (-0.67, 0.55)
Potatoes	-0.04 (-0.25, 0.16)	0.7	-0.09 (-0.70, 0.52)
White Meat	0.04 (-0.07, 0.15)	0.4	0.17 (-0.44, 0.78)
Red Meat	0.09 (-0.02, 0.19)	0.1	0.35 (-0.26, 0.97)
Fish	-0.09 (-0.27, 0.09)	0.3	-0.21 (-0.82, 0.40)
Eggs	**-0.35 (-0.60, -0.10)**	**0.008**	**-0.61 (-1.23, 0.01)**
Nuts	0 (-0.23, 0.23)	1	0 (-0.61, 0.61)
Oils	-0.04 (-0.29, 0.20)	0.7	-0.08 (-0.69, 0.53)
Sweets	0.09 (-0.04, 0.21)	0.2	0.30 (-0.31, 0.91)
Alcohol	0 (NA)	NA	NA (NA)
Statistical tests performed were paired t-tests			

Table 9. Dietary behavior measures at baseline prior to MB-BP intervention, and 10-weeks follow-up at MB-BP intervention completion for the pre-hypertension/controlled hypertension subgroup

Measure	**Mean Difference (95% CI)**	**P value**	**Cohen's *d* (95%CI)**
DASH (N=23)			
Overall	0.41 (-0.03, 0.86)	0.07	0.40 (-0.21, 1.02)
Dairy	0 (-0.09, 0.09)	1	0 (-0.61, 0.61)
Fruits	0.04 (-0.12, 0.20)	0.6	0.12 (-0.49, 0.73)
Vegetables	0.09 (-0.05, 0.23)	0.2	0.27 (-0.34, 0.88)
Meat	0.02 (-0.12, 0.16)	0.7	0.07 (-0.54, 0.68)
Total Grains	0 (NA)	NA	NA (NA)
Whole Grains	-0.04 (-0.19, 0.10)	0.5	-0.13 (-0.74, 0.48)
Nuts	**0.15 (0.0001, 0.30)**	**0.0497**	**0.43 (-0.18, 1.05)**
Oil	0 (-0.11, 0.11)	1	0 (-0.61, 0.61)
Sweets	0.15 (-0.01, 0.32)	0.07	0.40 (-0.22, 1.01)
MedDiet (N=23)			
Overall	0.61 (-0.27, 1.48)	0.2	0.30 (-0.31, 0.91)
Dairy	0 (-0.13, 0.13)	1	0 (-0.61, 0.61)
Fruits	0.17 (-0.33, 0.68)	0.5	0.15 (-0.46, 0.76)
Vegetables	0.26 (-0.09, 0.61)	0.1	0.32 (-0.29, 0.93)
Legumes	**0.35 (0.14, 0.56)**	**0.002**	**0.71 (0.09, 1.34)**
Grains	-0.04 (-0.38, 0.29)	0.8	-0.06 (-0.66, 0.55)
Potatoes	0.02 (-0.14, 0.19)	0.8	0.06 (-0.55, 0.66)
White Meat	0.02 (-0.06, 0.10)	0.6	0.12 (-0.49, 0.73)
Red Meat	0.04 (-0.12, 0.20)	0.6	0.12 (-0.49, 0.73)
Fish	-0.58 (-0.20, 0.12)	0.6	-0.12 (-0.73, 0.49)
Eggs	-0.17 (-0.42, 0.08)	0.2	-0.31 (-0.91, 0.31)
Nuts	-0.02 (-0.25, 0.21)	0.8	-0.04 (-0.65, 0.57)
Oils	0.04 (-0.16, 0.25)	0.7	0.09 (-0.52, 0.70)
Sweets	0.02 (-0.12, 0.16)	0.7	0.07 (-0.54, 0.68)
Alcohol	0 (NA)	NA	NA (NA)
Statistical tests performed were paired t-tests			

Table 10. Dietary behavior measures at baseline prior to MB-BP intervention, and 10-weeks follow-up at MB-BP intervention completion for the uncontrolled hypertension subgroup

