Behavioral Medicine

ISSN: 0896-4289 (Print) 1940-4026 (Online) Journal homepage: http://www.tandfonline.com/loi/vbmd20

Pilot Test of an Acceptance-Based Behavioral Intervention to Promote Physical Activity During Weight Loss Maintenance

Meghan L. Butryn, Stephanie Kerrigan, Danielle Arigo, Greer Raggio & Evan M. Forman

To cite this article: Meghan L. Butryn, Stephanie Kerrigan, Danielle Arigo, Greer Raggio & Evan M. Forman (2018) Pilot Test of an Acceptance-Based Behavioral Intervention to Promote Physical Activity During Weight Loss Maintenance, Behavioral Medicine, 44:1, 77-87, DOI: 10.1080/08964289.2016.1170663

To link to this article: https://doi.org/10.1080/08964289.2016.1170663

Accepted author version posted online: 21 Apr 2016.
Published online: 23 Jun 2016.

BEHAVIORAL MEDICINE
2018, VOL. 44, NO. 1, 77–87
https://doi.org/10.1080/08964289.2016.1170663

Taylor & Francis
Taylor & Francis Group

Pilot Test of an Acceptance-Based Behavioral Intervention to Promote Physical Activity During Weight Loss Maintenance

Meghan L. Butryn[a], Stephanie Kerrigan[a], Danielle Arigo[b], Greer Raggio[a], and Evan M. Forman[a]

[a]Drexel University; [b]University of Scranton

ABSTRACT

Behavioral interventions for obesity reliably facilitate short-term weight loss, but weight regain is normative. A high level of aerobic exercise may promote weight loss maintenance. However, adopting and maintaining a high level of exercise is challenging, and experiential acceptance may be important. The aim of this study was to pilot test the feasibility and efficacy of an acceptance-based behavioral treatment to promote moderate-to-vigorous physical activity (MVPA) among individuals who had recently lost weight. Adults (n = 16) who had recently lost ≥ 5% of weight were provided with a 12-week, group-based treatment. At 12 weeks, complete analyses indicated that participants had increased activity 69% (completing an average of 198.27 minutes/week of bouted MVPA, i.e., episodes of at least 10 minutes in duration). Medium-to-large effect sizes were observed for changes in process measures, including experiential acceptance. Future research to test this approach using an experimental design, a larger sample, and a longer period of observation is warranted.

KEYWORDS

physical activity; behavioral intervention; weight loss maintenance; experiential acceptance

Introduction

Obesity, a condition afflicting 35% of US adults,[1] diminishes quality of life[2,3] and increases risk for numerous health problems such as cardiovascular disease, type 2 diabetes, and several types of cancer. The current gold standard treatment, behavioral therapy (i.e., lifestyle modification), produces medically beneficial short-term weight losses.[3,4] However, participants regain about 30% of lost weight within one year of treatment completion, and many return to pretreatment weight after 4 to 5 years.[5,6] Thus, two of the key priorities for obesity-related clinical research are (1) developing treatments that increase the proportion of individuals who achieve long-term maintenance of weight loss, and (2) buffering against the health risks facing individuals who regain weight.

Benefits of physical activity

Promoting physical activity is a promising target for improving weight loss maintenance. Correlational evidence shows that individuals who report engaging in higher levels of physical activity after weight loss demonstrate significantly less weight regain relative to those reporting lower levels of physical activity.[7–15] In these studies, the amount of physical activity needed to observe this effect is high—the equivalent of expending 2000 to 3000 kcal per week through exercise, which requires approximately 250 minutes per week. Experimental research has confirmed this pattern, demonstrating that those assigned to a high physical activity level (i.e., the equivalent of expending 2500 kcal/week) maintained greater weight losses at 18 months into treatment than those assigned to a lower physical activity level (1500 kcal/week; 6.7 kg vs. 4.1 kg, respectively[16]). Less research has examined which types of exercise are most effective, but brisk walking and similar types of moderate-to-vigorous-intensity physical activity (i.e., MVPA) have the greatest evidence base regarding weight control and disease prevention.[8,17–19] High levels of MVPA[20] are known to have health benefits that are independent of effects on weight, such as improved cardiorespiratory fitness and reduced risk for conditions such as cardiovascular disease,[21] better metabolic regulation as demonstrated by improved triglycerides[22] and HbA1c,[23] greater bone mineral density,[24] and higher quality of life.[25] However, adherence to high MVPA levels remains a critical obstacle for current treatment regimens.[26]

Challenges in adhering to physical activity prescriptions

Only 2%–3% of overweight or obese adults engage in recommended amounts of physical activity.[25,27,28] Among those seeking weight loss treatment, behavioral therapy successfully promotes short-term increases in

CONTACT Meghan L. Butryn mlb34@drexel.edu 3141 Chestnut Street, Stratton 119, Philadelphia, PA 19104, USA.

physical activity, but increases are relatively modest and improvements are often not maintained.[11,29–33] Achieving a high level of physical activity is even more challenging. For example, one study found that only 11.9% of participants in a behavioral treatment program adhered to a prescribed high level of physical activity (2500 kcal/wk).[34] One basic approach to improving treatment may be to adopt a primary focus on physical activity during weight loss maintenance, devoting the majority of clinical attention and participants' efforts to this critical behavior. A novel framework for understanding the challenges of adopting and maintaining physical activity also may be valuable. Two key challenges to physical activity, described next, may be especially powerful targets of treatment.

Experiential discomfort

Although some people experience physical activity as pleasurable, most obese individuals endorse relatively lower levels of enjoyment and indicate a preference for sedentary leisure activities.[35–37] Enjoyment of physical activity is predictive of physical activity behavior among participants in lifestyle modification programs.[38,39] Other individuals experience not only a lack of enjoyment but also feel discomfort, which can be experienced as physiological sensations, including fatigue, sweating, and increased heart rate, as well as boredom or urges to slow down or stop moving, or the simple wish to engage in an alternative behavior, such as working or sleeping.[40] While standard behavioral treatment aims to increase the inherent enjoyment of physical activity, its effectiveness is limited. Thus, improving obese individuals' ability to tolerate psychological or physical discomfort associated with physical activity may bolster physical activity adherence.

