Daily Self-Monitoring of Body Weight, Step Count, Fruit/Vegetable Intake and Water Consumption: A Feasible and Effective Long-Term Weight Loss Maintenance Approach

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Abstract

Maintenance of weight loss remains a challenge for most individuals, thus practical and effective weight loss maintenance (WTLM) strategies are needed. A two-group (WEV versus WEV+) 12-month WTLM intervention trial was conducted (June 2007–February 2010) to determine the feasibility and effectiveness of weight loss maintenance intervention for older adults using daily self-monitoring of body weight, step count, fruit/vegetable intake and water consumption. Forty weight-reduced (mean weight lost = 6.7 ± 0.6 kg; BMI 29.2 ± 1.1 kg/m^2) individuals aged 63 ± 1 yrs, who had previously participated in a 12-week randomized controlled weight loss intervention trial, were instructed to record daily body weight (Weight), step count (Exercise), and fruit/vegetable intake (Vegetable). Experimental group (WEV+) participants were also instructed to consume 16 floz of water before each main meal (i.e., three times daily), and to record daily water intake. Outcome measures included weight change, diet/physical activity behaviors, theoretical constructs related to health behaviors, and other clinical measures. Statistical analyses included growth curve analyses and repeated measures ANOVA. Over 12 months, there was a linear decline in weight ($\beta = -0.32$, $P < 0.001$) and a quadratic trend ($\beta = 0.02$, $P < 0.01$) over time, but no group difference ($\beta = -0.23$, $P = 0.08$). Analysis of the 365 days of self-reported body weight for each participant determined that weight loss was greater over the study period in WEV+ than WEV, corresponding to weight changes of −0.67 kg and 1.00 kg respectively, and an 87% greater

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weight loss ($\beta = -0.01$, $P < 0.01$). Overall compliance to daily tracking was $76 \pm 5\%$. Daily self-monitoring of weight, physical activity, and fruit/vegetable consumption is a feasible and effective approach for maintaining weight loss for 12 months, and daily self-monitoring of increased water consumption may provide additional WTLM benefits.

Keywords

Weight Loss Maintenance; Water; Self-Regulation; Physical Activity; Fruits and Vegetables

INTRODUCTION

Maintenance of weight loss remains a significant challenge (1). Few people recover from even minor weight gains of 1–2 kg (2) and most regain all weight lost within three years (1, 3). These poor long-term outcomes highlight the need for practical and effective intervention strategies to maintain weight loss (4, 5). Self-regulatory strategies, such as daily self-monitoring of body weight, physical activity, and fruit/vegetable consumption, facilitate weight loss maintenance (WTLM) (3, 6–10). Daily self-weighing is associated with less weight regain and healthier lifestyle behaviors (2, 3, 7–11) and the importance of daily physical activity in weight gain prevention is well known (2, 9, 12–18). With regard to dietary strategies, increasing fruit/vegetable consumption helps to maintain weight loss, in combination with other healthy lifestyle strategies (19–23).

Water consumers ingest ~200 fewer calories per day and consume more fruits, vegetables and dietary fiber; fewer sugar-sweetened beverages and added sugars; and a less energy-dense diet (kcal/gram weight of food) than non-consumers of water (24–26). Among middle-aged and older adults (55+), consuming 16 fl oz of water 30 minutes before an ad libitum meal reduced meal energy intake compared to a no-water condition (27, 28). When combined with a hypocaloric diet, consuming 16 fl oz of water prior to each meal led to ~ 2 kg greater weight loss over 12 weeks in older adults compared to a hypocaloric diet alone (29). However, to date no studies have examined daily self-monitoring of increased water consumption as a long-term WTLM strategy.

The above mentioned weight loss approach for middle-aged and older adults (aged 55–75) may be attractive for several reasons. First, the number of obese older adults has increased in the past decade (30), making this a population which warrants additional attention (31). Second, water is widely available and inexpensive, and it has been shown to decrease energy intake and increase weight loss in this population (27–29). Increasing water consumption may also reduce risk of dehydration in a population with reduced thirst sensations (32–34). Thus, daily self-monitoring of water consumption, in combination with other behaviors that may be self-monitored (body weight, step count, fruit/vegetable consumption), could be a practical and effective WTLM self-regulation approach.

The aim of this study was to determine the feasibility and effectiveness of a WTLM intervention for older adults using daily self-monitoring of body weight, step count, fruit/vegetable intake, and water consumption. It was hypothesized that self-monitoring of increased water intake, body weight, step count, and fruit/vegetable consumption (WEV+) would be more effective at maintaining body weight than self-monitoring of weight, step count, and fruit/vegetable intake (WEV) alone.

METHODS

Participants and Recruitment

Participants were invited to participate in a 12-month single-blinded WTLM intervention (June 2007–February 2010) following completion of a 12-week randomized controlled weight loss (WL) intervention trial (July 2006–July 2008). The WL participants were overweight and obese (BMI 25–40 kg/m^2) adults aged 55–75 years who were recruited through local newspaper advertisements (29). To be included in the WL study, individuals were required to be weight stable (± 2kg, > one year), and non-smokers. Exclusion criteria were as follows: history of depression, eating disorders, diabetes, uncontrolled hypertension, heart/lung/kidney disease, cancer, or use of medications known to alter food intake or body weight (i.e. antidepressants, thyroid medications).