Measure	**Mean Difference (95% CI)**	**P value**	**Cohen's *d* (95%CI)**
DASH (N=21)			
Overall	0.07 (-0.40, 0.54)	0.8	0.07 (-0.57, 0.71)
Dairy	0 (-0.16, 0.16)	1	0 (-0.64, 0.64)
Fruits	0.02 (-0.13, 0.18)	0.7	0.07 (-0.57, 0.71)
Vegetables	0.05 (-0.05, 0.15)	0.3	0.22 (-0.42, 0.86)
Meat	-0.05 (-0.24, 0.14)	0.6	-0.11 (-0.75, 0.53)
Total Grains	0 (NA)	NA	NA (NA)
Whole Grains	-0.07 (-0.22, 0.08)	0.3	-0.22 (-0.86, 0.42)
Nuts	0 (-0.10, 0.10)	1	0 (-0.64, 0.64)
Oil	0.02 (-0.14, 0.19)	0.8	0.06 (-0.57, 0.70)
Sweets	0.10 (-0.10, 0.29)	0.3	0.22 (-0.42, 0.86)
MedDiet (N=21)			
Overall	0.45 (-0.44, 1.35)	0.3	0.23 (-0.41, 0.87)
Dairy	0.19 (-0.08, 0.46)	0.2	0.32 (-0.33, 0.96)
Fruits	0.24 (-0.30, 0.77)	0.4	0.20 (-0.44, 0.84)
Vegetables	0 (-0.25, 0.25)	1	0 (-0.64, 0.64)
Legumes	-0.05 (-0.22, 0.13)	0.6	-0.12 (-0.76, 0.52)
Grains	-0.10 (-0.47, 0.28)	0.6	-0.11 (-0.75, 0.53)
Potatoes	0 (-0.24, 0.24)	1	0 (-0.64, 0.64)
White Meat	0.05 (-0.05, 0.15)	0.3	0.22 (-0.42, 0.86)
Red Meat	0 (-0.10, 0.10)	1	0 (-0.64, 0.64)
Fish	0.10 (-0.10, 0.29)	0.3	0.22 (-0.42, 0.86)
Eggs	-0.24 (-0.48, 0.01)	0.06	-0.44 (-1.09, 0.21)
Nuts	0.40 (-0.05, 0.86)	0.08	0.41 (-0.24, 1.05)
Oils	-0.14 (-0.36, 0.07)	0.2	-0.30 (-0.94, 0.34)
Sweets	0 (-0.16, 0.16)	1	0 (-0.64, 0.64)
Alcohol	0 (NA)	NA	NA (NA)
Statistical tests performed were paired t-tests			

Table 11. Self-regulation measures at baseline prior to MB-BP intervention, and 10-weeks follow-up at MB-BP intervention completion

Measure	Baseline (n = 49)	10 Weeks (n = 44)	P value	Cohen's *d* (95%CI)
MAIA, mean ± SD				
Total*	**21.2 ± 6.3**	**25.3 ± 4.9**	**<0.001**	**0.89 (0.37, 1.41)**
Attention*	**2.4 ± 1.1**	**3.2 ± 0.9**	**<0.001**	**0.87 (0.39, 1.39)**
Body	**2.0 ± 1.2**	**2.7 ± 1.2**	**<0.001**	**0.73 (0.28, 1.17)**
Emotion	**3.1 ± 1.1**	**3.6 ± 0.9**	**<0.001**	**0.55 (0.12, 0.99)**
Noticing	**3.1 ± 1.1**	**3.6 ± 0.9**	**0.001**	**0.53 (0.93, 0.97)**
Not Distracting	2.2 ± 1.0	2.5 ± 0.9	0.1	0.23 (-0.20, 0.66)
Not Worrying	2.8 ± 0.9	3.0 ± 1.0	0.2	0.21 (-0.22, 0.64)
Self-Regulation	**2.5 ± 1.1**	**3.4 ± 0.8**	**<0.001**	**1.20 (0.73, 1.66)**
Trust	**3.0 ± 1.0**	**3.4 ± 0.9**	**0.003**	**0.48 (0.05, 0.92)**
DERS, mean ± SD				
Total	70.2 ± 18.5	67.4 ± 19.7	0.2	-0.2 (-0.63, 0.23)
Awareness	14.6 ± 4.9	13.8 ± 4.6	0.6	-0.08 (-0.51, 0.35)
Clarity	9.4 ± 3.2	9.4 ± 3.0	0.5	0.09 (-0.34, 0.52)
Goals	**12.5 ± 4.1**	**11.6 ± 4.1**	**0.02**	**-0.37 (-0.81, 0.06)**
Impulse	8.9 ± 2.8	8.9 ± 3.2	0.6	-0.09 (-0.52, 0.34)
Non-acceptance	11.2 ± 4.8	10.6 ± 5.1	0.3	-0.16 (-0.59, 0.27)
Strategies	13.6 ± 4.8	13.1 ± 5.2	0.2	-0.20 (-0.63, 0.23)
Statistical tests performed were paired t-tests *N=34				