Erosion of motivation

Adherence to physical activity reliably decreases over time, suggesting waning motivation.[41,42] Deci and Ryan's[43] self-determination theory suggested that lasting behavior change is facilitated by internalizing values for change and accepting responsibility for autonomous regulation of behaviors. These ideas align with newer behavioral theories that emphasize the necessity of clarifying one's most important values in order to justify uncomfortable choices.[44,45]

Theoretical model

The long-term effectiveness of behavioral treatment for weight control might be improved by focusing intervention efforts during the weight loss maintenance period on participants' ability to adopt and sustain a high level of physical activity. This theoretical model proposes that exercise-related behavior change will remain uncomfortable for many participants, even after traditional cognitive and behavioral skills are mastered, and that particular psychological skills may be necessary to achieve and maintain a high level of physical activity. Specifically, an intervention may be especially effective if it directly targets the seemingly incompatible goals of immediate satisfaction or pleasure and long-range health, and emphasizes the influence of distress intolerance and erosion of commitment on adherence to physical activity regimens.

An acceptance-based approach to behavior change

Acceptance-based strategies are a key feature of "third generation" behavioral therapies, such as Acceptance and Commitment Therapy (ACT[44]). The goal of acceptance-based treatment is to foster willingness to engage in behavior that is consistent with long-term goals and values, even when doing so is difficult. Acceptance-based strategies emphasize the ability to tolerate unpleasant internal experiences in the service of goal-directed behavior. Additionally, acceptance-based strategies are designed to facilitate the identification and internalization of values and lasting commitment to behavior consistent with these values. Such strategies are believed to combat waning commitment. ACT theory recognizes that a behavior perceived as less desirable (e.g., going to the gym) in the short-term compared with other behavioral options (e.g., eating, socializing) will only be undertaken if connected to higher-order life values (e.g., health maintenance). Thus, ACT facilitates the identification and clarification of, and commitment to, such values. Moreover, the approach aims to make the participants' moment-by-moment behavior choices referendums on their continued commitment to identified values.

A small, but growing, literature supports the efficacy of acceptance-based treatment for weight loss.[46–50] However, promotion of physical activity was not the primary focus of any of these interventions, and none used gold-standard measurement of physical activity (e.g., accelerometers) to assess change in that behavior. Only one study to date has examined the feasibility and effectiveness of an acceptance-based intervention targeting physical activity.[40] In that study, students assigned to the two-session acceptance-based intervention increased their bouts of exercise significantly more than those in a psychoeducation comparison group. The present study built on this existing research by developing a more comprehensive acceptance-based program for physical activity promotion and testing it in a sample of adults who were aiming to maintain weight losses.

Pilot-testing aims

The present study was a single-group pilot test of an intervention designed to promote physical activity during weight loss maintenance by teaching acceptance-based behavioral skills. Feasibility, acceptability, and efficacy were examined. Evaluating feasibility and acceptability was critical, because this intervention was innovative in two ways: (1) it focused group sessions primarily on physical activity goals and skills (whereas most weight management programs give equal or more attention to eating behavior), and (2) it provided acceptance-based treatment as a novel way of approaching behavior change. To evaluate feasibility and acceptability, therapist fidelity to the treatment manual, participant retention, and participant evaluation of treatment were measured. The primary outcome to measure efficacy was change in minutes of bouted moderate-to-vigorous intensity physical activity (i.e., MVPA episodes of at least 10 minutes in duration). Change in acceptance-based process measures was examined as a secondary outcome.

Methods

Participants and procedure

Adults aged 18–70 years were recruited via radio and print advertisements in the community. Research staff met with interested individuals to explain the study and answer questions, followed by obtaining written informed consent. Individuals were eligible to participate if they were maintaining a recent intentional weight loss (i.e., current weight 5% or more below highest body weight within the past 2 years), with a current Body Mass Index (BMI) of less than 35 kg/m^2 and a previous BMI (before weight loss) of 25 kg/m^2 or higher. Amount of recent weight loss and previous BMI were collected via self-report. Participants also were required to have the ability to safely engage in MVPA, such as brisk walking. Eligible participants who completed screening, informed consent, and baseline assessment procedures (n = 16) were enrolled. The average participant was 53 years. Most participants were Caucasian (75%; 19% were African American and 6% were more than one race). At study entry, participants were an average of 12.9% below their highest weight in the preceding 24 months; mean BMI at study entry was 28.8 kg/m^2.

Assessments took place at baseline, week 6 (midtreatment), and week 12 (end-of-treatment). At each assessment, participants completed self-report measures and were weighed in the clinic. Participants were required to wear an accelerometer for 7 days at each assessment point. This study was approved by the Institutional Review Board of Drexel University.

Materials and measures

Treatment fidelity

All sessions were audio recorded, and adherence to the treatment manual was evaluated by 2 independent coders with experience in acceptance-based treatment approaches to weight control. Coders rated each major component of the session on a scale of 1 (no adherence to the manual) to 10 (material presented clearly, thoroughly, and as written in the manual), and these ratings were used to calculate percent adherence. A key aspect of adherence was the extent to which session content was focused primarily on physical activity (as designed) versus diet.

Treatment acceptability

Participants were asked to rate the program on the following dimensions: effectiveness of the program for promoting physical activity, helpfulness of acceptance-based strategies for making healthy choices, satisfaction with the approach to weight loss maintenance and physical activity change, and confidence in ongoing weight loss maintenance and physical activity. Items were rated on a scale of 1 (not at all) to 5 (very much). Mean ratings of 4 or higher were *a priori* selected as indicating a high level of acceptability. Participants provided qualitative feedback about the best aspects of the program and their suggestions for improvement.

Physical activity

Physical activity was measured using Actigraph GT3X+ accelerometers worn around the waist for 7 consecutive days. This type of accelerometer is a valid and reliable measure of physical activity, and is superior to self-report measures.[51–53] Intensity and bout cutpoints suggested by Troiano[53] were used to define moderate and vigorous activity; bouts were defined by periods of at least 10 consecutive minutes of continuous counts above the moderate-to-vigorous threshold (with a 2-minute drop time). Minutes per week spent in bouts of moderate-to-vigorous physical activity (i.e., MVPA) was the primary physical activity outcome. Number of bouts per week, minutes per bout, and total minutes per week of MVPA also were examined. Accelerometer data were downloaded and processed using Actilife version 6.11.8. A valid wear day consisted of at least 10 hours of wear (nonwear time was defined by 60 consecutive minutes of zero counts) and a valid wear period was at least 5 of 7 days. All participants who completed the assessments met the minimum requirements for valid accelerometer wear time at each assessment point. There were no significant differences in wear time between assessment points ($p = 0.68$).

