

# Lifestyle Strategies after Intentional Weight Loss: Results from the MAINTAIN-pc Randomized Trial

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## ABSTRACT

**Introduction/Purpose:** Weight maintenance after intentional weight loss is challenging and often unsuccessful. Physical activity and self-monitoring are strategies associated with successful weight loss maintenance. However, less is known about the type and number of lifestyle strategies used after intentional weight loss. The purpose of this study was to determine the types and amounts of strategies associated with successful long-term weight loss maintenance. **Methods:** Data from the 24-month Maintaining Activity and Nutrition Through Technology-Assisted Innovation in Primary Care (MAINTAIN-pc) trial were analyzed. MAINTAIN-pc recruited adults ( $n = 194$ ;  $53.4 \pm 12.2$  yr of age; body mass index,  $30.4 \pm 5.9$   $\text{kg} \cdot \text{m}^{-2}$ ; 74% female) with recent intentional weight loss of  $\geq 5\%$ , randomized to tracking tools plus coaching (i.e., coaching group) or tracking tools without coaching (i.e., tracking-only group). At baseline and at 6, 12, and 24 months, participants reported lifestyle strategies used in the past 6 months, including self-monitoring, group support, behavioral skills, and professional support. General linear models evaluated changes in the number of strategies over time between groups and the consistency of strategies used over the 24-month intervention. **Results:** At baseline, 100% used behavioral skills, 73% used group support, 69% used self-monitoring, and 68% used professional support in the past 6 months; at 24 months, these rates were 98%, 60%, 75%, and 61%, respectively. Although the number of participants utilizing individual strategies did not change significantly over time, the overall number of strategies participants reported decreased. More strategies were used at baseline and 6 months compared with 12- and 24-month follow-ups. The coaching group used more strategies at months 6 and 12 than the tracking-only group. Consistent use of professional support strategies over the 24-month study period was associated with less weight regain. **Conclusion:** Weight loss maintenance interventions that incorporate continued follow-up and support from healthcare professionals are likely to prevent weight regain after intentional weight loss.

weight regain, making long-term maintenance of weight loss challenging and complex to achieve (3–5). Despite these difficulties, weight loss maintenance is possible. Adults maintaining significant weight loss (e.g.,  $>10\%$  reduction in body mass) consistently report participation in high levels of physical activity (PA) and continued self-monitoring practices (e.g., frequent weighing, tracking dietary intake) (6–8). Although it is well established that PA and self-monitoring are lifestyle strategies associated with successful weight loss maintenance, it is unknown if the number of strategies utilized is predictive of weight regain. In addition, a greater understanding of the strategies that most effectively prevent weight regain is crucial to developing and refining evidence-based weight maintenance programs.

Long-term maintenance of weight loss requires continued attention. The primary care setting is likely to be promising for incorporating ongoing support to maintain weight loss due to continuity of care over time (9,10). Most primary care clinics now use an electronic health record (EHR) that allows providers to automate the addressing, tracking, and referring of patients to

interventions and programs for preventive health services. However, weight management services and interventions are rarely delivered through the EHR (11). The Maintaining Activity and Nutrition through Technology-Assisted Innovation in Primary Care (MAINTAIN-pc) trial demonstrated that health

## INTRODUCTION

Despite various effective weight loss strategies (1), the prevalence of overweight and obesity remains high in the United States (2). Biological, behavioral, and environmental factors promote

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coaching and communication with the primary care physician (PCP) through the EHR led to less weight regain through 24 months as compared with a control intervention (12).

The purpose of these secondary analyses was to determine whether the number and/or consistency of reported lifestyle strategies used by participants is associated with weight regain over 24 months, and if the number of strategies differed between the tracking-only and coaching (including tracking) groups.