Table 12. Self-regulation measures at baseline prior to MB-BP intervention, and 10-weeks follow-up at MB-BP intervention completion for the very confident to change subgroup

Measure	Mean Difference (95% CI)	P value	Cohen's *d* (95%CI)
MAIA (N=17)			
Total*	2.18 (-1.12, 5.48)	0.2	0.42 (-0.47, 1.32)
Attention*	0.56 (-0.001, 1.12)	0.05	0.63 (-0.27, 1.54)
Body	0.53 (-0.09, 1.15)	0.09	0.44 (-0.29, 1.17)
Emotion	0.23 (-0.25, 0.70)	0.3	0.24 (-0.48, 0.97)
Noticing	0.46 (-0.08, 1.0)	0.09	0.43 (-0.29, 1.17)
Not Distracting	0.40 (-0.22, 1.02)	0.19	0.33 (-0.39, 1.06)
Not Worrying	0.15 (-0.36, 0.66)	0.5	0.15 (-0.57, 0.87)
Self-Regulation	**0.64 (0.21, 1.06)**	**0.006**	**0.77 (0.02, 1.52)**
Trust	0.30 (-0.14, 0.74)	0.2	0.35 (-0.38, 1.07)
DERS (N=17)			
Total	-4.90 (-11.88, 2.08)	0.2	-0.36 (-1.09, 0.37)
Awareness	-1.72 (-4.16, 0.72)	0.2	-0.36 (-1.09, 0.37)
Clarity	-0.41 (-1.53, 0.71)	0.4	-0.19 (-0.91, 0.53)
Goals	-1.35 (-2.94, 0.23)	0.09	-0.44 (-1.17, 0.29)
Impulse	-0.47 (-1.56, 0.62)	0.4	-0.22 (-0.94, 0.50)
Non-acceptance	0.41 (-2.11, 2.93)	0.7	0.08 (-0.64, 0.80)
Strategies	-1.35 (-3.17, 0.46)	0.1	-0.38 (-1.11, 0.34)
Statistical tests performed were paired t-tests *N=11			

Table 13. Self-regulation measures at baseline prior to MB-BP intervention, and 10-weeks follow-up at MB-BP intervention completion for the less confident to change subgroup

Measure	Mean Difference (95% CI)	P value	Cohen's *d* (95%CI)
MAIA (N=26)			
Total*	**5.04 (3.40, 6.69)**	**<0.0001**	**1.40 (0.68, 2.11)**
Attention*	**0.85 (0.45, 1.25)**	**0.0002**	**0.96 (0.28, 1.64)**
Body	**0.91 (0.55, 1.27)**	**<0.0001**	**1.02 (0.42, 1.63)**
Emotion	**0.59 (0.34, 0.85)**	**<0.0001**	**0.95 (0.35, 1.55)**
Noticing	**0.47 (0.14, 0.81)**	**0.008**	**0.57 (-0.01, 1.15)**
Not Distracting	0.21 (-0.19, 0.61)	0.3	0.21 (-0.36, 0.78)
Not Worrying	0.29 (-0.07, 0.65)	0.1	0.33 (-0.24, 0.90)
Self-Regulation	**1.21 (0.90, 1.52)**	**<0.0001**	**1.56 (0.90, 2.21)**
Trust	**0.50 (0.23, 0.77)**	**0.0009**	**0.74 (0.15, 1.32)**
DERS (N=26)			
Total	-1.43 (-8.48, 5.61)	0.7	-0.08 (-0.65, 0.49)
Awareness	0.67 (-1.30, 2.65)	0.5	0.14 (-0.43, 0.71)
Clarity	0.62 (-0.29, 1.52)	0.2	0.27 (-0.30, 0.85)
Goals	-1.21 (-2.60, 0.18)	0.09	-0.35 (-0.92, 0.22)
Impulse	0.19 (-0.88, 1.26)	0.7	0.07 (-0.50, 0.64)
Non-acceptance	-1.48 (-3.56, 0.60)	0.2	-0.29 (-0.86, 0.28)
Strategies	-0.23 (-1.80, 1.35,)	0.8	-0.06 (-0.63, 0.51)
Statistical tests performed were paired t-tests *N=21			