Weight

Participants were weighed at all assessments using a standardized Seca® scale that is accurate to 0.01 kg. Weights were taken while participants wore light street clothing and no shoes.

Cold pressor task

In this test of distress tolerance, each participant places his or her nondominant hand in cold water, and is instructed to keep the hand submerged until compelled to remove it due to pain. The assessor uses a stopwatch to measure pain tolerance latency (for a maximum of 5 minutes). The cold pressor is a standard measure of physical distress tolerance and has demonstrated good reliability and validity.[55–57] In order to reduce practice effects, this measure was administered at baseline and post-treatment only.

Physical Activity Acceptance Questionnaire (PAAQ)

The PAAQ is a 10-item measure of the extent to which individuals apply experiential acceptance of negative internal experiences (e.g., discomfort) to physical activity engagement.[58] Items such as "Even if I have the desire to stop while I am exercising, I can still follow my exercise plan" are rated on a scale of 1 (never true) to 7 (always true), with higher scores indicating greater acceptance. Subscales include acceptance of physical activity-related thoughts and acceptance of physical activity-related barriers. The PAAQ has demonstrated high internal consistency (Cronbach's $\alpha = 0.87$) and one-week retest reliability ($r = 0.83$), as well as convergence with objectively-assessed MVPA ($r = 0.26$). Alpha for the present study was 0.62.

Philadelphia Mindfulness Scale (PHLMS)

The PHLMS consists of 20 items that evaluate mindfulness on two dimensions: present-moment awareness and nonjudgmental acceptance.[59] Items are rated on a scale of 1 (never) to 5 (very often); higher scores denote greater mindfulness. The PHLMS has strong psychometric properties, including internal consistency ($\alpha = 0.75$). In the present study, alpha was 0.82.

Drexel Defusion Scale

The Drexel Defusion Scale consists of 10 items that evaluate the extent to which individuals can defuse (i.e., step away or distance) from unpleasant internal experiences. The measure begins with an explanation of defusion, followed by examples of situations that would elicit negative internal experiences (e.g., "You become angry when someone takes your place in a long line. To what extent would you normally be able to defuse from feelings of anger?"). Items are rated on a scale from 1 (not at all) to 6 (very much); higher scores denote greater ability to defuse. This measure has shown acceptable reliability.[60] Cronbach's alpha in the present study was 0.93.

Treatment delivery

Treatment was delivered in 12 group meetings (75 minutes each) over a period of 12 weeks. One group had 6 participants and the other had 10 participants. Group meetings began with a structured check-in (30 minutes), in which each participant reported on total minutes of MVPA, average calorie intake for the week, and progress toward individual behavioral goals, as well as the application of acceptance-based treatment skills to physical activity and weight control behaviors. Participants who reported difficulty achieving their goals, or those who were particularly successful, received feedback from the group. The primary focus during the check-in was adherence to MVPA goals. The next 40 minutes of each session were typically devoted to learning acceptance-based techniques for adopting and maintaining a high level of MVPA. The final 5 minutes were spent identifying goals for the coming week. Participants completed worksheets to facilitate skill practice between group meetings. Groups were led by doctoral-level clinicians with prior experience teaching acceptance-based treatment principles for weight control and physical activity promotion. The treatment manual was adapted from an existing acceptance-based behavioral weight control program that was developed by Forman and Butryn (2016); it was modified to emphasize initiation and maintenance of physical activity. The acceptance-based strategies were originally adapted from materials created by Hayes and colleagues.[45,62]

Foundational behavioral skills

Sessions 1 and 2 focused on teaching foundational behavioral skills for weight loss maintenance. Education was provided about basic principles of energy balance and nutrition. Group leaders described the common difficulty of sustaining weight losses, as well as emerging support for the importance of physical activity after initial weight loss. Participants learned how to self-monitor their weight, calorie intake, and physical activity. Goal setting for these domains of weight control was discussed. Participants were instructed to engage in MVPA as their primary form of exercise, to slowly increase MVPA until they reached and maintained 250 minutes per week, and to engage in bouts of 10 minutes or longer. The exercise prescription was as follows: 3 days × 20 min in Week 1; 4 days × 20 min in Week 2; 4 days × 25 min in Week 3; 4 days × 30 min in Week 4; 4 days × 35 min in Week 5; 5 days × 40 min in Weeks 6 and 7;

5 days × 45 min in Week 8; 5 days × 50 min in Weeks 9–12. Brisk walking was recommended as a form of MVPA that is highly feasible and sustainable. Participants also learned how to set reasonable and specific goals and form behavioral intentions. In addition, stimulus control was introduced as a strategy for promoting healthy weight control behaviors.

Flexibility

Psychological and behavioral *flexibility* was introduced as a skill necessary for facilitating long-term maintenance of behaviors, regardless of circumstances. Its opposite, *narrowness*, was defined as always responding the same way to thoughts, feelings, and situations; narrowness of responses limits one's ability to make healthy behavior changes, as alternative behaviors are not options. For example, group leaders engaged participants in discussion of all possible responses to common situations, such as finding oneself outside in the rain. In addition to going inside or otherwise finding shelter, sitting outside and playing in puddles are viable (though typically undesirable) options. The tendency to do what is desirable or comfortable limits options for behavior, and a values-consistent behavior may not be the most comfortable option. Without willingness to modify current behaviors, there will be little opportunity to change.

For example, participants were asked to consider 3 key times during their week: the first hour they are awake in the morning on weekdays and, separately, on weekends, as well as the hour after dinner each evening. Participants generated a list of all of the behaviors they could possibly engage in during those times (including exercise), identified behaviors they were most likely to engage in (and why), discussed what it would take to make a less comfortable choice, and reflected on the difference between what is possible and what they were *willing* to do. Participants considered how "pattern smashing" could position them to behave more flexibly and challenge their assumptions about what is possible (e.g., "I'm not a morning person," or "I need to watch TV at night to unwind" or "I can't go for a walk on Saturday mornings because I'm in charge of watching my kids then").

Willingness

Willingness was introduced as a core skill, rooted in a psychological stance of openness to engaging in behaviors that are less pleasurable, comfortable, or easy than an alternative behavior.[45] As exercise does not feel enjoyable to many people and as this creates a critical barrier to engagement, willingness to exercise despite discomfort or lack of pleasure may be necessary for promoting sustained exercise behavior.

