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Comparative Effectiveness of a Mindful Eating Intervention to a Diabetes Self-Management Intervention among Adults with Type 2 Diabetes: A Pilot Study

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Abstract

Mindful eating offers promise as an effective approach for weight management and glycemic control in people with diabetes. Diabetes self-management education (DSME) is an essential component of effective self-care. Yet, little research has compared the effect of mindful eating to DSME-based treatment. This study compared the impact of these two interventions in adults with type 2 diabetes mellitus (T2DM). A prospective randomized controlled trial with two parallel interventions was employed. Participants included adults aged 35–65 with T2DM for ≥ 1 year, body mass index (BMI) ≥ 27.0, and A1c ≥ 7.0% who were randomly assigned to a 3-month mindful eating (MB-EAT-D; n=27) or Smart Choices (SC) DSME-based (n=25) intervention. Follow-up occurred 3-months following intervention completion. Dietary intake, physical activity, weight, glycemia, and fasting insulin were assessed using repeated measures ANOVA with contrast analysis. There was no significant difference between groups in the change in weight or glycemia at study end. Significant difference occurred between groups in the change in dietary intake/1000 kcal of trans fats, total fiber, and sugars (all $P<0.05$). Mean (±SE) reduction in weight (−2.92 ± 0.54 kg for SC vs. −1.53 ± 0.54 kg for MB-EAT-D) and A1c (−0.67 ± 0.24% for SC and −0.83 ± 0.24% for MB-EAT-D) were significant ($P<0.01$). Significant reduction in energy intake and glycemic load occurred (all $P<0.0001$) for both groups. Training in mindful eating and diabetes self-management facilitate improvement in dietary intake, modest weight loss, and

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glycemic control. The availability of effective treatments allows diabetes patients choices in meeting their self-care needs.

Keywords

type 2 diabetes mellitus; meditation; patient education; randomized controlled trial

Current projections indicate the number of people with diabetes will more than double from 2005 to 2050.[1] Findings from the National Health and Nutrition Examination Survey 1999–2002 showed only 42.3% of adults had hemoglobin A_{1c} (A1c) values < 7.0%, a reasonable goal established by the American Diabetes Association; furthermore, only 55% of those with diabetes reported receiving diabetes education.[2] Diabetes self-management education (DSME) is an essential component of care for all people with diabetes and is necessary to improve patient outcomes and dietary quality.[3] DSME is the process of facilitating the knowledge, skills and ability necessary for diabetes self-care.[4] Previous systematic reviews found DSME improved dietary intake and glycemic control, and medical nutrition therapy (MNT) had the largest impact on weight loss.[5–6] However, prior research found "one size fits all" interventions may limit outcome improvements,[7] and there is no one "best" educational approach.[8–9] Thus, DSME is necessary and effective in improving diabetes outcomes but various approaches are likely needed to meet diverse patient needs.

Growing evidence suggests intervention techniques that enhance mindful self-awareness improve well-being, including anxiety and depression,[10] eating disorders,[11–12] food cravings,[13] and weight loss.[14] Mindfulness-based interventions employ systematic procedures for developing greater awareness of moment-to-moment experience of physical sensations, affective states, and thoughts without judgment.[15] Mindful eating, as taught in Mindfulness-Based Eating Awareness Training (MB-EAT),[16] includes making conscious food choices, developing awareness of physical vs. psychological hunger and satiety cues, and eating healthfully in response to those cues.

Psychological distress also is associated with impaired glycemic control in people with type 2 diabetes mellitus (T2DM).[17–18] Mindfulness-based interventions have been shown to improve A1c in people with diabetes[19] and reduce episodes of binge eating in obese individuals.[12,20] While mindfulness interventions offer promise as an effective approach for diabetes management, little research has compared the efficacy of DSME to a mindfulness-based approach in adults with T2DM. Therefore, the purpose of this study was to evaluate the impact of a DSME intervention compared to the MB-EAT program adapted for adults with T2DM. It was hypothesized the mindful eating intervention would facilitate greater weight loss than the DSME approach.

METHODS

Research Design

A prospective randomized controlled trial with two parallel interventions was employed. Participants were randomly assigned to treatment group, stratified by race. Randomization by computer occurred after the collection of baseline data. Following randomization, participants proceeded through a 3-month intervention followed by a second round of data collection. Follow-up assessments occurred for both treatment groups one and three months following the second data collection period.