Table 14. Self-regulation measures at baseline prior to MB-BP intervention, and 10-weeks follow-up at MB-BP intervention completion for the very motivated to change subgroup

Measure	Mean Difference (95% CI)	P value	Cohen's *d* (95%CI)
MAIA (N=20)			
Total*	**3.08 (0.53, 5.63)**	**0.02**	**0.67 (-0.13, 1.47)**
Attention*	**0.67 (0.20, 1.13)**	**0.008**	**0.79 (-0.01, 1.60)**
Body	**0.70 (0.16, 1.24)**	**0.01**	**0.61 (-0.07, 1.28)**
Emotion	0.29 (-0.13, 0.72)	0.2	0.32 (-0.34, 0.98)
Noticing	**0.49 (0.03, 0.95)**	**0.04**	**0.50 (-0.17, 1.16)**
Not Distracting	0.39 (-0.14, 0.91)	0.1	0.35 (-0.32, 1.01)
Not Worrying	0.18 (-0.28, 0.64)	0.4	0.18 (-0.48, 0.84)
Self-Regulation	**0.64 (0.25, 1.03)**	**0.003**	**0.78 (0.09, 1.46)**
Trust	**0.44 (0.04, 0.83)**	**0.03**	**0.52 (-0.15, 1.19)**
DERS (N=20)			
Total	-6.8 (-14.42, 0.79)	0.08	-0.42 (-108, 0.25)
Awareness	-1.71 (-4.08, 0.65)	0.1	-0.34 (-1.00, 0.32)
Clarity	-0.60 (-1.57, 0.37)	0.2	-0.29 (-0.95, 0.37)
Goals	-1.60 (-3.21, 0.01)	0.05	-0.47 (-1.13, 0.20)
Impulse	-0.55 (-1.59, 0.49)	0.3	-0.25 (-0.91, 0.41)
Non-acceptance	-0.80 (-3.42, 1.82)	0.5	-0.14 (-0.80, 0.51)
Strategies	-1.55 (-3.31, 0.21)	0.08	-0.41 (-1.08, 0.25)
Statistical tests performed were paired t-tests *N=14			

Table 15. Self-regulation measures at baseline prior to MB-BP intervention, and 10-weeks follow-up at MB-BP intervention completion for the less motivated to change subgroup

Measure	Mean Difference (95% CI)	P value	Cohen's *d* (95%CI)
MAIA (N=23)			
Total*	**4.77 (2.68, 6.87)**	**0.0002**	**1.13 (0.38, 1.89)**
Attention*	**0.81 (0.34, 1.27)**	**0.002**	**0.87 (0.14, 1.60)**
Body	**0.81 (0.41, 1.22)**	**0.0004**	**0.88 (0.24, 1.52)**
Emotion	**0.58 (0.32, 0.85)**	**0.0002**	**0.94 (0.30, 1.58)**
Noticing	**0.45 (0.07, 0.82)**	**0.02**	**0.52 (-0.10, 1.14)**
Not Distracting	0.20 (-0.26, 0.65)	0.4	0.19 (-0.42, 0.80)
Not Worrying	0.29 (-0.09, 0.67)	0.1	0.33 (-0.28, 0.94)
Self-Regulation	**1.23 (0.96, 1.60)**	**<0.0001**	**1.73 (1.01, 2.45)**
Trust	**0.40 (0.11, 0.70)**	**0.01**	**0.59 (-0.03, 1.21)**
DERS (N=23)			
Total	0.68 (-5.87, 7.24)	0.8	0.05 (-0.56, 0.65)
Awareness	0.98 (-0.99, 2.95)	0.3	0.21 (-0.39, 0.82)
Clarity	0.91 (-0.04, 1.87)	0.06	0.41 (-0.20, 1.03)
Goals	-0.98 (-2.35, 0.39)	0.2	-0.31 (-0.92, 0.30)
Impulse	0.34 (-0.79, 1.48)	0.5	0.13 (-0.48, 0.74)
Non-acceptance	-0.67 (-2.71, 1.37)	0.5	-0.14 (-0.75, 0.47)
Strategies	0.09 (-1.49, 1.67)	0.9	0.03 (-0.58, 0.63)
Statistical tests performed were paired t-tests *N=18			