Procedures

Participants in the WL intervention trial were randomly assigned to one of two groups: 1) intervention group (1200–1500 kcal hypocaloric diet + 16 floz water prior to each daily main meal) or 2) control group (1200–1500 kcal hypocaloric diet alone), as previously described (29). The WL intervention did not include self-regulation, or self-monitoring strategies (29). The pre-meal water level was based upon prior research (27, 28). For the WTLM intervention, participants continued in their assigned treatment group (increased water consumption, "WEV+"; versus no increased water consumption, "WEV"); program characteristics are described below. This study protocol was approved by Virginia Tech Institutional Review Board. All participants provided written informed consent prior to study enrollment.

12-month WTLM intervention period

An overview of the study protocol is depicted in Figure 1. During the "*WEV Changed*" program, participants were instructed to record their body weight (*W*), daily physical activity (*E*) assessed by pedometer step count, and fruit/vegetable intake (*V*) using the self-monitoring tracking sheets. In addition, WEV+ was instructed to record daily water consumption. Participants were provided with a home-use digital scale (Tanita HD350, Tanita Inc., Arlington Heights, IL) and a pedometer (ACCUSPLIT Eagle AX120, San Jose, CA). WEV+ participants were provided with a 16 fl oz Nalgene water bottle with fl oz markings, and were instructed to continue consuming water as they did in the WL phase (16 fl oz, three times per day, 30 minutes prior to breakfast, lunch, and dinner). Targeted health behaviors included program and individual goals; individual goals were determined by the participant and discussed with the study coordinator. Program goals were as follows: 10,000 steps per day, five fruit and vegetable servings per day, remain at or below baseline "reduced" body weight (within 3 lbs.; 1.36kg), and consume at least 16 fl oz water three times per day (48 fl oz), prior to each main meal (WEV+ only). Although there is no standard definition of WTLM, changes in fluid balance can yield a daily weight change of ± 3 lbs (35). The intervention's criterion of successful WTLM was consistent with this figure, and that of the Study to Prevent Regain (STOP Regain) Program (3).

Participants were instructed to return tracking sheets weekly to the study coordinator for the duration of the 12-month study. Tracking sheets were returned by e-mail, or postal service if requested by the participant. For individuals who sent tracking sheets by postal service, pre-stamped and addressed envelopes were provided. Individualized feedback on goal achievement was provided weekly via e-mail or postal service for ongoing support. A feedback algorithm was utilized to standardize the feedback system.

Monthly laboratory-based assessments included body weight, four-day food intake records, resting blood pressure (BP), and an individualized counseling session with an RD. Counseling sessions varied with each participant and were based on the participant's personal need each month (e.g., holiday eating, eating while traveling, physical activity routines). Baseline assessments were repeated at six and 12 months (Figure 1).

Laboratory Measures

Body weight and composition—Height (m) was measured without shoes using a wall mounted stadiometer, and weight (kg) was measured without shoes wearing light street clothes, to the nearest 0.1 kg on a digital scale (Scale-tronix 5002, White Plains, NY). BMI was calculated as weight (kg)/height (m)^2. Waist circumference was measured to the nearest 0.5 cm at the umbilicus, using a tape measure (Gulick, Country Technology, Gays Mill, WI). Body composition was measured using dual-energy X-ray absorptiometry (DXA) (GE Lunar Prodigy; GE Healthcare, Madison, WI).

Clinical measures—Seated resting BP was measured using an automated blood pressure monitor (Colin Pressmate, Omron Co., San Antonio, TX). After a five-minute rest, measurements were taken every three minutes until two measurements were within six mmHg for systolic and diastolic BP. The average of two measurements is reported. To assess possible changes in metabolic rate over the 12-month WTLM intervention (36, 37), resting metabolic rate (RMR) was measured by indirect calorimetry using a ventilated hood and a metabolic system (Parvo Medics TrueOne 2400, Sandy, UT) (38, 39). Participants were tested 30 minutes upon awakening and after a 12-hour fast. After a 10-minute rest period on a hospital bed, inspired (O_2) and expired (CO_2) gases were collected and analyzed while participants rested quietly for a 45-minute testing period. Participants collected urine for one 24-h period for assessment of total urine volume, and specific gravity was determined using a refractometer (Fisher UriSystem; Fisher Scientific, Hampton, NH).

Health Beliefs Survey—Participants completed a questionnaire to measure the Social Cognitive Theory constructs of self-efficacy, social support, outcome expectations and self-regulation for diet and physical activity variables (40). The scales have adequate to high internal consistency (Cronbach's $\alpha = 0.68$–0.90).