Subjects

Eligibility criteria for study participation included being 35–65 years old with diagnosed T2DM for at least one year, body mass index (BMI) ≥ 27.0, A1c ≥ 7.0%, and not requiring insulin therapy for glucose management. Individuals concurrently participating in a structured weight loss program or women who were pregnant or lactating were ineligible. Participants were recruited through local medical practices, the university newswire, radio and electronic advertisements, and community flyers. All procedures were followed in accordance with the ethical standards of the Institutional Review Board at Ohio State University; participants provided written, informed consent.

Measures

Anthropometric, metabolic, dietary, and physical activity measures were obtained at each assessment. Height was measured using a wall-mounted stadiometer (Seca, Hanover, Maryland). Weight was determined using an electronic scale (Tanita Corporation, Tokyo, Japan) with participants wearing light clothing and no shoes. BMI, which measures weight adjusted for height, was calculated. Waist circumference measurements were obtained following standardized procedures in the National Health and Nutrition Examination Survey.[21]

An overnight 12 hour fasting blood sample was drawn by venipuncture. Glucose was measured by standard enzymatic procedures (coefficient of variation of 2.0%), A1c was assessed by high performance liquid chromatography (coefficient of variation of 2.58%), and serum insulin was determined by immunoassay (coefficient of variation 5.9–8.0%) (Ohio State University Medical Center, Columbus, OH). Participants were asked to record the type, dose and frequency of prescribed medications by means of an interview at the assessment visits to assess possible changes in glycemia due to medication changes.

The valid 110-item Block 2005 Food Frequency Questionnaire (NutritionQuest, Berkeley, CA) was self-administered to assess usual intake in the previous year.[22,23] Participants received a food portion visual to assist with estimating portions; nine response options regarding frequency were included. Nutrient intakes were quantified per 1000 kcal to control for energy intake.

Change in physical activity was assessed using the Modifiable Physical Activity Questionnaire. This questionnaire assesses leisure-time physical activities performed during the past week and was previously shown to be reliable and associated with activity and physical fitness measures.[24] Activity levels are calculated as the product of the duration and frequency of each activity weighted by an estimate of the metabolic equivalent (MET) of that activity[25] and summed for all activities performed as MET hours per week.

Diabetes Interventions

Individuals in both treatment groups participated in a group-based, 3-month intervention. Each intervention included 8 weekly and 2 biweekly 2 ½ hour sessions led by facilitators trained in the intervention protocol. If participants missed a group session, they were encouraged to attend a make-up session. One- and 3-month follow-up sessions also were provided to facilitate maintenance of change. Intervention facilitators followed a manualized protocol for each session.

The MB-EAT for Diabetes (MB-EAT-D) intervention is a variation of the intervention developed for binge eating disorder and obesity.[16] The intervention incorporated training in mindful meditation, eating, and practice of physical activity and body awareness. Participants were encouraged to cultivate “inner wisdom” (i.e., mindful awareness related to

eating) and “outer wisdom” (i.e., personal knowledge of food/diabetes needs). A primary component of the intervention was mindful meditation and its application to eating. Every session included guided meditations oriented toward the experiences and emotions associated with food intake. Other elements included cultivating awareness of the distinction between physical and emotional hunger cues, social pressures to eat, and preferences regarding food choices. Each participant received two CD-ROMs for home use to guide their meditation practice. Participants were encouraged to meditate with a CD-ROM 6 days/week and to practice mini-meditations before meals (i.e., awareness of breath, hunger and/or social pressures). MB-EAT-D also included basic information regarding MNT, including the relationship among energy, carbohydrate and fat intake, weight regulation, and glycemia. Participants were encouraged to engage in physical activity and mindful movement; however, no specific diet or activity goals were provided.