## METHODS

### Study Overview

MAINTAIN-pc was a 24-month randomized controlled trial designed to evaluate the use of a weight loss maintenance intervention within the primary care setting, fully embedded in the EHR. The Institutional Review Board at the University of Pittsburgh approved all study procedures, and the study was registered on Clinicaltrials.gov (NCT01946191). Detailed methods for the MAINTAIN-pc trial have been published previously, as well as results of the main trial outcomes (12,13). Briefly, after screening and baseline assessments, enrolled participants were randomized using a 1:1 ratio to either a tracking-only group or a coaching group, which also had access to tracking tools, stratified by sex and primary care clinic. Sample size was determined based on the outcomes prespecified in the main outcome article (12).

Participants in the tracking-only group received access to the study-specific portal, which contained flowsheets in which participants could enter their daily weight, dietary intake, and PA. Weekly reminders were sent to encourage participants to log this information into their accounts. However, neither coaching nor feedback from the health coach was provided based on the entries. In addition, this group was provided questionnaires on general health-related prevention topics (e.g., sun safety and sunscreen use, tobacco use) to ensure the groups were attention-matched. The PCPs of the participants in the tracking-only group received only research progress reports.

Participants in the coaching group also received access to the study portal and flowsheets for logging daily weight, dietary intake, and PA, along with the weekly reminders encouraging them to complete self-monitoring logs. In addition, participants in the coaching group received personalized coaching via their patient portal account in the EHR. Participants were contacted regularly (weekly for month 1, biweekly for months 2–5, monthly for months 6–12, and quarterly for months 13–24) by trained health coaches. The trained health coaches in this trial had backgrounds in nursing, nutrition, and exercise physiology. All coaches received training on the study protocol and the EHR. All coaches had previously completed coach training for the Diabetes Prevention Program (14), but for this trial, they were not required to have a national coaching certification or credential.

Contact included questionnaires on weight management-related topics and individually tailored brief notes addressing questionnaire responses and challenges mentioned by participants. Furthermore, PCPs of the participants in the coaching group received notifications of weight gain or loss and progress notes, both delivered to coincide with routine care (delivered via EHR 24–48 h before a scheduled office visit) and sent after the 6-, 12-, and 24-month research assessment visits.

## Participants

Adult (18–75 yr old) patients of participating PCPs in the University of Pittsburgh Medical Center system that had a verified intentional weight loss of  $\geq 5\%$  within the last 2 yrs and a pre-weight loss body mass index (BMI) of  $\geq 25 \text{ kg}\cdot\text{m}^{-2}$  were recruited for enrollment in this trial. To be eligible, patients had to have achieved their weight loss through lifestyle strategies (i.e., diet, exercise), had to have or be willing to create a patient portal account, and had to have approval from the PCP. Individuals were excluded from participation in MAINTAIN-pc if their PCP indicated they were unable to perform moderate-intensity PA, they were pregnant or breastfeeding or planned to become pregnant during the study period, they had a history of recent (within 5 yrs) bariatric surgery or planned to undergo bariatric surgery during the study period, they had edema due to medical condition, they were treated for cancer (except nonmelanoma skin cancer) or thyroid disease in the past year, they had no computer access, or they would be unable to attend an orientation session. Before enrollment, individuals were fully informed of study procedures and provided written informed consent.

## Measurements

The current analyses used self-reported lifestyle strategies related to weight loss maintenance from baseline and 6-, 12-, and 24-month assessments. All assessments were completed in person. Body mass (WB-100A scale; Tanita Corporation of America, Arlington Heights, IL) and height (wall-mounted stadiometer) were measured by trained personnel, and BMI was calculated as kilograms per meter squared. At each time point, participants completed a Lifestyle Strategies Inventory questionnaire (see Supplemental Contents 1, <http://links.lww.com/TJACSM/A204>, and 2, <http://links.lww.com/TJACSM/A205>, tables) to report on the use of diet and PA self-monitoring strategies, group or commercial program support, other behavioral skills (e.g., daily weighing, stress management), and professional support (e.g., personal trainer, registered dietitian, mental health therapist).