Dietary intake—To assess habitual dietary intake, participants were instructed in proper methods to record four-day food intake records by an RD. Records were kept for three consecutive weekdays and one weekend day. Two-dimensional food diagrams were provided to assist participants in portion size determination. Records were reviewed for completeness and analyzed using the Nutrition Data System for Research nutrition analysis software (NDS-R 4.05, 2007, University of Minnesota, Minneapolis, MN). A second trained technician reviewed all diet analyses for data entry errors. To assess habitual beverage consumption, baseline, months six and 12 food intake records were manually reviewed to determine mean daily amounts (kcal, g) of water and other beverages consumed. Dietary energy density (kcal/g) was calculated using the baseline, six and 12-month food intake record analyses.

Statistical analyses

The sample size for the WL intervention (20 subjects/group) was determined based upon expected group differences in daily energy intake (180 kcals/day) and body weight reduction (2.0 kg) and associated standard deviations (energy intake: 200 kcal; body weight: 2.5 kg) with an alpha of 0.05 and 80% power (beta) (29). Independent samples *t*-tests were used to compare baseline demographic characteristics between groups using the Statistical Package for the Social Sciences software (SPSS version 12.0 for Windows, 2003, SPSS Inc, Chicago,

IL). When baseline group differences were present (i.e. pre-study average weight loss), those variables were used as covariates in subsequent analyses. A random coefficients (multi-level) model (i.e. growth curve analysis) was used to determine the effects of the intervention on both self-reported (daily for 365 days) and laboratory-based measures of body weight (monthly for 12 months) among the WEV+ and the WEV groups. The growth curve model was fitted using STATA 9.1 xtmixed function. Growth curve analysis, as opposed to repeated-measures analysis of variance, is able to correct for measurement unreliability, uses all of an individual's data, and utilizes individual trajectories as opposed to average value (41, 42). Two levels were used, with the first being an estimation of the individual regression for weight change over time. The second level included the predictors of the regression parameters of individual trajectories (assignment to the WEV+ or WEV condition). This model could also determine if there was a quadratic effect of time on weight change and whether there was an interaction between treatment condition and the quadratic effect of time. Because of the small sample size with the monthly measured data, bootstrapping using 1,000 samples was used to estimate bias-corrected confidence intervals by repeated re-estimation of the parameter estimates. To do this, a random samples with replacement from the original data was used (43). When data were analyzed by random coefficients model, full information maximum likelihood estimation was computed for the observed portion of each participant's data, accumulated, and then maximized to address missing data (44). Analysis of the daily self-reported body weight data over the 365-day study period provided more statistical power to test for possible group differences in weight change; daily weight change was calculated as the difference from Day 1, and a quadratic growth curve model was fitted to the weight data for participants in two groups. To assess consistency between the two sets of body weight data (i.e., monthly laboratory weights and daily self-reported weights over 365 days), the 12 laboratory weights for each participant were compared to the same days' self-reported weight using correlational analyses (Pearson's r).

Differences between groups and over time (i.e., baseline, months six and 12) in other variables were assessed using repeated measures ANOVA; when significant differences were detected, paired t-tests were used for time measures and independent samples t-tests were used as post-hoc analyses for group differences. Program compliance was determined by number of tracking days completed divided by 365. Self-reported adherence to program goals (body weight, step count, water, and fruit and vegetable consumption) was determined by number of days reported adherent to each goal divided by the number of days recorded. Group differences in criteria for successful WTLM were assessed using a Pearson's X^2. Significance level was set at P 0.05.

RESULTS AND DISCUSSION

Baseline characteristics

Forty two individuals completed the WL intervention (29) and were invited to participate in the WTLM intervention. Of these, 40 individuals aged 62.7 ± 0.9 years enrolled, and 39 individuals completed the 12-month intervention (i.e., 98% retention; Figure 1). The sample was 95% Caucasian and 55% female. There was a group baseline difference in previous weight loss (-7.7 ± 1.0kg WEV+ versus -5.7 ± 0.6kg WEV), but no significant group differences in height, body weight, BMI, and waist circumference. Clinical measures and self reported diet and physical activity expenditures are reported in the Table.

Intervention

Using the definition of successful WTLM of 3% weight regain from baseline (35), 80% of all participants were categorized as successful. There was a significant linear decline in