Table 16. Self-regulation measures at baseline prior to MB-BP intervention, and 10-weeks follow-up at MB-BP intervention completion for the pre-hypertension/controlled hypertension subgroup

Measure	Mean Difference (95% CI)	P value	Cohen's *d* (95%CI)
MAIA (N=23)			
Total*	**4.55 (2.78, 6.32)**	**<0.0001**	**1.28 (0.51, 2.05)**
Attention*	**0.85 (0.52, 1.18)**	**<0.0001**	**1.27 (0.50, 2.04)**
Body	**0.73 (0.35, 1.11)**	**0.0008**	**0.81 (0.18, 1.45)**
Emotion	**0.66 (0.38, 0.94)**	**<0.0001**	**1.03 (0.38, 1.68)**
Noticing	**0.43 (0.03, 0.82)**	**0.04**	**0.47 (-0.15, 1.08)**
Not Distracting	0.08 (-0.43, 0.58)	0.8	0.07 (-0.54, 0.67)
Not Worrying	0.03 (-0.38, 0.44)	0.9	0.03 (-0.57, 0.64)
Self-Regulation	**1.05 (0.74, 1.37)**	**<0.0001**	**1.43 (0.75, 2.12)**
Trust	**0.44 (0.16, 0.72)**	**0.003**	**0.69 (0.06, 1.31)**
DERS (N=23)			
Total	-3.42 (-8.50, 1.66)	0.2	-0.29 (-0.90, 0.32)
Awareness	-0.88 (-2.84, 1.08)	0.4	-0.19 (-0.80, 0.41)
Clarity	0.11 (-0.68, 0.91)	0.8	0.06 (-0.55, 0.67)
Goals	-0.91 (-2.21, 0.38)	0.2	-0.30 (-0.92, 0.31)
Impulse	-0.17 (-1.05, 0.71)	0.7	-0.09 (-0.69, 0.52)
Non-acceptance	-0.35 (-2.17, 1.48)	0.7	-0.08 (-0.69, 0.53)
Strategies	**-1.22 (-2.42, -0.02)**	**0.047**	**-0.44 (-1.05, 0.18)**
Statistical tests performed were paired t-tests *N=18			

Table 17. Self-regulation measures at baseline prior to MB-BP intervention, and 10-weeks follow-up at MB-BP intervention completion for the uncontrolled hypertension subgroup

Measure	Mean Difference (95% CI)	P value	Cohen's *d* (95%CI)
MAIA (N=21)			
Total*	**3.17 (0.41, 5.92)**	**0.03**	**0.61 (-0.15, 1.38)**
Attention*	**0.70 (0.11, 1.29)**	**0.02**	**0.63 (-0.13, 1.40)**
Body	**0.76 (0.23, 1.30)**	**0.007**	**0.65 (-0.004, 1.31)**
Emotion	0.18 (-0.21, 0.56)	0.4	0.21 (-0.43, 0.85)
Noticing	**0.54 (0.12, 0.96)**	**0.01**	**0.58 (-0.07, 1.24)**
Not Distracting	0.44 (-0.01, 0.88)	0.05	0.45 (-0.20, 1.09)
Not Worrying	0.39 (-0.03, 0.80)	0.07	0.42 (-0.22, 1.07)
Self-Regulation	**0.95 (0.52, 1.39)**	**0.0002**	**0.99 (0.32, 1.67)**
Trust	0.31 (-0.11, 0.74)	0.14	0.33 (-0.31, 0.98)
DERS (N=21)			
Total	-2.95 (-12.01, 6.11)	0.5	-0.15 (-0.79, 0.49)
Awareness	0.12 (-2.35, 2.59)	0.9	0.02 (-0.62, 0.66)
Clarity	0.30 (-0.89, 1.50)	0.6	0.12 (-0.52, 0.76)
Goals	-1.54 (-3.16, 0.07)	0.06	-0.43 (-1.08, 0.21)
Impulse	-0.29 (-1.76, 1.18)	0.7	-0.09 (-0.73, 0.55)
Non-acceptance	-1.30 (-3.98, 1.38)	0.3	-0.22 (-0.86, 0.42)
Strategies	-0.23 (-2.32, 1.86)	0.8	-0.05 (-0.69, 0.59)