As an illustration of willingness, participants were asked to consider giving up one's coat on a cold day to their shivering child. Although this behavior is associated with costs (e.g., feeling cold), it aligns with important priorities (e.g., being a nurturing parent). Similarly, exercise was identified as a behavior that might involve a perceived cost, require greater effort expended relative to other leisure activities, and produce difficult thoughts and emotions (e.g., worry about having less time to engage in other activities). The group discussed the internal experiences that can act as barriers to exercise, and identified ways in which they used an *only if* style of responding to these challenges. With this style of responding, participants operate with an agenda that indicates they will exercise only when conditions make it comfortable to do so. For example, "I will walk tomorrow morning only if the rain has stopped," "I will go to the gym on my lunch break only if I feel like I can afford the time away from my desk," or "I will take a spin class tonight only if I have the energy." The group then practiced adopting *even if* styles of responding, indicating willingness to exercise regardless of how ideal the conditions are: "I will walk tomorrow morning even if I'm going to get wet in the rain," "I will go to the gym on my lunch break even if I feel anxious about the work I have left to do," or "I will take a spin class tonight even if I feel lethargic."

Defusion

Participants also learned to gain psychological distance from internal experiences, including thoughts (i.e., "cognitive defusion"). Participants were taught to relate to their thoughts, feelings, sensations, and urges as transient cues that do not have to inflexibly dictate their behavior. To illustrate, group leaders asked participants to imagine that they felt such a lack of energy that they could not pick up a pen, which was sitting on the table in front of them. As participants imagined this, they were asked to simultaneously pick up the pen and say out loud, "I have no energy to pick up this pen, I can't pick up the pen." Participants were able to have the internal experience of "not being able to" pick up the pen and doing so anyway, showing that having a thought did not impact their ability to act against that thought. Throughout the treatment program, participants were encouraged to integrate defusion, willingness, and flexible action skills to support healthy behavior change.

Values clarification

Following from the acceptance-based treatment model, participants were taught that successful weight control requires that an individual connect specific healthy behaviors to deeply held values, to which he or she feels actively committed. In group meetings and in homework assignments, participants were asked to reflect on their reasons

for exercising and to consider how exercise could position them to pursue important activities and roles in the most important domains of their life (e.g., "I want to be fit enough to travel with my husband; I want to be healthy enough to be part of my grandchildren's lives for a long time to come"). These reasons were described as values, or principles important to them as individuals, and strategies for increasing clarity of values were taught. Participants also learned to identify discrepancies between their personal values and their chosen health behaviors, focusing on how unwillingness to experience discomfort can lead to values-inconsistent behavior (e.g., skipping planned exercise sessions). Mindful awareness of values was highlighted as a key component of engaging in exercise, and participants were encouraged to evaluate exercise-related decisions as "up" or "down" votes for their values. Behaviors consistent with values counted as "up" votes; inconsistent behaviors (such as skipping a bout of planned exercise) counted as "down" votes. A homework assignment directed participants to record their exercise decisions as "up" or "down" votes for their values. Participants also were encouraged to rely less on the "short-term mind" during decision making, which focuses on immediate reward or pleasure, and instead shift the perspective to "long-term mind," which focuses on values.

Data analysis

Data were analyzed with SPSS version 20. Feasibility and acceptability were evaluated using descriptive data. The primary outcome (change in MVPA minutes per week, as measured by accelerometer) and process measures were analyzed using repeated measures ANOVA (for overall change). As this study used a small sample to pilot test this approach, the interpretation of the results also makes note of effect sizes (η_p^2).

Results

Feasibility

Participant retention and treatment fidelity were the primary metrics for feasibility. Participants attended an average of 7.12 (SD = 2.95) of the 12 scheduled treatment sessions. Of the 16 participants who were initially enrolled in treatment, 13 completed treatment (81% retention in treatment) and 11 completed end-of-treatment assessments (69% retention in assessments). The three participants who discontinued treatment reported scheduling conflicts interfering with group; none acknowledged dissatisfaction with the program as their reason for withdrawing. Baseline differences between those who completed post-treatment assessments and those who did not were examined; no differences existed in bouted MVPA ($p = 0.22$) or total MVPA ($p = 0.33$) or any process variables (all $ps > 0.10$). With respect to treatment fidelity, 2 expert raters showed 93% overall agreement ($r = 0.99$) with fidelity ratings on a 0–10 scale. Clinician adherence to the protocol was 91%, indicating that treatment providers successfully emphasized physical activity (vs. diet or other topics) and taught acceptance-based skills as described in the treatment manual throughout the program.

Acceptability

As shown in Table 1, mean ratings of acceptability were 4 or higher (on a scale of 1–5) on 5 of 6 items. Participants found the intervention effective for increasing physical activity ($M = 4.55$). Satisfaction with the approach used to promote physical activity ($M = 4.27$) and weight loss maintenance ($M = 4.18$) was high. Acceptance-based techniques were, on average, rated as helpful for making healthy choices ($M = 4.09$). Although confidence in engaging in a high level of physical activity over the next year was high ($M = 4.18$), confidence in avoiding weight regain was below the specified threshold for acceptability ($M = 3.82$).

Participants identified the most helpful aspects of the program as (1) acceptance-based techniques (including mindfulness and defusion), (2) self-monitoring of calories and physical activity, and (3) discussion of these principles among participants. Additional open-ended feedback was elicited. Suggestions focused on increasing attention to the program's overarching framework (to improve participants' ability to organize specific content), more detailed coverage of relapse prevention, and devoting more time to participant interaction. Participants also expressed a desire for program continuation or follow-up to boost content retention and accountability, adding further support to their perception of the program's effectiveness.

Efficacy

The observed pattern of changes in MVPA is shown in Table 2. A large effect size was observed for increases in minutes of bouted physical activity over time ($p = 0.05$,

Table 1. Participant Ratings of Treatment Acceptability.

Acceptability Item	Mean	SD
Effective in helping to increase PA	4.55	0.52
Satisfied with approach for increasing PA	4.27	0.79
Satisfied with approach for weight loss maintenance	4.18	0.75
Confidence in ability to engage in high level of PA over next year	4.18	0.75
Helpfulness of ACT strategies for making healthy choices	4.09	0.70
Confidence in ability to avoid weight regain over next year	3.82	0.75

Table 2. Change in Moderate-to-Vigorous Physical Activity (MVPA).