weight ($\beta = -0.32$, $P < 0.001$), indicating that participants in both groups lost weight over time. There was also a significant quadratic trend in weight change ($\beta = 0.02$, $P < 0.01$), indicating that weight change leveled off in the final months. There was no group difference in overall weight change using the laboratory-based weights ($\beta = -0.23$, $P = 0.08$). Monthly laboratory weights were closely associated with self-reported weights ($r = 0.99$, $P < 0.001$). Results utilizing the daily self-reported body weight data over the 365-day study period indicated that WEV+ exhibited greater weight loss over the 365 days than WEV, representing an 87% greater decline in weight ($\beta = -0.01$, $P < 0.01$) and mean weight changes of -0.67 kg and 1.00 kg, respectively (online supplemental Figure 2). Thus daily self-monitoring of pre-meal water consumption may be an effective WTLM self-regulation approach, beyond that achieved by daily monitoring of body weight, step count, and fruit/ vegetable consumption. Previous investigations have shown that as part of a WL intervention, increasing water consumption can lead to greater weight loss (29, 45) and a reduction in meal and total daily energy intake (27, 28, 46). Yet, a recent cross-sectional survey of self-reported weight loss and WTLM maintenance practices did not identify water consumption (i.e., "drink plenty of water") as a dietary strategy used more often among successful weight loss maintainers as compared to those unsuccessful at weight loss maintenance (47). The findings of this investigation are consistent with intervention trials reporting that self-monitoring of body weight and physical activity (48), and increasing fruit and vegetable consumption (49), are effective long-term weight loss and maintenance strategies. Taken together, these findings suggest that practitioners could recommend daily self-monitoring of increased water consumption, along with body weight, step count, and fruit/vegetable consumption, as a feasible and effective WTLM approach.

Clinical Measures and Behavioral Measures

As shown in the Table, WEV+ had significantly lower percent body fat at six months; however there were no other significant differences in body composition, BMI, or waist circumference. Water intake and 24-h urine volume was significantly higher in the WEV+ group compared to the WEV group at 12 months. WEV+ reported a higher mean yearly step count and fruit/vegetable intake (data not shown).

There were no group differences in scores for Social Cognitive Theory determinants of health behaviors, thus mean changes are presented. Strategies to improve self-regulation (0.2 ± 0.1), self monitoring of physical activity (0.6 ± 0.2), goal setting and planning of physical activity (0.5 ± 0.1), and friend support for dietary and physical activity behaviors increased (0.3 ± 0.1, 0.4 ± 0.2, respectively) (all $P < 0.05$). Negative dietary outcome expectations declined, while perceived positive benefits of physical activity increased (-0.3 ± 0.1, 1.4 ± 0.8, respectively). No changes were noted in self-efficacy for diet and physical activity behaviors. Collectively, improvements in these theory-based determinants of health behaviors are consistent with the intervention approach, which included self-regulation, self-monitoring, and goal setting. After four years, intervention participants in the Look AHEAD (Action for Health in Diabetes) trial achieved a mean WTLM of 4.7% of initial body weight, which suggests that behavioral interventions aimed at WTLM can achieve clinically significant long-term success (48). As with this intervention, the Look AHEAD intensive lifestyle intervention included self-weighing and diet/physical activity goal setting as interventions strategies (48).

Weekly Tracking Sheets

Overall compliance with returning tracking sheets was 76±5%, with no group difference (supplemental online Figure 3). Among WEV+ participants, self-reported adherence to the daily water intake regimen was 66±7%. The lowest level of self-reported adherence was to the physical activity goal; there were no group differences in yearly mean adherence to the

fruit and vegetable intake goal and adherence to the daily weight goal (Figure 3). Compliance with returning tracking sheets was related to successful WTLM using the < 3% of baseline weight criterion ($X^2 = 5.516$, $P < 0.05$). This finding is consistent with that reported by a nationally representative sample of successful weight-loss maintainers, who used similar behavioral strategies (i.e., tracking body, setting weight goals) (47).

Limitations

The sample size was limited and included primarily Caucasian middle-aged and older adults, who were recruited primarily through newspaper advertisements; all of which may limit generalizability. Further studies are warranted to determine program participation rate (i.e. intervention reach), in order to determine potential broader impacts of this intervention approach. Self-reported water intake compliance was less than ideal (i.e. 66%). The longer-term effectiveness (i.e. > 12 months) of this approach is not known; some have suggested that a WTLM intervention be assessed for at least five years (50), yet few trials have continued past 12 months (3, 4, 51, 52).

CONCLUSIONS

These findings indicate that daily monitoring of weight, physical activity, and fruit/vegetable consumption is an effective WTLM approach, and suggest that daily self-monitoring of increased water consumption may provide additional WTLM benefits. Future studies are warranted to determine the translation potential of effective WTLM interventions, such as within community-based settings, worksites, and medical systems, which also include formal cost analyses. Due to the December 2011 ruling by the Centers for Medicare and Medicaid which excluded registered dietitians (RD) from direct billing for intensive behavioral counseling for obesity, clinical evidence which demonstrates the effectiveness of RD-delivered WTLM interventions is clearly needed (53). These findings may serve as the methodological basis for designing large-scale, longer terms WTLM trials investigating daily self-monitoring of weight, step count, fruit/vegetable intake and water consumption.