The Smart Choices (SC) intervention is a group DSME-based intervention. The self-management content addressed topics such as factors influencing the development of T2DM and glycemic control, common diabetes complications, incorporating physical activity, self-monitoring glucose, and sick day management, which are topics frequently incorporated into DSME programs.[26] However, SC emphasized MNT more heavily than other DSME programs, since MNT was addressed during every session. In-depth information regarding recommended energy, carbohydrate and fat intakes and factors influencing weight and glycemia was provided. Estimated total energy needs were calculated by multiplying resting energy expenditure by an activity factor.[27] The participant’s individual dietary goals represented calories to promote weight maintenance and weight loss with a 500 kcal/day deficit from the weight maintenance level for weight loss. Participants received carbohydrate (~50% energy) and total fat (< 30% energy) goals. The MNT addressed portion control, carbohydrate counting, guidelines for choosing low fat/saturated fat foods, dining out guidelines, and the glycemic index. One session on physical activity was included,[28] and several sessions included a 15–20 minute walk. The study design intentionally de-emphasized changes in physical activity to better match MB-EAT-D so that diet effects on study outcomes would not be overshadowed by changes in physical activity. Participants established self-set diet and/or activity goals at the end of each session. Progress in meeting goals were reviewed at the next group session and problem solving regarding barriers to goal attainment were discussed. No information regarding mindful eating or meditation was presented during the SC group sessions.

The 90-minute 1- and 3-month follow-up sessions reviewed the key principles in each intervention, assessed participant progress in their change efforts, and addressed barriers to change. The MB-EAT-D intervention included meditation practice while the SC intervention included time for walking during these sessions.

Statistical Methods

The Fisher exact text or two-sample t test compared between-group differences in participant characteristics at baseline. Repeated measures ANOVA compared change in outcomes across time. The time-by-group interaction effect assessed group differences in outcome changes. Contrast analysis was used to evaluate between group differences in outcome measures; corrections for multiple comparisons were made. Change in outcomes from baseline to immediate post-intervention and the change from baseline to the 3-month follow-up assessment are presented. Change in outcomes from baseline to the 1-month follow-up assessment is not presented since the results are similar to the 3-month follow-up results. Participants with at least two observed measures were included in the analyses. There were few missing values (≤9%) and the statistical mixed effect models and the associated REML (restricted maximum likelihood) analysis did not use imputed data. Power analysis for the primary outcome weight change (power = 0.80; 2-tailed α=0.05) based on a

previous MNT intervention for T2DM indicated 29 people per treatment group were needed to detect a 2.7 kg difference between groups.[29] All analyses were completed using the SAS statistical software package JMP version 9.0 (SAS Institute Inc., Cary, NC).

RESULTS

A total of 450 people inquired about the study. Forty-four did not respond to repeated contact and 406 were assessed for eligibility. Of those, 245 did not meet inclusion criteria and 93 declined to participate. Thirty-two participants were randomized to MB-EAT-D; 27 received the allocated intervention and completed data collection. Thirty six people were randomized to SC; 25 received the allocated intervention and completed data collection. There was no significant difference in rates of attrition between treatment groups (P>0.05). There were no differences in demographic characteristics, BMI, or A1c between those who did and did not complete the study. On average, participants attended 7.0 and 6.5 of the 10 group sessions for MB-EAT-D and SC, respectively.

Table 1 reports the characteristics of participants in each treatment group. Randomization resulted in balanced groups at baseline (Tables 2 and 3). There was no significant difference between groups with regard to the change in weight, BMI, waist circumference, fasting glucose, A1c, or insulin at study end (Table 2). Mean (±SE) reduction in weight for the SC group (−2.92 ± 0.54 kg) was greater than the MB-EAT-D group (−1.53 ± 0.54 kg) at 3-month follow-up but this was not statistically significant (P=0.07). Changes in weight and BMI from baseline to post-intervention and from baseline to study end were significant in both groups (all P<0.01). Both the SC and MB-EAT-D groups experienced a significant decline from baseline to study end in mean (±SE) A1c values (−0.67 ± 0.24% vs. −0.83 ± 0.24%, respectively; P<0.01 for both groups). There was a significant decrease in fasting insulin for the SC group immediately following the intervention (P<0.01).

There was a significant difference between treatment groups in the change in intake of trans fats, total fiber and total sugars (all P<0.05) at study end (Table 3). There was a significant reduction in energy intake, glycemic index and glycemic load for the SC group immediately following the intervention and at study end (all P<0.0125). MB-EAT-D participants reported a significant decrease in energy intake immediately following the intervention and at 3-month follow-up and a significant decrease in glycemic load at study end (all P<0.01).

Physical activity and prescribed medications were similar between groups throughout the study and did not change significantly.