	Baseline *M* (*SD*)	Week 6 *M* (*SD*)	Week 12 *M* (*SD*)	*F*	*p*-value	η_p^2
Total time spent in bouts of MVPA (min/week)	117.40 (137.97)	150.69 (140.59)	198.27 (112.86)	3.39	0.05	0.25
Number of MVPA bouts* per week	4.94 (5.52)	5.92 (5.55)	8.77 (4.85)	2.91	0.08	0.54
Time per bout* of MVPA (min)	19.09 (16.40)	23.78 (11.91)	23.24 (10.98)	0.85	0.44	0.08
Total time spent in MVPA (unbouted; min/week)	326.68 (152.91)	378.14 (168.32)	420.71 (142.04)	3.07	0.07	0.24

*Note: Bouted MVPA was calculated as episodes of moderate-to-vigorous exercise at least 10 minutes in duration.

$\eta_p^2 = 0.25$). Participants' average minutes in bouts of MVPA per week averaged 117.40 at baseline, 150.69 at mid-treatment, and 198.27 at end-of-treatment, an increase of 69% over the course of the program. Of the 11 participants with complete data, 8 increased bouted MVPA from baseline to post-treatment (mean at baseline = 93.21 min/week, mean at post = 214.38 min/week, average increase of 121.17 min/week) and 3 decreased bouted MVPA (mean at baseline = 181.89 min/week, mean at post = 155.30 min/week, average decrease of 26.59 min/week). Of the 11 participants with complete post-treatment data, 7 were completing 150 min/week or more of MVPA at post-treatment; 3 were exceeding the program goal of 250 min/week. At the level of a statistical trend, a large effect size was observed for participants' increases in number of bouts of MVPA per week, from approximately 5 bouts at baseline to approximately 9 bouts at end-of-treatment ($p = 0.08$, $\eta_p^2 = 0.54$). Total minutes per week spent in MVPA (unbouted) was 326.68 at baseline, 378.14 at midtreatment, and 420.71 at post-treatment ($p = 0.07$, $\eta_p^2 = 0.24$).

Weight change was not a primary outcome because 12 weeks was not expected to be long enough to observe meaningful effects for weight loss maintenance. However, descriptive information is provided here. Mean BMI at baseline was 28.9 kg/m^2 (*SD* = 4.23), indicating that after their initial (pre-study) weight loss, most participants remained overweight. Surprisingly, because the program was not designed to produce additional weight loss, participants continued to lose weight during treatment, losing an average of 4% of their pretreatment weight by the end of treatment ($p = 0.01$; $\eta_p^2 = 0.59$).

Process measures

Finally, we examined measures of acceptance-based skills emphasized in program content, as shown in Table 3. Participants showed large and significant increases in defusion. Increases at the level of a statistical trend were observed for distress tolerance, as well as for the mindful awareness subscale of the PHLMS. Increases in experiential acceptance related to physical activity were nonsignificant but observed at a medium effect size.

Discussion

Acceptance-based treatment is emerging as a promising approach to long-term behavior change in multiple domains.[49,63–67] However, little research has examined the efficacy of acceptance-based interventions to promote physical activity. Further, no previous study has focused on delivering such an intervention during weight loss maintenance, a time in which physical activity levels may be especially important. In this pilot study, clinically significant increases in physical activity were observed in completer analyses and preliminary support was gathered for intervention feasibility and acceptability. However, these data must be interpreted with caution given the uncontrolled study design and participant attrition.

This study demonstrated that it was feasible for clinicians to deliver the treatment as described in its manual. When developing this treatment, there was some concern that participants would steer exercises and discussions to be primarily focused on eating behavior and diet, rather than physical activity, or favor learning traditional behavioral skills, rather than acceptance-based skills. It is notable that treatment providers were able to stay on task throughout sessions and deliver the material as described in the treatment manual.

Participants generally rated the intervention as effective for helping them to meet physical activity goals. However, participants had notably lower ratings for their confidence that the intervention would help them avoid

Table 3. Change in Process Measures.

	Baseline *M* (*SD*)	6 Weeks *M* (*SD*)	12 Weeks *M* (*SD*)	*F*	*p*-value	η_p^2
Drexel Defusion Scale	28.18 (10.37)	37.18 (10.51)	43.27 (7.72)	24.14	0.01	0.71
PAAQ—Thoughts subscale	33.18 (6.87)	34.73 (4.88)	36.64 (4.18)	2.05	0.16	0.17
PAAQ—Barriers subscale	26.36 (5.66)	27.36 (2.38)	28.81 (2.52)	1.31	0.28	0.12
Cold Pressor (sec)	61.12 (84.78)	N/A	66.13 (83.78)	4.53	0.06	0.31
PHLMS—Awareness subscale	30.91 (6.88)	33.27 (7.21)	34.82 (6.75)	2.68	0.09	0.21
PHLMS—Acceptance subscale	36.82 (6.66)	34.18 (5.44)	35.00 (6.59)	2.35	0.12	0.19

weight regain. It is possible that participants underestimated the extent to which physical activity or acceptance-based skills more generally would help them reach weight loss maintenance goals. It also is possible that participants had particular concerns about their weight loss maintenance (e.g., emotional eating, inadequate nutrition knowledge) that were not addressed by the intervention. Participants were retained in the treatment at acceptable levels (i.e., 81% retention in treatment), but the post-treatment assessment was completed by only 69% of the sample, which may have introduced bias into interpretation of study results. This program was novel in several ways and participants may have had different expectations for what it would deliver; it is possible that retention could be improved by providing participants with more information about what to expect from treatment in terms of theoretical approach, focus on physical activity (vs. diet), and program goals for weight loss maintenance (vs. weight loss). Participants provided several suggestions for improving the treatment, such as unifying the core concepts; implementing these suggestions might increase treatment retention in the future.