## Statistical Analyses

Responses from the Lifestyle Strategies Questionnaire were categorized into four strategies: diet/PA self-monitoring, group support, other behavioral strategies (e.g., self-weighing), and professional support. A strategy was considered used if any of the items in that strategy were checked “yes.” Change and percent change in weight from baseline to 24 months were the primary outcomes.

All analyses were performed using SAS software, version 9.4 (SAS Institute, Cary, NC). All significance tests were two-sided with an  $\alpha$  level of 0.05. Data are presented as mean and standard deviation (SD) or 95% confidence interval (CI).

### DID THE NUMBER OF STRATEGIES USED VARY ACROSS TIME POINTS?

To control for repeated measures among subjects, a generalized linear model with an unstructured covariance matrix was used to determine the effect of time on total number of strategies used at each time point. A term for treatment group was included in the model to reflect the randomized clinical trial design. Results are shown as the mean number of strategies used and 95% CIs at each time point. Differences in the mean number of strategies across time points are shown as the

adjusted mean difference with its 95% CI. This model was used with and without controlling for the number of strategies used at baseline.

#### WERE THERE TREATMENT GROUP DIFFERENCES IN THE NUMBER OF STRATEGIES USED ACROSS TIME POINTS?

This model is similar to the first but includes treatment, time point, and treatment–time point interaction. The effect of interest is the treatment–time point interaction term. Results are shown as mean number of strategies used and 95% CIs at each time point by treatment. Differences in means and 95% CIs at each time point across groups are shown. This model was used with and without controlling for number of strategies used at baseline.

#### DID THE CONSISTENCY OF USE OF A STRATEGY AFFECT THE OUTCOME AT 24 MONTHS?

Two models were analyzed: For each possible lifestyle strategy, a general linear model was performed with the change from baseline values used as the outcomes. The model included the baseline value of the outcome and a categorical term for the number of strategies used in the prior 24 months using responses from all four assessments. A subject could have used the strategy at none of the time points, one of the time points, and so on, up to all four of the time points. A test for linear trend of the number of strategies used is the main analysis of interest. The test for linear trend shows whether a higher use of each particular strategy had a linear effect on the outcome as measured at 24 months. The model was reestimated with an interaction term of number of strategies and treatment group. The tests for linear trend of number of strategies used within each treatment group and the test for differences in linear trends across treatment groups are the main analyses of interest.

## RESULTS

### Participant Characteristics

A total of 194 participants (mean (SD) age, 53.4 (12.2) yr; mean (SD) BMI, 30.4 (5.9) kg·m<sup>-2</sup>) enrolled in the trial and were randomized to coaching (*n* = 98) or tracking-only (*n* = 96) groups. A majority of participants were White (88.1%) and female (73.7%). On average, participants lost 11.3% of their body weight before enrollment in the trial. Retention was

considered high because 81% of participants who underwent baseline assessments completed the 24-month intervention. More detailed participant demographic and health information have been previously published (12,13).

### Utilization of Lifestyle Strategies

Frequencies for the use of specific lifestyle strategies are presented in Supplemental Contents 1, <http://links.lww.com/TJACSM/A204>, and 2, <http://links.lww.com/TJACSM/A205> (tables). There was no difference in the number of strategies used between coaching and tracking groups over time (*P* = 0.08 for group–time effect). However, the main effect for time in the total sample revealed a greater number of strategies used at baseline and month 6 compared with later follow-up (Table 1). The main effect for each group revealed that the coaching group reported using a greater number of strategies than the tracking-only group at months 6 and 12 (Table 2). When controlling for baseline, results were similar with differences between groups still present at 12 months (*P* = 0.03).

### Prediction of Weight Change at 24 Months Based on Strategies

A significant linear trend was found for the effect of cumulative number of professional support strategies used by 24 months for a change in body weight (*P* = 0.02), but not for the other strategy categories (self-monitoring of diet/PA or any group/commercial support; Table 3). The “other behavioral skills” category was not included in this analysis because nearly all participants endorsed engagement with these strategies (99.5% at baseline and 97.9% at 24 months); thus, this category was nondiscriminatory.

