Steps to Health Employee Weight Management Randomized Control Trial

Short-Term Follow-Up Results

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Objective: To present the short-term follow-up findings of the Steps to Health study, a randomized trial to evaluate the effectiveness of two employee weight management programs offered within Duke University and the Health System. **Methods:** A total of 550 obese (body mass index, ≥30 kg/m^2) employees were randomized 1:1 between January 2011 and June 2012 to the education-based Weight Management (WM) or the WM+ arm, which focused on behavior modification. Employees were contacted to complete a follow-up visit approximately 14 months after baseline. **Results:** There were no clinically, or statistically, meaningful differences between arms, but there were modest reductions in body mass index, and positive, meaningful changes in diet and physical activity for both arms. **Conclusions:** The modest positive effects observed in this study may suggest that to achieve weight loss through the workplace more intensive interventions may be required.

Obesity remains a public health epidemic. Worksite interventions for weight management can reach large numbers of adults by targeting the more than 100 million Americans who spend most of their waking hours at work.[1] Worksites generally function as systems for communication, education, and social support, and offer a unique recurring setting for repeated contacts with program participants as well as a social environment that can influence norms and expectations.[1,2] Even with moderate intervention effects, approaches that target large groups could yield important public health benefits.[3,4]

Health promotion theories are frequently used in combination with workplace weight management programs.[5,6] Specific strategies used in these interventions vary in intensity, scope, and cost. Informational strategies such as e-mail communications, posters, and classes have shown some effect[7,8] and can reach large numbers of people at low cost. More resource-intensive behavioral strategies such as one-on-one coaching, self-monitoring, and access to fitness centers are also common with worksite weight management programs, may show somewhat better effects on weight,[6,8,9] and be associated with higher employee satisfaction.[10]

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A 2009 review[8] found that, overall, workplace weight management programs for overweight and obese employees resulted in a modest mean net loss of 2.8 lb at 6 to 12 months from program initiation. That review attempted to look at difference in weight loss by program components (eg, behavioral or educational interventions), but was unable to draw conclusions on the basis of limited evidence. More recent reviews of outcomes of workplace interventions[11–14] to increase physical activity have deemed the results of such programs to be inconclusive, and all concluded that further well-designed studies were needed. A 2011 review found that interventions targeting both diet and physical activity were moderately effective at reducing body weight, but did not comment on the differences in outcomes by the types of program components offered.[6] Finally, the RAND review of workplace wellness programs[15] found that participation in a weight control program at work was associated with the same-year reduction in body mass index (BMI) of about 0.15 units, but that review did not address change in weight by program type (examples of which were educational and behavioral interventions, weight-loss competitions, and meal delivery programs).

Many of the studies demonstrating the potential effectiveness of workplace wellness interventions on weight have not been randomized controlled trials.[4,16,17] These studies found clinically relevant reductions in weight or BMI among employees who participated in the wellness programs. Although there has been a number of randomized controlled trials of workplace programs that measured weight or BMI change, most of these were targeted at disease prevention and management (ie, diabetes or cardiovascular disease), and only a few had weight loss as their primary target.[8] Randomized controlled trials that have demonstrated positive effects on weight loss often had small sample sizes.[18–20] These limitations highlight the need for larger randomized controlled trials of workplace weight loss programs.

The primary goal of the Steps to Health study is to determine the effectiveness of a behavioral worksite weight control program relative to an established "usual standard of care" educational worksite weight control program at reducing BMI through improved lifestyle behaviors. Using a randomized controlled trial design, employees were assigned to one of the two preexisting worksite weight management programs with different components (one was primarily educational, whereas the other offered more extensive behavioral coaching) and intensity levels. The primary endpoints for Steps to Health study are change in BMI from baseline to immediately postintervention (14 months after baseline), and from baseline to long-term follow-up (26 months after baseline). We present immediate postintervention outcomes in this article. We also present secondary outcomes—change in diet and physical activity behaviors related to weight, changes in planning and goal setting behaviors around diet and activity, as well as the effects of program participation on outcomes. Finally, potential predictors of weight loss and participation were examined.