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┌─────────────────────────────────────────┐
│ Participants from 12-week Weight Loss    │
│ Intervention Study Invited to Participate│
│ (n=42)                                   │
└─────────────────────────────────────────┘
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┌──────────────────┐  ┌──────────────┐  ┌──────────────────┐
│ Increased Water  │  │ Declined     │  │ No Increased Water│
│ Consumption Group│  │ Participation│  │ Consumption Group │
│ (n=19)           │  │ (n=2)        │  │ (n=21)            │
└──────────────────┘  └──────────────┘  └──────────────────┘
```

Baseline Assessments:

Anthropometrics (Wt, Ht, WC, BMI)   Resting BP
Health Beliefs Survey   Resting Metabolic Rate
Dietary Intake Analysis   Body Composition (DXA)
24-hr Urine Collection (Specific Gravity, Total Volume)

Weeks 1-52:
Daily "Self-monitoring" Using
Weekly Tracking Sheets:
    Weight (lbs.)
    Water (fl oz)
    Physical Activity (steps)
    Fruits and Vegetables (servings)
Create a Personal Weekly Goal
Turn in Weekly Log Sheet
Receive Weekly Tailored Feedback
by Email or Print

**Monthly Laboratory
Assessments:
Months 1-12**
Dietary and Behavioral
Counseling
Wt
Resting BP

Weeks 1-52:
Daily "Self-monitoring" Using
Weekly Tracking Sheets:
    Weight (lbs.)
    Physical Activity (steps)
    Fruits and Vegetables (servings)
Create a Personal Weekly Goal
Turn in Weekly Log Sheet
Receive Weekly Tailored Feedback
by Email or Print

Discontinued
intervention (n=1)
No reason given

6 and 12 Month Assessments:
Anthropometrics (Wt, Ht, WC, BMI)   Resting BP