## DISCUSSION

In the present analysis, the number of reported lifestyle strategies used decreased over the 24-month intervention. Although there was no difference in the number of strategies used between the coaching and tracking-only groups at 24 months, the coaching group used a greater number of strategies than tracking-only participants up to the 12-month assessment. In addition, regardless of study arm, consistent use of professional support strategies was predictive of less weight regain at 24 months. Collectively, these findings provide evidence of the critical role of professional support for maintaining weight loss long term.

**TABLE 1.**  
Utilization of Lifestyle Strategies by Time Point.

Time Point	Comparison Time Point	Comparison		Comparison Mean	95% CI Comparison Mean	Difference in Means	95% CI for Diff. in Means	Difference in Means <i>P</i> Value
		Mean	95% CI					
0	6	3.10	(2.98–3.22)	3.29	(3.17–3.41)	–0.19	(–0.34 to –0.04)	0.01
	12	3.10	(2.98–3.22)	2.91	(2.76–3.06)	0.19	(0.03 to 0.34)	0.02
	24	3.10	(2.98–3.22)	2.91	(2.75–3.07)	0.19	(0.03 to 0.36)	0.02
6	12	3.29	(3.17–3.41)	2.91	(2.76–3.06)	0.38	(0.23 to 0.52)	<0.001
	24	3.29	(3.17–3.41)	2.91	(2.75–3.07)	0.38	(0.21 to 0.55)	<0.001
12	24	2.91	(2.76–3.06)	2.91	(2.75–3.07)	0.01	(–0.16 to 0.17)	0.95

Table shown not controlling for baseline.

**TABLE 2.**  
**Comparison of Number of Lifestyle Strategies Used by Intervention Group.**

Time Point	Treatment				Difference in Means	95% CI for Difference in Means	Difference in Means <i>P</i> value
	Coaching Group		Tracking-Only Group				
	Mean	95% CI	Mean	95% CI			
0	3.09	(2.93–3.25)	3.11	(2.93–3.29)	–0.03	(–0.27 to 0.21)	0.82
6	3.42	(3.26–3.58)	3.16	(2.97–3.34)	0.27	(0.02 to 0.51)	0.03
12	3.08	(2.86–3.29)	2.75	(2.55–2.95)	0.33	(0.04 to 0.62)	0.03
24	2.89	(2.66–3.13)	2.92	(2.71–3.13)	–0.03	(–0.35 to 0.28)	0.85

Table shown not controlling for baseline.

The high degree of weight regain after intentional weight loss is the largest challenge in obesity medicine (4). In clinical trials, weight loss (achieved through nonsurgical interventions) typically occurs through 6 months, followed by a plateau and weight regain over the first couple of years after initial weight loss (1). Thus, uncovering strategies and developing interventions to prevent weight regain are crucial. To date, the work in this area has been largely observational and examined specific dietary intake behaviors, self-monitoring (e.g., frequent self-weighing) patterns, and PA habits that are associated with weight regain (6,15), although we recently reported detailed dietary behavior strategies associated with weight regain in the MAINTAIN-pc trial (16). Findings are relatively consistent and show that decreased intake of dietary fat and sugar-sweetened beverages, increased fruit and vegetable intake, utilization of portion control/meal replacements, decreased eating out, frequent self-weighing, and high PA levels are associated with less weight regain over time (6,15–17). However, this prior work has not evaluated other lifestyle strategies for maintaining weight loss, such as professional support. In addition, the statistical analyses often do not correct for multiple testing and therefore could be susceptible to type 1 errors. In the current analysis, we grouped together specific lifestyle strategies (recording dietary intake, monitoring PA, etc.) into broader self-monitoring and other overall strategies.