DISCUSSION

An urgent need exists for comparative-effectiveness research to evaluate novel interventions.[30,31] This single-center randomized controlled trial is one of the first trials reported to compare the effect of group training in mindful eating to group self-management education in adults with T2DM. Outcomes comparing weight and glycemia were comparable between the two interventions and indicate modest reductions in body weight and A1c.

A meta-analysis evaluating the effect of nutrition counseling on weight loss found a change of −0.1 BMI unit per month during 3–12 months of treatment.[32] Another meta-analysis reported a loss of 1.7 kg following a lifestyle intervention in adults with T2DM compared to usual care.[33] Both analyses found less weight loss among people with T2DM than among those without diabetes. Weight loss among participants in the SC group in the present study was greater than those observed in these prior reports. The Look AHEAD trial also investigated the impact of an intensive lifestyle intervention in adults with T2DM. In Look

AHEAD, participants in the intensive intervention lost 8.71 kg after 1-year of treatment.[34] The Look AHEAD intervention included a longer time period (12 months) than the current study (3 months), provided participants with meal replacements free of charge, and emphasized physical activity. Food was not provided to participants in the current study. Instead, participants purchased and prepared their own food and were encouraged to modify intake based on awareness of hunger and satiety cues in MB-EAT-D or self-selected goals in SC. Both mindful awareness of hunger and goal setting strategies were effective in helping participants reduce energy intake and lose weight.

Studies regarding the effect of changes in diet and/or physical activity on weight control found interventions that targeted both diet and physical activity rather than only one of these behaviors promoted a 2–3 kg greater weight change.[32,35,36] Increasing physical activity was not the primary focus of either the MB-EAT-D or SC interventions. MB-EAT-D focused primarily on eating regulation; body awareness and physical activity were discussed but MB-EAT-D did not emphasize activity at a level of intensity to promote weight loss. Therefore, SC also did not place as much emphasis on physical activity as dietary change to enable a comparable evaluation of dietary change across intervention conditions and only one session in each intervention focused on physical activity. No significant increase in physical activity occurred in this study. Prior studies found greater weight loss when changes in both diet and physical activity were promoted.[35,37] Thus, greater weight loss would likely be observed following the current interventions with more emphasis directed toward physical activity; future research should evaluate the magnitude of weight loss with this added emphasis.

Significant reduction in energy intake occurred for both groups following the interventions. In addition, significant improvement in intake of trans fats, fiber and glycemic load occurred. SC included five sessions on dietary fats, carbohydrates and glycemic index combined and considerable time was spent on strategies and skill-building for improving intakes. MB-EAT-D provided less detailed information on MNT due to the time spent in meditation practice during group sessions. Thus, the dietary changes observed are consistent with the focus of each intervention.

Participants in the current study had significant improvement in A1c, and the improvement in glycemia was similar to that observed previously. Look AHEAD participants in the intensive intervention had a mean reduction in A1c of −0.643% at 1-year.[34] A 6-week group-based intervention, which included diabetes education, cognitive behavioral approaches, goal-setting, and problem-solving regarding diabetes management, observed a mean reduction in A1c of −0.82% at 3-months.[38] Mean reduction in A1c was −0.27% following four 2-hour group-based DSME sessions in primary care patients.[39] A pilot study that involved implementation of an 8-week mindfulness intervention resulted in a mean reduction in A1c of −0.48% 1-month following the intervention.[19] Thus, glycemia was improved in both DSME-based and mindfulness-based interventions in the current and prior studies. A reduction in A1c of −0.67% to −0.83% observed at 3-month follow-up in this study, if sustained over the long term, could result in significant reduction in microvascular and cardiovascular end points.[40–42]

The identification of effective treatment approaches that improve diabetes outcomes is necessary to meet the educational needs of the escalating diabetes population. People with diabetes need the necessary knowledge and skills to modify behavior and successfully self-manage the disease. Few randomized trials have been conducted to compare alternative models for delivering patient education and MNT. DSME is widely endorsed through diabetes practice guidelines.[4] However, little research has evaluated the impact of mindful eating on diabetes outcomes. Results from the current study indicate training in mindful

eating is feasible, well accepted, and effective in promoting modest weight loss. Prior research found behavioral lifestyle interventions, similar to the MB-EAT-D and SC interventions, which provided instruction, modeling, goal setting, and problem-solving also helped participants integrate diet and physical activity behaviors into their self-care and facilitated improvement in glycemic control.[5,38] The availability of multiple effective educational approaches to diabetes self-management will likely improve treatment adherence among patients and is a necessary first step in treatment evaluation. However, educators and clinicians need to know not only that a treatment works on average but also which intervention works best for specific types of patients and the conditions under which each treatment is most effective. The answer to these questions was beyond this pilot study, and future research is needed to determine delivery of the right educational approach to the right patient at the right time.