Health Beliefs Survey   Resting Metabolic Rate
Dietary Intake Analysis   Body Composition (DXA)
24-hr Urine Collection (Specific Gravity, Total Volume)

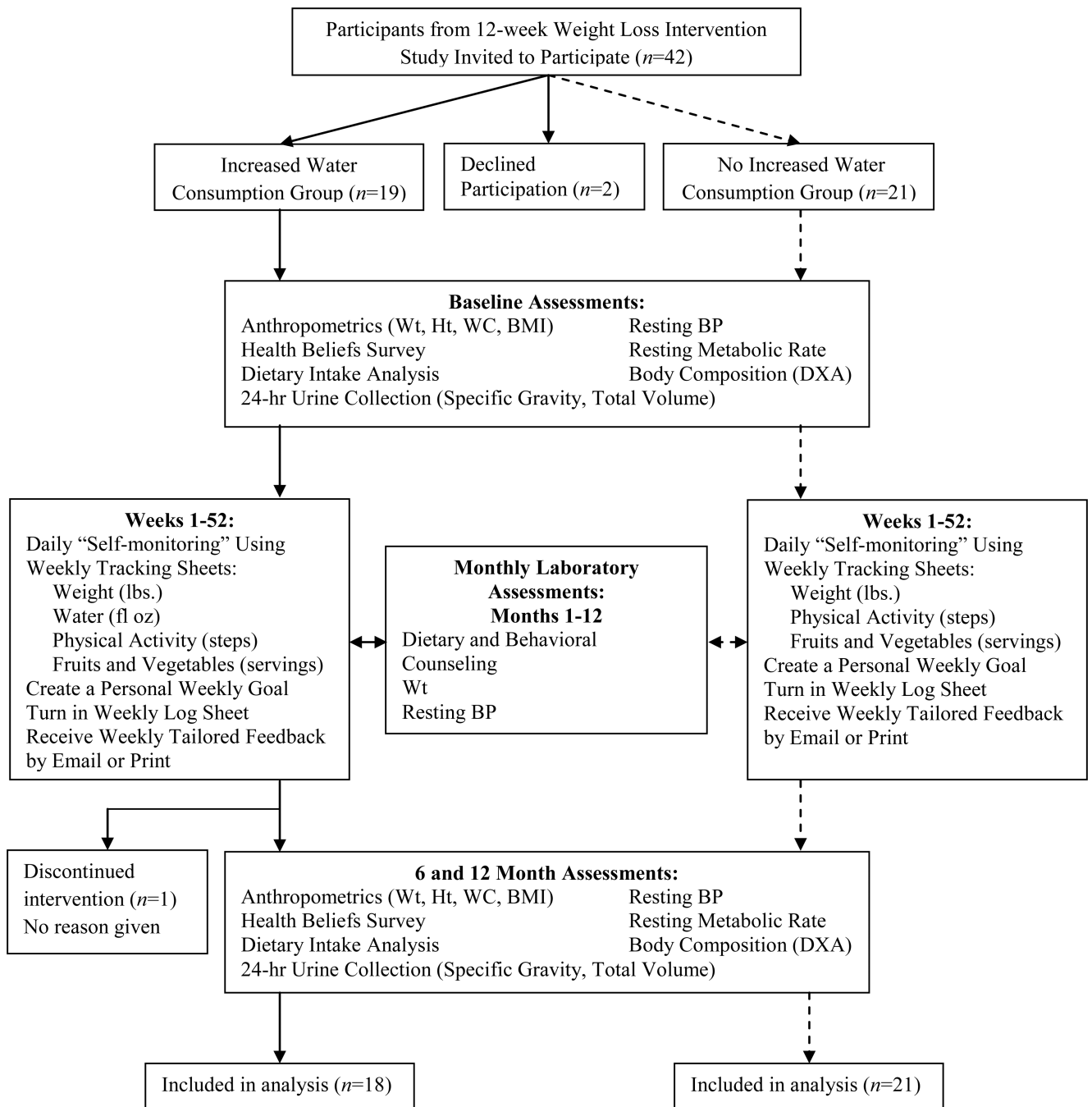Included in analysis (n=18)   Included in analysis (n=21)

Figure 1.
Study Procedures: 12-month weight loss maintenance (WTLM) intervention. Abbreviations used: DXA, dual-energy X-ray absorptiometry; BMI, body mass index; BP, blood pressure; Ht, height; WC, waist circumference; Wt, weight.
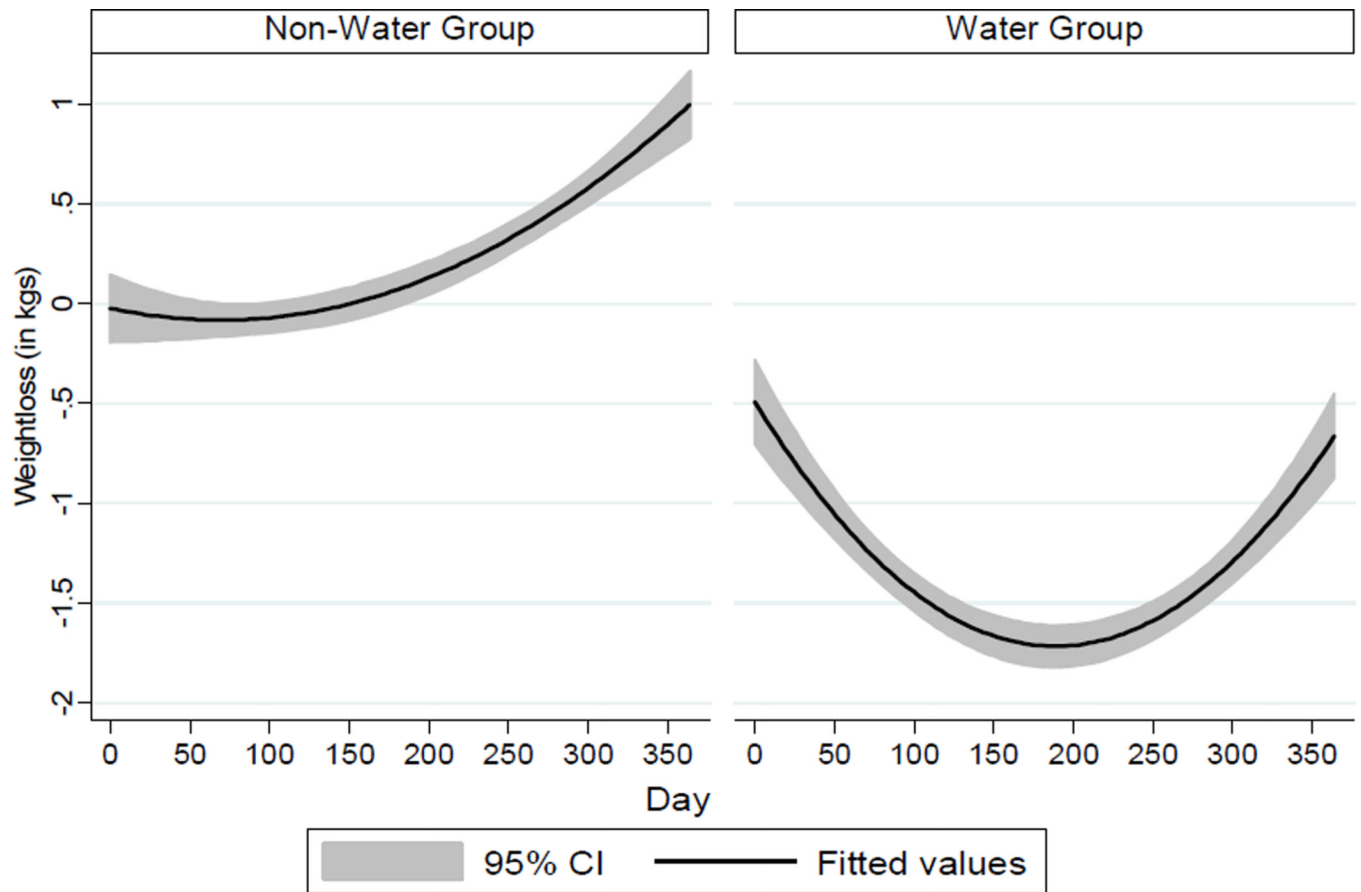
Figure 2.
Body weight change according to daily self-reported body weight among "WEV+" water and "WEV" non-water group participants over the 365-day weight loss maintenance intervention period. (Supplemental Online Figure)
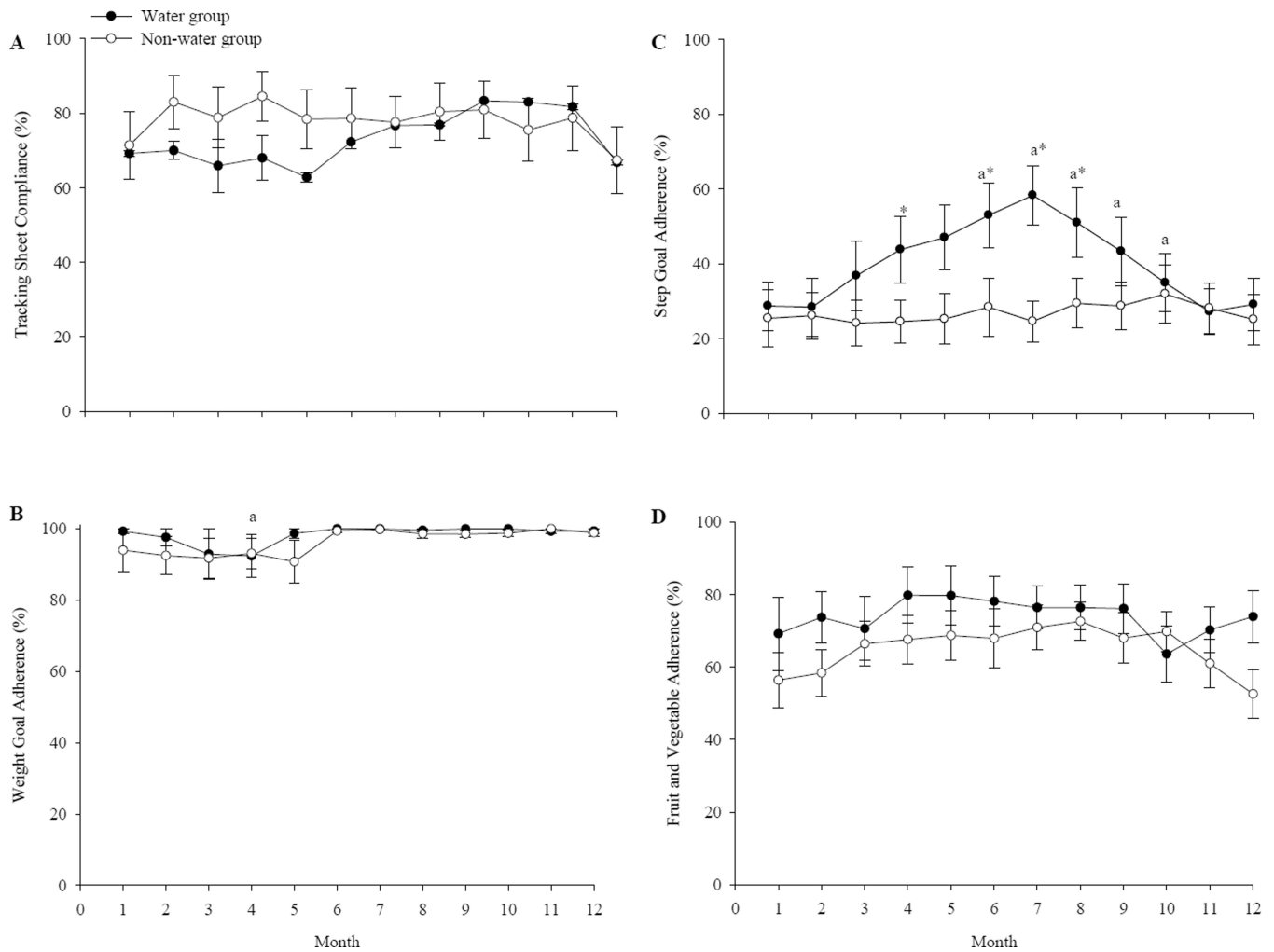
Figure 3.
Monthly program compliance and self-reported goal adherence among the "WEV+" water group and "WEV" non-water group during a 12-month weight loss maintenance intervention: (A) compliance with turning in weekly tracking sheets, (B) adherence to the program body weight goal, (C) adherence to the program step count goal, and (D) adherence to the program fruit/vegetable intake goal. [a] Significant difference versus month one (P<0.05). *Group difference P<0.05. (Supplemental Online Figure)

Table

Body composition, other clinical characteristics, and self-reported dietary intake and physical activity in the increased daily water consumption† and no increase in daily water consumption†† at baseline, six, and 12 months of the weight loss maintenance intervention*

	WEV+†			WEV††		