At end-of-treatment, participants were engaging in approximately 200 minutes per week of bouted MVPA, an increase of 69% from baseline. This amount of increase in MVPA is clinically significant, as is the absolute amount of MVPA observed at post-treatment. Previous research has shown that there is dose-response relationship such that even relatively modest increases in MVPA (e.g., pre-post increases of 55–70 min/week) can improve glycemic control and cardiovascular risk, and that achieving 150 min/week or more of MVPA significantly reduces all-cause mortality.[68–70] Previous research also has shown than 200 min/week of MVPA may be sufficient to provide protection against weight regain.[71,72] It also is encouraging that this program, in just 12 sessions, was able to produce an amount of change similar to or greater than that typically observed in more intensive lifestyle modification programs.[71–74]

Although the observed increases in physical activity were notable, most participants did not reach the program goal of 250 min/week of MVPA bouts. It is possible that greater treatment response could be facilitated by providing a more intensive dose of treatment (e.g., more sessions) or by delivering sessions over a longer period to allow for more gradual increases in physical activity. Additional research on the dose-response relationship between exercise and weight loss maintenance, as well as between exercise and disease prevention, will likely provide guidance about the extent to which clinicians and participants should primarily focus on a uniform target of minutes per week of physical activity, or whether focusing on relative or absolute increases in physical activity from baseline is equally or more important. It also is unknown whether focusing on increasing versus reaching a target amount of physical activity facilitates greater adoption or maintenance of physical activity. The study was not designed with a sufficient follow-up period to measure weight loss maintenance, but the observed data indicated that participants' weight decreased by an average of 4% during the program. It is possible that increases in MVPA produced some of this additional weight loss, and/or that participating in the program provided motivation to make further improvements in diet.

Several participants began treatment with a higher than expected level of physical activity. (MVPA at entry to weight control programs commonly ranges from 30–60 min/week.[75,76]) It is possible that some participants were more active than expected at baseline because they began engaging in some exercise as part of their recent weight loss efforts. A ceiling effect may have limited amount of change observed among participants who were already regularly exercising. Future research should determine if the amount of benefit participants receive from the intervention depends on initial level of MVPA.

Changes in process measures suggest that participants achieved clinically meaningful increases in their ability to defuse from internal experiences, have an accepting stance toward the thoughts and barriers that can make physical activity difficult, engage in a goal-driven behavior despite physical discomfort, and maintain greater awareness of internal experiences. However, expectancy effects cannot be ruled out as a driver of these changes, particularly because change in a comparison condition cannot be evaluated. One unexpected finding was noted, in that nonsignificant but large *decreases* in mindful acceptance were observed on the PHLMS-Mindful Acceptance subscale. This measure assesses mindful acceptance as a global construct, rather than being domain specific. Given that improvements in the PAAQ were observed, it is possible that participants learned to have mindful acceptance with respect to physical activity, but did not learn to apply mindful acceptance principles more generally. It also is possible that the program did not teach this particular skill in an especially powerful or effective way.

Objective measurement of MVPA with accelerometers is a key strength of this study. This study also had several limitations that should be addressed in future research. At study entry, amount of recent weight loss and previous BMI were collected via self-report and thus were not objectively verified; future research might validate these self-report data by requiring that participants document their weight history with medical records or other sources. Due to the single group design, it is not

possible to determine how much change in MVPA and process variables was the result of particular factors such as group meetings (i.e., interactions among participants), traditional behavioral components (e.g., self-monitoring), or acceptance-based behavioral components. A randomized, controlled trial is warranted to do so. A small sample of participants was enrolled in this study. Retention at the final assessment point was 69%, and it is likely that the participants who did not complete assessments differed in a systematic way from those who did complete assessments (e.g., less satisfaction with treatment). Future research should enroll a larger sample and use rigorous methods to promote retention (e.g., use of home visits to collect data; payment or gift incentives that will sufficiently compensate participants for their time and efforts in completing assessment tasks; continued contact with participants who withdraw from treatment groups). The period of data collection also was brief, so this study does not provide information about maintenance of behavior change. Future research might deliver intervention sessions over a longer period of time and examine maintenance of physical activity during a follow-up period during which there is no or little intervention contact. This study used physical activity as the primary outcome. It did not provide information about whether these participants ultimately had better weight loss maintenance or protection against weight-related diseases or conditions as a result of their increased level of physical activity.

Conclusions

This pilot study provided some preliminary support for the notion that acceptance-based behavioral interventions delivered during weight loss maintenance may help individuals to engage in a high level of MVPA. Additionally, preliminary support for feasibility and acceptability was gathered. Future research is needed in order to replicate the study with a larger sample and controlled design to better establish the efficacy of this treatment compared to existing treatments and to evaluate the unique contributions of acceptance-based principles to treatment effectiveness. Finally, future research should determine if focusing treatment on adopting and maintaining a high level of aerobic exercise during this period renders long-term benefits for weight and health.

References

[1] Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity in the united states, 2009–2010. In: National Center for Health Statistics. 2012; 82.

[2] Basen-Engquist K, Chang M. Obesity and cancer risk: Recent review and evidence. *Curr Oncol Rep*. 2011;13:71–76.

[3] Jensen MD, Ryan DH, Apovian CM, et al. 2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. *J Am Coll Cardiol*. 2014;63:2985–3023.

[4] National Institutes of Health & National Heart L, and Blood Institutes. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: The evidence report. *Obes Res*. 1998;6.

[5] Wadden TA, Butryn ML. Behavioral treatment of obesity. *Endocrinol Metab Clin North Am*. 2003;32:981–1003.

[6] Butryn ML, Webb V, Wadden TA. Behavioral treatment of obesity. *Psychiatric Clinics of North America*. 2011;34:841–859.

[7] Anderson JW, Konz EC, Frederich RC, Wood CL. Long-term weight-loss maintenance: a meta-analysis of US studies. *Am J Clin Nutr*. 2001;74:579–584.

[8] Wadden TA, Vogt RA, Foster GD, Anderson DA. Exercise and the maintenance of weight loss: 1-year follow-up of a controlled clinical trial. *J Consult Clin Psych*. 1998;66:429–433.

[9] Catenacci VA, Grunwald GK, Ingebrigtsen JP, et al. Physical activity patterns using accelerometry in the National Weight Control Registry. *Obesity*. 2011;19:1163–1170.

[10] Catenacci VA, Ogden LG, Stuht J, et al. Physical activity patterns in the national weight control registry. *Obesity*. 2008;16:153–161.

[11] Jakicic JM, Marcus BH, Lang W, Janney C. Effect of exercise on 24-month weight loss maintenance in overweight women. *Arch Intern Med*. 2008;168:1550–1559.

[12] Schoeller DA, Shay K, Kushner RF. How much physical activity is needed to minimize weight gain in previously obese women? *Am J Clin Nutr*. 1997;66:551–556.

[13] Weinsier RL, Hunter GR, Desmond RA, Byrne NM, Zuckerman PA, Darnell BE. Free-living activity energy expenditure in women successful and unsuccessful at maintaining a normal body weight. *Am J Clin Nutr*. 2002;75:499–504.

[14] Wadden TA, Webb VL, Moran CH, Bailer BA. Lifestyle modification for obesity new developments in diet, physical activity, and behavior therapy. *Circulation*. 2012;125:1157–1170.