Statistical tests performed were paired t-tests
*N=16

Table 18. Single Mediation Analysis between change in self-regulation on change in dietary pattern

Model	Coefficient	95% CI	R^2	P Value
Outcome: Change in DASH Diet Sweets Component				
Total MAIA	-0.002	-0.03, 0.03	0.0003	0.9
MAIA: Attention	-0.01	-0.17, 0.15	0.0006	0.9
MAIA: Body	-0.06	-0.19, 0.06	0.03	0.3
MAIA: Emotion	-0.09	-0.25, 0.07	0.03	0.3
MAIA: Noticing	0.02	-0.12, 0.16	0.001	0.8
MAIA: Self-Regulation	-0.09	-0.22, 0.04	0.04	0.2
MAIA: Trust	-0.02	-0.17, 0.14	0.001	0.8
DERS: Goals	0.02	-0.02, 0.06	0.02	0.4
Outcome: Change in MedDiet Legumes Component				
Total MAIA	0.02	-0.02, 0.05	0.02	0.4
MAIA: Attention	0.08	-0.11, 0.27	0.02	0.4
MAIA: Body	-0.06	-0.21, 0.08	0.02	0.4
MAIA: Emotion	0.09	-0.11, 0.28	0.02	0.4
MAIA: Noticing	0.05	-0.11, 0.21	0.009	0.5
MAIA: Self-Regulation	-0.03	-0.19, 0.12	0.004	0.7
MAIA: Trust	0.03	-0.15, 0.21	0.003	0.7
DERS: Goals	0.04	-0.01, 0.08	0.06	0.1
Outcome: Change in MedDiet Egg Component				
Total MAIA	0.03	-0.01, 0.08	0.06	0.2
MAIA: Attention	**0.2**	**0.02, 0.48**	**0.1**	**0.03**
MAIA: Body	0.05	-0.11, 0.22	0.01	0.5
MAIA: Emotion	0.08	-0.14, 0.31	0.01	0.4
MAIA: Noticing	0.1	-0.06, 0.31	0.04	0.2
MAIA: Self-Regulation	-0.01	-0.19, 0.17	0.0003	0.9
MAIA: Trust	0.02	-0.19, 0.23	0.001	0.8
DERS: Goals	-0.04	-0.09, 0.02	0.04	0.2
Outcome (Subgroup: Less Confident): Change in DASH Diet Overall				
Total MAIA	0.01	-0.12, 0.13	0.001	0.9
MAIA: Attention	0.2	-0.31, 0.71	0.03	0.4
MAIA: Body	0.2	-0.24, 0.63	0.03	0.4
MAIA: Emotion	-0.3	-0.87, 0.36	0.03	0.4
MAIA: Noticing	0.2	-0.28, 0.65	0.03	0.4
MAIA: Self-Regulation	-0.002	-0.40, 0.39	<0.0001	1.0
MAIA: Trust	-0.3	-0.78, 0.23	0.05	0.3
Outcome (Subgroup: Less Confident): Change in DASH Diet Sweet Component				
Total MAIA	-0.02	-0.07, 0.02	0.06	0.3
MAIA: Attention	-0.07	-0.26, 0.12	0.03	0.5
MAIA: Body	-0.09	-0.26, 0.08	0.05	0.3
MAIA: Emotion	-0.2	-0.46, 0.006	0.1	0.06
MAIA: Noticing	0.004	-0.18, 0.19	<0.0001	1.0
MAIA: Self-Regulation	**-0.2**	**-0.31, -0.02**	**0.2**	**0.02**
MAIA: Trust	**-0.2**	**-0.42, -0.05**	**0.2**	**0.01**
Outcome (Subgroup: Less Confident): Change in MedDiet Egg Component				
Total MAIA	**0.08**	**0.02, 0.15**	**0.3**	**0.02**
MAIA: Attention	**0.4**	**0.17, 0.66**	**0.4**	**0.002**
MAIA: Body	0.1	-0.10, 0.40	0.06	0.2
MAIA: Emotion	0.3	-0.01, 0.67	0.1	0.06
MAIA: Noticing	0.2	-0.06, 0.46	0.09	0.1
MAIA: Self-Regulation	0.1	-0.09, 0.36	0.06	0.2
MAIA: Trust	-0.03	-0.34, 0.28	0.002	0.8
Outcome (Subgroup: Less Motivated): Change in DASH Diet Overall				