Despite the comparative effectiveness findings, some limitations of the study should be noted. First, the sample had limited racial and ethnic diversity; replication of the study with more diverse populations would be desirable. Second, 24% of participants enrolled in the study withdrew prior to completing the interventions, which prevented adequate testing of hypotheses. The findings obtained from this study enable estimates of effect sizes for a future larger study. It should be noted that other studies experienced similar rates of attrition from group-based interventions.[38,39] This study required a significant time commitment with a predefined group schedule and participants were randomly assigned to treatment group. Of the 16 participants who withdrew prior to completing their assigned intervention, 7 withdrew due to scheduling conflicts and competing time demands. Whether greater retention would be achieved by allowing participants to self-select their intervention condition requires additional research. However, non-randomized designs pose threats to validity. Finally, the long-term impact of the MB-EAT-D and SC interventions beyond 3-months is not known, and future research should evaluate the long-term impact on outcomes.

In summary, the present results suggest that adults with T2DM can modify their dietary intake to achieve weight loss and improve glycemia regardless of whether they receive training in mindful eating or MNT for diabetes self-management. Maintenance of weight loss and optimal glycemia are associated with reductions in the morbidity associated with diabetes. Future research should examine preferences for treatment focus (i.e., MNT only versus mindful eating only versus combined treatment) and whether the magnitude of change is greater when patients select one approach over another. Alternatively, some diabetes patients may prefer to complete a DSME-based program first to learn the fundamentals of MNT and self-management followed by a mindful-eating intervention to facilitate maintenance of change. Eating in response to bodily awareness and hunger cues offers the opportunity to develop self-management skills for weight maintenance. The availability of several effective treatments allows patients greater choice in meeting their self-care needs and enables clinicians to tailor diabetes programs.

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Table 1

Demographic and diabetes characteristics of participants at baseline

Characteristic	MB-EAT-D [a] (n=27)	Smart Choices (n-25)	P-value
	%	%	
Female	63.0	64.0	1.00
Race:			0.52
Caucasian	81.5	72.0	
Black	18.5	24.0	
Asian	0	4.0	
Married	66.7	68.0	1.00
Bachelor's degree or higher	48.2	60.0	0.42
Employed full-time	77.8	84.0	0.73
Household income ≥ $60,000/year	51.9	63.6	0.56
Received previous diabetes education	65.4	80.0	0.20
Self-monitor blood glucose	69.2	76.0	0.76
Want more information about overall diabetes care	63.0	62.5	1.00
	Mean ± SD	**Mean ± SD**	**P-value**
Age (years)	53.9 ± 8.2	54.0 ± 7.0	0.94
Diagnosed with diabetes (years)	6.9 ± 3.9	5.9 ± 3.4	0.31

[a] Mindfulness-Based Eating Awareness Training for Diabetes (MB-EAT-D) group

Table 2

Mean (±SE) anthropometric and clinical outcomes at baseline and change in outcomes across time for the MB-EAT-D [a] (n=27) and Smart Choices (n=25) treatment groups