	Baseline	**6-month**	**12-month**	**Baseline**	**6-month**	**12-month**
Body weight, kg[a]	83.7 ± 2.7	81.4 ± 2.5	81.8 ± 2.6	82.7 ± 3.7	81.2 ± 3.9	81.6 ± 4.3
Body Mass Index, kg/m² [a, b]	29.1 ± 0.8	27.9 ± 0.7	28.6 ± 0.7	29.4 ± 1.3	29.0 ± 1.3	29.6 ± 1.5
Waist circumference, cm[a, b]	99.0 ± 2.1	95.5 ± 1.7	98.4 ± 2.2	99.2 ± 2.8	95.4 ± 2.9	98.7 ± 3.5
Body fat, %[c, d]	36.2 ± 2.2	34.6 ± 2.0	36.0 ± 2.1	38.5 ± 1.9	36.8 ± 2.2	38.5 ± 2.3
Total fat mass, kg	28.2 ± 2.3	26.8 ± 1.8	28.4 ± 2.1	30.0 ± 2.0	29.9 ± 2.3	30.2 ± 2.5
Total fat-free mass, kg	51.1 ± 2.3	51.2 ± 2.4	50.6 ± 2.3	48.1 ± 3.0	49.0 ± 3.0	48.3 ± 3.4
Systolic BP, mmHg[c, d]	124 ± 2	125 ± 2	120 ± 1	117 ± 2	115 ± 3	118 ± 3
Diastolic BP, mmHg[c]	72 ± 2	74 ± 2	74 ± 1	66 ± 2	65 ± 2	65 ± 2
RMR, kcal/day	1604 ± 50	1563 ± 58	1588 ± 49	1582 ± 78	1523 ± 66	1482 ± 83
RMR, kcal/FFM kg[c]	31.1 ± 0.7	31.2 ± 0.8	31.5 ± 0.8	33.7 ± 0.8	32.5 ± 0.8	33.3 ± 1.2
Urine volume, ml[e]	2452 ± 183	2356 ± 232	2621 ± 305	2173 ± 158	2196 ± 139	1938 ± 161
Specific gravity, UG	1.009 ± 0.000	1.011 ± 0.001	1.010 ± 0.001	1.011 ± 0.001	1.030 ± 0.016	1.013 ± 0.001
Energy, kcal/d[a,d,f]	1466 ± 101	1481 ± 101	1726 ± 121	1490 ± 90	1678 ± 98	1654 ± 170
Food Weight, g/d[c,d,e]	3242 ± 189	3152 ± 189	3562 ± 267	2458 ± 175	2587 ± 170	2620 ± 198
Carbohydrate, % energy	50.7 ± 2.9	54.4 ± 2.3	53.4 ± 2.4	50.2 ± 2.5	53.5 ± 2.4	50.2 ± 2.1
Protein, % energy	18.2 ± 0.5	18.7 ± 1.0	18.6 ± 1.1	17.0 ± 0.6	15.6 ± 0.5	17.3 ± 1.0
Fat, % energy	31.5 ± 2.2	27.8 ± 1.9	28.8 ± 1.9	31.5 ± 1.7	31.0 ± 1.8	30.8 ± 1.8
Fiber, g/d	20.5 ± 2.0	21.6 ± 2.1	23.9 ± 1.6	20.3 ± 1.6	22.9 ± 1.7	21.8 ± 2.2
Energy density, kcal/g **	0.48 ± 0.04	0.49 ± 0.04	0.51 ± 0.04	0.63 ± 0.05	0.69 ± 0.06	0.68 ± 0.06