[15] Ogden LG, Stroebele N, Wyatt HR, et al. Cluster analysis of the national weight control registry to identify distinct subgroups maintaining successful weight loss. *Obesity*. 2012;20:2039–2047.

[16] Jeffery RW, Wing RR, Sherwood NE, Tate DF. Physical activity and weight loss: Does prescribing higher physical activity goals improve outcome? *Am J Clin Nutr*. 2003;78:684–689.

[17] Borg P, Kukkonen-Harjula K, Fogelholm M, Pasanen M. Effects of walking or resistance training on weight loss maintenance in obese, middle-aged men: A randomized trial. International journal of obesity and related metabolic disorders. *Journal of the International Association for the Study of Obesity*. 2002;26:676–683.

[18] Wadden TA, Vogt RA, Andersen RE, et al. Exercise in the treatment of obesity: Effects of four interventions on

body composition, resting energy expenditure, appetite, and mood. *J Consult Clin Psychol*. 1997;65:269.
[19] Banz WJ, Maher MA, Thompson WG, et al. Effects of resistance versus aerobic training on coronary artery disease risk factors. *Exp Biol Med*. 2003;228:434–440.
[20] Haskell WL, Lee IM, Pate RR, et al. Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation*. 2007;116:1081–1093.
[21] Aadahl M, von Huth Smith L, Pisinger C, et al. Five-year change in physical activity is associated with changes in cardiovascular disease risk factors: The Inter99 study. *Prev Med*. 2009;48:326–331.
[22] Kelley GA, Kelley KS, Vu Tran Z. Aerobic exercise, lipids and lipoproteins in overweight and obese adults: a meta-analysis of randomized controlled trials. *Int J Obes Relat Metab Disord*. 2005;29:881–893.
[23] Boulé NG, Haddad E, Kenny GP, Wells GA, Sigal RJ. Effects of exercise on glycemic control and body mass in type 2 diabetes mellitus. *JAMA*. 2001;286:1218–1227.
[24] Hurley B, Armstrong TJ. Bisphosphonates vs exercise for the prevention and treatment of osteoporosis. *The Journal for Nurse Practitioners*. 2012;8:217–224.
[25] Heath GW, Brown DW. Recommended levels of physical activity and health-related quality of life among overweight and obese adults in the United States. 2005. *J Phys Act Health*. 2009;6:403–411.
[26] Catenacci VA, Wyatt HR. The role of physical activity in producing and maintaining weight loss. *Nat Clin Pract Endocrinol Metab*. 2007;3:518–519.
[27] Adams SA, Der Ananian CA, DuBose KD, Kirtland KA, Ainsworth BE. Physical activity levels among overweight and obese adults in South Carolina. *South Med J*. 2003;96:539–543.
[28] Tudor-Locke C, Brashear MM, Johnson WD, Katzmarzyk PT. Accelerometer profiles of physical activity and inactivity in normal weight, overweight, and obese US men and women. *Int J Behav Nutr Phys Act*. 2010;7:60.
[29] Dunn AL, Marcus BH, Kampert JB, Garcia ME, Kohl HW, Blair SN. Comparison of lifestyle and structured interventions to increase physical activity and cardiorespiratory fitness. *JAMA*. 1999;281:327–334.
[30] Wilson G. Behavioral treatment of obesity: Thirty years and counting. *Advances in Behaviour Research & Therapy*. 1994;16:31–75.
[31] Perri MG, Corsica JA. Improving the maintenance of weight lost in behavioral treatment of obesity. In: Wadden TA, Stunkard AJ, eds. *Handbook of Obesity Treatment*. New York: Guilford; 2002:357–379.
[32] Müller-Riemenschneider F, Reinhold T, Nocon M, Willich SN. Long-term effectiveness of interventions promoting physical activity: A systematic review. *Prev Med*. 2008;47:354–368.
[33] Opdenacker J, Delecluse C, Boen F. A 2-year follow-up of a lifestyle physical activity versus a structured exercise intervention in older adults. *J Am Geriatr Soc*. 2011;59:1602–1611.
[34] Tate DF, Jeffery RW, Sherwood NE, Wing RR. Long-term weight losses associated with prescription of higher physical activity goals. Are higher levels of physical activity protective against weight regain? *Am J Clin Nutr*. 2007;85:954–959.
[35] Sherwood NE, Jeffery RW. The behavioral determinants of exercise: Implications for physical activity interventions. *Annu Rev Nutr*. 2000;20:21–44.
[36] Patel A, Schofield GM, Kolt GS, Keogh JWL. Perceived barriers, benefits, and motives for physical activity: Two primary-care physical activity prescription programs. *J Aging Phys Act*. 2013;21:85–99.
[37] Ekkekakis P, Parfitt G, Petruzzello SJ. The pleasure and displeasure people feel when they exercise at different intensities: decennial update and progress towards a tripartite rationale for exercise intensity prescription. *Sports Medicine (Auckland, NZ)*. 2011;41:641–671.
[38] Rhodes RE, Fiala B, Conner M. A review and meta-analysis of affective judgments and physical activity in adult populations. *Ann Behav Med*. 2009;38:180–204.
[39] Salmon J, Owen N, Crawford D, Bauman A, Sallis JF. Physical activity and sedentary behavior: A population-based study of barriers, enjoyment, and preference. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association*. 2003;22:178–188.
[40] Butryn ML, Forman E, Hoffman K, Shaw J, Juarascio A. A pilot study of acceptance and commitment therapy for promotion of physical activity. *J Phys Act Health*. 2011;8:516–522.
[41] Befort CA, Donnelly JE, Gibson CA, Smith BK, Stewart EE, Sullivan DK. Weight maintenance, behaviors and barriers among previous participants of a university-based weight control program. *Int J Obes*. 2008;32:519–526.
[42] Jeffery RW, Kelly KM, Rothman AJ, Sherwood NE, Boutelle KN. The weight loss experience: A descriptive analysis. *Ann Behav Med*. 2004;27:100–106.
[43] Deci E, Ryan RM. *Intrinsic Motivation and Self-Determination in Human Behavior*. New York: Plenum; 1985.
[44] Hayes SC, Bissett R, Korn Z, et al. The impact of acceptance versus control rationales on pain tolerance. *Psychol Rec*. 1999;49:33–47.
[45] Hayes SC, Strosahl KD, Wilson KG. *Acceptance and Commitment Therapy: The Process and Practice of Mindful Change*. New York: Guilford Press, 2011.
[46] Lillis J, Hayes SCP, Bunting K, Masuda A. Teaching acceptance and mindfulness to improve the lives of the obese: A preliminary test of a theoretical model. *Ann Behav Med*. 2009;37:58–69.
[47] Tapper K, Shaw C, Ilsley J, Hill AJ, Bond FW, Moore L. Exploratory randomised controlled trial of a mindfulness-based weight loss intervention for women. *Appetite*. 2009;52:396–404.
[48] Lillis J, Kendra KE. Acceptance and commitment therapy for weight control: Model, evidence, and future directions. *J Contextual Behav Sci*. 2014;3:1–7.
[49] Forman EM, Butryn ML, Juarascio AS, et al. The mind your health project: a randomized controlled trial of an innovative behavioral treatment for obesity. *Obesity*. 2013;21:1119–1126.
[50] Niemeier HM, Leahey T, Reed KP, Brown RA, Wing RR. An acceptance-based behavioral intervention for weight loss: A pilot study. *Behav Ther*. 2012;43:427–435.
[51] Bouten CV, Westerterp KR, Verduin M, Janssen JD. Assessment of energy expenditure for physical activity using a triaxial accelerometer. *Med Sci Sports Exerc*. 1994;26:1516–1523.