MAIA Total	-0.01	-0.13, 0.12	0.001	0.9
MAIA: Attention	0.2	-0.35, 0.74	0.03	0.5
MAIA: Body	0.1	-0.32, 0.60	0.02	0.5
MAIA: Emotion	-0.3	-1.02, 0.34	0.05	0.3
MAIA: Noticing	0.3	-0.20, 0.76	0.06	0.2
MAIA: Self-Regulation	-0.08	-0.51, 0.35	0.01	0.7
MAIA: Trust	-0.4	-0.93, 0.17	0.09	0.2
Outcome (Subgroup: Less Motivated): Change in DASH Diet Sweets Component				
MAIA Total	-0.02	-0.07, 0.03	0.05	0.4
MAIA: Attention	-0.09	-0.30, 0.13	0.04	0.4
MAIA: Body	-0.08	-0.27, 0.10	0.04	0.4
MAIA: Emotion	-0.2	-0.51, 0.01	0.2	0.06
MAIA: Noticing	-0.01	-0.22, 0.19	0.001	0.9
MAIA: Self-Regulation	**-0.2**	**-0.34, -0.03**	**0.2**	**0.02**
MAIA: Trust	**-0.3**	**-0.47, -0.06**	**0.3**	**0.01**
Outcome (Subgroup: Less Motivated): Change in MedDiet Egg Component				
MAIA Total	**0.08**	**0.02, 0.15**	**0.3**	**0.01**
MAIA: Attention	**0.4**	**0.14, 0.68**	**0.4**	**0.005**
MAIA: Body	0.1	-0.14, 0.40	0.05	0.3
MAIA: Emotion	0.4	-0.03, 0.74	0.1	0.07
MAIA: Noticing	0.2	-0.03, 0.53	0.1	0.08
MAIA: Self-Regulation	0.1	-0.12, 0.38	0.05	0.3
MAIA: Trust	-0.08	-0.43, 0.26	0.01	0.6
Outcome (Subgroup: Controlled Blood Pressure): Change in DASH Diet Nuts Component				
MAIA Total	-0.02	-0.08, 0.04	0.04	0.5
MAIA: Attention	-0.02	-0.33, 0.28	0.002	0.9
MAIA: Body	-0.03	-0.21, 0.15	0.001	0.7
MAIA: Emotion	0.01	-0.24, 0.26	0.0003	0.9
MAIA: Noticing	0.01	-0.16, 0.19	0.001	0.9
MAIA: Self-Regulation	0.02	-0.20, 0.23	0.001	0.9
MAIA: Trust	-0.08	-0.33, 0.17	0.02	0.5
DERS: Strategies	-0.01	-0.07, 0.04	0.01	0.6
Outcome (Subgroup: Controlled Blood Pressure): Change in MedDiet Legumes Component				
MAIA Total	0.02	-0.06, 0.09	0.01	0.6
MAIA: Attention	0.2	-0.18, 0.56	0.07	0.3
MAIA: Body	-0.2	-0.43, 0.03	0.1	0.09
MAIA: Emotion	-0.01	-0.36, 0.33	0.0003	0.9
MAIA: Noticing	0.1	-0.10, 0.37	0.06	0.3
MAIA: Self-Regulation	0.03	-0.27, 0.33	0.002	0.9
MAIA: Trust	0.09	-0.25, 0.44	0.02	0.6
DERS: Strategies	0.03	-0.04, 0.11	0.04	0.4