Beverages only:						
Total beverages, kcal/d	144 ± 16	174 ± 28	134 ± 17	195 ± 32	197 ± 34	211 ± 33
Total beverages, g/d[c,d,e]	2276 ± 166	2067 ± 204	2279 ± 206	1454 ± 138	1485 ±170	1493 ± 213
Water, g/d[c,d,e]	1548 ± 295	1073 ± 147	1241 ± 144	349 ± 96	495 ± 134	451 ± 132
Non-water beverages, g/d	1078 ± 161	1042 ± 99	1014 ± 120	1103 ± 112	1292 ± 298	1041 ± 149

	WEV+[†]			WEV[††]		
	Baseline	6-month	12-month	Baseline	6-month	12-month
Weekly tracking sheet variables [***]:						
Physical activity, steps/d[e]	9582 ± 605	8225 ± 752	9137 ± 762	8104 ± 735	7295 ± 729	7859 ± 711
Fruit and vegetable, servings/d	5.6 ± 0.4	5.4 ± 0.3	5.6 ± 0.3	5.6 ± 0.3	5.1 ± 0.4	5.2 ± 0.3
Water, fl oz/d	47.7 ± 4.4	49.9 ± 3.1	50.1 ± 4.3	___	___	___

Data are presented as mean ± standard error of the mean.

[†]WEV+

[††]WEV

[a]Significant main effect of time, baseline to six months (P<0.01).

[b]Significant main effect of time, six to 12 months (P<0.01).

[c]Significant group difference at baseline (P<0.05).

[d]Significant group difference at six months (P<0.05).

[e]Significant group difference at 12 months (P<0.05).

[f]Significant main effect of time, baseline to 12 months (P<0.05).

[*]Abbreviations: BP, Blood pressure; FFM, Fat free mass; RMR, Resting metabolic rate; UG, Urine Specific Gravity

[**]Calculated with all foods and beverages, including water.

[***]Baseline data is the average of weeks one through four (month one), six month data is the average of weeks 25 through 28, and 12 month data is the average of weeks 49–52 of the weight loss maintenance intervention.