Baseline Values	**Weight (kg)**	**Waist circum. (cm)**	**BMI (kg/m^2)**	**A1c (%)**	**Glucose (mg/dL)[b]**	**Insulin (μU/mL)**
MB-EAT-D	106.04 (±3.66)	115.06 (±2.80)	36.19 (±1.18)	8.49 (±0.24)	181.89 (±9.31)	13.32 (±1.91)
Smart-Choices	103.38 (±3.80)	112.53 (±2.91)	36.08 (±1.22)	8.33 (±0.25)	163.80 (±9.67)	17.07 (±1.99)
P-value [c]	P = 0.6169	P = 0.5326	P = 0.9523	P = 0.6587	P = 0.1812	P = 0.1775
Change Score at Immediate Post-intervention [d]						
MB-EAT-D	−1.78 (±0.54) P = 0.0012	−1.59 (±0.80) P = 0.0493	−0.62 (±0.19) P = 0.0014	−0.77 (±0.23) P = 0.0015	−15.93 (±8.38) P = 0.0592	−0.95 (±1.52) P = 0.5339
Smart Choices	−3.25 (±0.57) P < 0.0001	−3.92 (±0.85) P < 0.0001	−1.13 (±0.20) P < 0.0001	−0.45 (±0.25) P = 0.0716	−12.24 (±8.85) P = 0.1690	−4.84 (±1.61) P = 0.0031
Change Score at 3-month Follow-up [d]						
MB-EAT-D	−1.53 (±0.54) P = 0.005	−2.48 (±0.80) P = 0.0025	−0.53 (±0.19) P = 0.0058	−0.83 (±0.24) P = 0.0008	−5.43 (±8.38) P = 0.5186	−0.96 (±1.52) P = 0.5295
Smart Choices	−2.92 (±0.54) P < 0.0001	−4.71 (±0.81) P < 0.0001	−1.03 (±0.19) P < 0.0001	−0.67 (±0.24) P = 0.0077	−14.68 (±8.60) P = 0.0902	−3.58 (±1.54) P = 0.0214
P-value [e]	P = 0.0728	P = 0.0523	P = 0.0678	P = 0.6222	P = 0.4424	P = 0.2277

[a] Mindfulness-Based Eating Awareness Training for Diabetes (MB-EAT-D) group

[b] To convert mg/dL to mmol/L multiply by 0.0555

[c] Student t-test within an ANOVA for between-group comparison at baseline; P-value < 0.05 used for statistical significance.

[d] P-value < 0.0125 used for statistical significance to account for the Bonferroni correction of the 4 comparisons for the within-group changes from baseline to immediate post-intervention and from baseline to 3-month follow-up.

[e] Student t-test within an ANOVA to compare the between-group change from baseline to 3-month follow-up; P-value < 0.05 used for statistical significance.

Table 3

Mean (±SE) energy, nutrient intakes, and MET hours/week of physical activity at baseline and change in outcomes across time for the MB-EAT-D [a] (n=26) and Smart Choices (n=25) treatment groups

Baseline Values	**Energy (kcal)**	**Total Fat (% Energy)**	**Saturated Fat (grams/1000 kcal)**	**Monounsat. Fat (grams/ 1000 kcal)**	**Polyunsat. Fat (grams/ 1000 kcal)**	**Trans Fat (grams/1000 kcal)**	**Cholesterol (mg/1000 kcal)[b]**
MB-EAT-D	1851 (±129)	41.16 (±1.15)	14.53 (±0.47)	18.14 (±0.62)	9.64 (±0.44)	1.48 (±0.10)	147 (±12.68)
Smart Choices	2019 (±131)	40.53 (±1.17)	13.38 (±0.48)	18.01 (±0.63)	10.20 (±0.45)	1.60 (±0.10)	152 (±12.93)
P-value [c]	P = 0.3628	P = 0.7056	P = 0.0937	P = 0.8816	P = 0.3715	P = 0.4232	P = 0.9738
Change Score at Immediate Post-intervention [d]							
MB-EAT-D	−298 (±109) P = 0.0068	−0.62 (±1.03) P = 0.551	−0.65 (±0.41) P = 0.1147	−0.02 (±0.59) P = 0.9721	0.15 (±0.44) P = 0.7255	0.00 (±0.10) P = 0.9838	5.59 (±11.94) P = 0.6505
Smart Choices	−574 (±114) P < 0.0001	−1.46 (±1.09) P = 0.1813	−0.79 (±0.43) P = 0.0698	−0.84 (±0.62) P 0.1734	0.18 (±0.46) P =0.6898	−0.30 (±0.10) P = 0.0030	−14.37 (±12.76) P = 0.3189
Change Score at 3-month Follow-up [d]							
MB-EAT-D	−490 (±109) P < 0.0001	−0.19 (±1.04) P = 0.8517	0.12 (±0.41) P = 0.7724	0.10 (±0.59) P = 0.8644	0.46 (±0.44) P = 0.2962	0.05 (±0.10) P = 0.6361	−4.01 (±11.95) P = 0.9734
Smart Choices	−682 (±111) P < 0.0001	−1.26 (±1.06) P = 0.2364	−1.04 (±0.42) P = 0.0151	0.64 (±0.60) P = 0.2868	0.42 (±0.44) P = 0.3442	−0.23 (±0.10) P = 0.0219	−4.58 (±12.19) P = 0.4615
P-value [e]	P = 0.2198	P = 0.3286	P = 0.1221	P = 0.5206	P = 0.9553	P = 0.0489	P = 0.5827
Baseline Values	**Carbohydrate (% Energy)**	**Total Fiber (grams/100 kcal) [f]**	**Total Sugars (grams/1000 kcal)**	**Glycemic Index**	**Glycemic Load**	**Protein (% Energy)**	**MET hr/week [g]**
MB-EAT-D	43.57 (±1.35)	10.48 (±0.82)	42.52 (±2.78)	51.59 (±0.82)	101.35 (±5.48)	16.76 (±0.49)	9.56 (±2.41)
Smart Choices	44.38 (±1.38)	10.18 (±0.84)	45.53 (±2.83)	52.04 (±0.83)	106.40 (±7.83)	16.56 (±0.50)	10.00 (±2.50)
P-value [c]	P = 0.6738	P = 0.9928	P = 0.4494	P = 0.7014	P = 0.3603	P = 0.7754	P = 0.3307
Change Score at Immediate Post-intervention [d]							
MB-EAT-D	0.37 (±1.23) P = 0.7629	0.77 (±0.70) P = 0.0887	1.02 (±2.95) P = 0.7307	−0.77 (±0.70) P = 0.2705	−16.25 (±6.61) P = 0.0151	0.41 (±0.49) P = 0.4075	0.62 (±0.28) P = 0.0277
Smart Choices	1.25 (±1.30)	2.97 (±0.74)	4.80 (±3.09)	−2.32 (±0.73)	−34.12 (±6.94)	0.92 (±0.52)	0.38 (±0.29)