[52] Corder K, Brage S, Ekelund U. Accelerometers and pedometers: Methodology and clinical application. *Curr Opin Clin Nutr Metab Care*. 2007;10:597–603.
[53] Ward DS, Evenson KR, Vaughn A, Rodgers AB, Troiano RP. Accelerometer use in physical activity: Best practices and research recommendations. *Med Sci Sports Exerc*. 2005;37:S582–588.
[54] Troiano RP, Berrigan D, Dodd KW, Mâsse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc*. 2008;40:181.
[55] Edens JL, Gil KM. Experimental induction of pain: Utility in the study of clinical pain. *Behav Ther*. 1995;26:197–216.
[56] Keogh E, Bond FW, Hanmer R, Tilston J. Comparing acceptance-and control-based coping instructions on the cold-pressor pain experiences of healthy men and women. *European Journal of Pain*. 2005;9:591–598.
[57] Snyder CR, Berg C, Woodward JT, et al. Hope against the cold: Individual differences in trait hope and acute pain tolerance on the cold pressor task. *J Pers*. 2005;73:287–312.
[58] Butryn ML, Arigo D, Raggio GA, Kaufman AI, Kerrigan SG, Forman EM. Measuring the ability to tolerate activity-related discomfort: Initial validation of the Physical Activity Acceptance Questionnaire (PAAQ). *J Phys Act Health* 2014; 12(5):716–717.
[59] Cardaciotto L, Herbert JD, Forman EM, Moitra E, Farrow V. The assessment of present-moment awareness and acceptance the Philadelphia mindfulness scale. *Assessment*. 2008;15:204–223.
[60] Forman EM, Herbert JD, Juarascio AS, et al. The Drexel Defusion Scale: A new measure of experiential distancing. *J Contextual Behav Sci*. 2012;1:55–65.
[61] Forman EM, Butryn ML. *Effective Weight Loss: An Acceptance-based Behavior Approach*. New York: Oxford University Press, 2016.
[62] Hayes SC, Smith S. Get Out of Your Mind and Into Your Life: The New Acceptance and Commitment Therapy. Oakland, CA: New Harbinger Publications, 2005.
[63] Bricker JB, Bush T, Zbikowski SM, Mercer LD, Heffner JL. Randomized trial of telephone-delivered acceptance and commitment therapy versus cognitive behavioral therapy for smoking cessation: A pilot study. *Nicotine & Tobacco Research*. 2014:ntu102.
[64] Fledderus M, Schreurs KMG, Bohlmeijer ET, Vollenbroek-Hutten MMR. Development and pilot evaluation of an online relapse-prevention program based on acceptance and commitment therapy for chronic pain patients. *JMIR Human Factors*. 2015;2:e1.
[65] Hayes SC, Pistorello J, Levin ME. Acceptance and commitment therapy as a unified model of behavior change. *Couns Psychol*. 2012;40:976–1002.
[66] Moitra E, Herbert JD, Forman EM. Acceptance-based behavior therapy to promote HIV medication adherence. *AIDS Care*. 2011;23:1660–1667.
[67] Morrison KL, Madden GJ, Odum AL, Friedel JE, Twohig MP. Altering impulsive decision making with an acceptance-based procedure. *Behav Ther*. 2014;45:630–639.
[68] Arem H, Moore SC, Patel A, et al. Leisure time physical activity and mortality: A detailed pooled analysis of the dose-response relationship. *JAMA Intern Med*. 2015;175:959–967.
[69] Kirk A, Mutrie N, MacIntyre P, Fisher M. Effects of a 12-month physical activity counselling intervention on glycaemic control and on the status of cardiovascular risk factors in people with type 2 diabetes. *Diabetologia*. 2004;47:821–832.
[70] Samitz G, Egger M, Zwahlen M. Domains of physical activity and all-cause mortality: Systematic review and dose–response meta-analysis of cohort studies. *Int J Epidemiol*. 2011;40:1382–1400.
[71] Jakicic JM, Marcus BH, Gallagher KI, Napolitano M, Lang W. Effect of exercise duration and intensity on weight loss in overweight, sedentary women: a randomized trial. *JAMA*. 2003;290:1323–1330.
[72] Jakicic JM, Winters C, Lang W, Wing RR. Effects of intermittent exercise and use of home exercise equipment on adherence, weight loss, and fitness in overweight women: A randomized trial. *JAMA*. 1999;282:1554–1560.
[73] Group DPPR. Achieving weight and activity goals among diabetes prevention program lifestyle participants. *Obes Res*. 2004;12:1426.
[74] Wadden TA, West DS, Neiberg RH, et al. One-year weight losses in the Look AHEAD Study: Factors associated with success. *Obesity*. 2009;17:713–722.
[75] Foster-Schubert KE, Alfano CM, Duggan CR, et al. Effect of diet and exercise, alone or combined, on weight and body composition in overweight-to-obese postmenopausal women. *Obesity*. 2012;20:1628–1638.
[76] Linde JA, Jeffery RW, Crow SJ, et al. The Tracking Study: Description of a randomized controlled trial of variations on weight tracking frequency in a behavioral weight loss program. *Contemp Clin Trials*. 2015;40:199–211.