Interestingly, in the current analysis, the use of diet/PA self-monitoring, group/commercial support, and other behavioral skills (e.g., self-weighing, mindful eating, stress management) over time was not associated with the prevention of weight regain. This is likely due to the high self-reported use of at least one of the substrategies within each category, leading to most MAINTAIN-pc participants endorsing use of these strategies over time. Thus, these behavioral strategies were not discriminatory in the prevention of weight regain. However, an important finding from this analysis is that consistent use of professional support over 24 months was associated with less weight regain. These results are consistent with a prior observational trial evaluating determinants of weight loss and weight loss maintenance success when behavioral nutrition coaching was provided within the primary care setting by trained PCPs (18). In this trial, successful weight loss maintainers (defined as achieving and maintaining 10% weight loss over 1 yr) consulted with their PCPs on average 19.6 times over a 34-month period.

Patients who did not maintain a 10% weight loss consulted with their PCPs 15.6 times over a similar time period, and patients who did not achieve 10% weight loss consulted with their PCPs an average of 10.8 times over 34 months (18). Similarly, utilization of an intensive meal-replacement program that required frequent visits with nutrition support staff and the PCP was associated with significant weight loss (11% reduction in body mass by month 6) and weight loss maintenance (8.4% reduction in body mass through 36 months) (19). These prior trials were also effective at preventing weight regain but were more intensive and required greater PCP time than MAINTAIN-pc (12). Collectively, these findings highlight the importance of ongoing support for weight maintenance after intentional weight loss. However, the incorporation of and funding for trained health coaches and educators in the primary care team will be crucial for the sustained delivery of comprehensive lifestyle behavioral support for patients. A recent National Academies of Science Engineering and Math report makes the case for incorporating health coaches into primary care clinics (20). Furthermore, the American College of Sports Medicine Exercise is Medicine initiative is focused on ensuring assessment of PA, and referral to qualified exercise professionals is standard in medical encounters (21). Incorporation of trained health coaches into the primary care setting would enhance the referral network and enable greater interdisciplinary collaboration related to improving patient health and wellbeing.

### Limitations

Although this study has multiple strengths, including the randomized trial design, novel method of delivering a weight loss maintenance intervention through the EHR, and evaluation of behavioral strategies used to maintain weight loss, we acknowledge a number of limitations. First, the present analyses are of secondary outcomes from the MAINTAIN-pc trial (12) and as such should be viewed as hypothesis generating. Second, use of lifestyle strategies was self-reported and not objectively measured. Third, the questionnaire provided only binary “yes” versus “no” options in response to “any use of” specific strategies rather than asking more detailed questions regarding the frequency that strategies were used. Fourth, we were unable to look at the use of specific items within a strategy category and instead considered a strategy to be used if a participant endorsed using any of the sub-items. In addition,



the weight loss inclusion criteria (i.e., weight loss of  $\geq 5\%$  within the past 2 yr) has been debated (17,22,23). It is possible that the utilization of lifestyle strategies associated with preventing weight regain may differ in the earlier versus later phases of weight loss maintenance. Sixth, although participants were enrolled in our trial longer than most studies on this topic (24 months), it is unknown what strategies would be associated with continued successful weight maintenance beyond this period. Because the number of strategies decreased from baseline and 6 to 24 months, it is possible that this would have detrimental effects on weight longer term. However, it is also possible that the reduction in number of strategies used by participants was also an efficient approach because they ceased utilization of unneeded strategies. Longer-term trials will be needed to elucidate this information. Finally, the sample included in this trial was primarily White and female. Thus, we cannot generalize these findings to other groups, and recent evidence indicates that preferences for weight loss maintenance interventions may differ by race (24).

## Conclusions

Continued professional support for weight loss maintenance is associated with less weight regain over 24 months of follow-up. This finding provides evidence for the effectiveness of embedding weight loss maintenance interventions within primary care settings and EHR to consistently ensure both support and continuity of care. Future trials that directly measure utilization of lifestyle strategies will be essential to uncover specific approaches that prevent weight regain after intentional weight loss. Furthermore, this trial provides support for the incorporation of trained health coaches into the primary care team. Additional pragmatic trials to evaluate feasibility and cost-benefit analyses of this strategy will be necessary to determine overall effectiveness.

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The results of this study do not constitute endorsement by the American College of Sports Medicine.

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