Baseline Values	Energy (kcal)	Total Fat (% Energy)	Saturated Fat (grams/1000 kcal)	Monounsat. Fat (grams/ 1000 kcal)	Polyunsat. Fat (grams/ 1000 kcal)	Trans Fat (grams/1000 kcal)	Cholesterol (mg/1000 kcal)[b]
	P = 0.3370	P < 0.001	P = 0.1229	P = 0.0019	P < 0.0001	P = 0.0784	P = 0.1970
Change Score at 3-month Follow-up [d]							
MB-EAT-D	1.38 (±1.23) P = 0.2641	0.86 (±0.70) P = 0.0656	−1.50 (±2.95) P = 0.6127	−1.53 (±0.70) P = 0.0301	−30.13 (±6.61) P < 0.0001	1.27 (±0.49) P = 0.0107	0.49 (±0.28) P = 0.0809
Smart Choices	1.87 (±1.26) P = 0.1394	3.46 (±0.72) P < 0.001	7.03 (±3.01) P = 0.0209	−2.87 (±0.71) P = 0.0001	−38.80 (±6.74) P < 0.0001	0.40 (±0.50) P = 0.4277	0.30 (±0.28) P = 0.2926
P-value [e]	P = 0.0670	P = 0.0221	P = 0.0449	P = 0.1793	P = 0.3603	P = 0.2156	P = 0.6325

[a] Mindfulness-Based Eating Awareness Training for Diabetes (MB-EAT-D) group

[b] Dietary cholesterol intakes were not normally distributed and were log-transformed; the p-values were based on the comparison of means of the log-transformed data using the transform log(x).

[c] Student t-test within an ANOVA for between-group comparison at baseline; P-value < 0.05 used for statistical significance.

[d] P-value < 0.0125 used for statistical significance to account for the Bonferroni correction of the 4 comparisons for the within-group changes from baseline to immediate post-intervention and from baseline to 3-month follow-up.

[e] Student t-test within an ANOVA to compare the between-group change from baseline to 3-month follow-up; P-value < 0.05 used for statistical significance.

[f] Dietary fiber intakes were not normally distributed and were log-transformed; the p-values were based on the comparison of means of the log-transformed data using the transform log(x).

[g] Gender, employment, current age, age at time of diabetes diagnosis, and diabetes duration were significant covariates for MET hours/week and were incorporated into the repeated measures model. The data were not normally distributed and were log-transformed; the p-values were based on the comparison of means of the log-transformed data using the transform log(1+x).