We hypothesize that participants assigned to the more intensive intervention, involving behavioral coaching, will lose more weight and show greater improvement in dietary and exercise behaviors than participants in the educational intervention. We also hypothesize that greater program participation will result in larger reductions in BMI at the immediate postintervention follow-up.

MATERIALS AND METHODS

Interventions, Study Population, Recruitment, and Randomization

The rationale and design of the study, including the interventions and their components, have previously been described in detail.[21] Briefly, the target population was obese (BMI, $\geq$30 kg/m^2) employees at Duke University and within the Duke University Health System. Participants were identified by employee health nurses at complimentary health screening events between January 2011 and July 2012. Health screenings are an ongoing employee wellness benefit offered at the time of hire and annually to all employees; screenings are conducted at locations all across the workplace multiple times per month. Employees were identified as potentially eligible on the basis of having a measured BMI of 30 kg/m^2 or more, and having completed an annual health risk appraisal. Interested employees were approached by study staff, screened for eligibility, and consented. To be eligible for the study, employees must have been benefit-eligible, enrolled in one of the health insurance programs offered through Duke, and not planning to leave Duke during the next 12 months. Current pregnancy precluded inclusion, as did enrollment in the weight management program as a means to qualify for bariatric surgery. All participants provided informed consent. The study was approved by the Duke University Health System Institutional Review Board and is registered on the clinicalTrials.gov Web site (number NCT01299051).

Upon completion of baseline measures, participants were randomized 1:1 to one of the two pre-existing weight management programs offered at Duke (Weight Management [WM], or Weight Management Plus [WM+]). Both programs are grounded in current health promotion theories but differ in focus (educational vs behavioral), intensity, frequency, and resource requirements. Both programs are considered wellness benefits offered by Duke Human Resources, and made available to all benefit-eligible employees. The combined programs have had, on average, 800 participants per year before the start of this study, and saw an increase of 1000 participants per year since this study began.

WM+ is focused on behavior modification and is informed by social cognitive theory[22,23] and the transtheoretical model.[24,25] It involves once-a-month contacts with a health coach who provides relevant materials, helps with goal-setting, encourages self-monitoring to boost self-efficacy, and assists in problem solving and reduction of barriers. The intervention is stage-based, and counselors work with the participant at his/her level of readiness to change using, motivational interviewing.[26] The WM+ program was originally based on the employee health and wellness program offered at Johnson & Johnson.[27–29] This program has been offered at Duke for the past 15 years and is well established and supported within the institution. Participants in the WM+ program have (1) monthly meetings with a health coach (in person at months 1, 4, 8, and 12, and the rest via telephone), (2) optional meetings at months 2 and 5 with an exercise physiologist, (3) quarterly biometric feedback, (4) targeted health education materials, and (5) information and active linking with various Duke programs and wellness resources.

The WM program was developed at Duke 10 years ago and incorporates portions of the WM+ program, but without the behavioral modification coaching aspect. This program relies mostly on educating participants about weight management strategies, and is informed by constructs of the information processing paradigm. WM leverages the concept of frequent exposure to health to weight management tips, delivered via e-mail or print, in attractive packaging. WM also offers three contacts with a health coach (one in-person meeting in month 1, and one contact via the telephone in months 6 and 12), and optional meetings at months 2 and 5 with an exercise physiologist and with a nutritionist (a total of four optional meetings over the course of the study). The coaching contacts focus discussions on self-reported weight, as well as educational materials.

In both programs, the health coaches are required to be registered dieticians. All coaching contacts are made during work hours, with the coaches traveling to the participant's work location for in-person meetings. Individual work areas set policies for time related to participation in these programs; some employees are allowed to have "release time" to complete coaching sessions, whereas others have to complete the sessions during their break times. Both programs last 12 months, and to accommodate the additional time needed for the program to assign a health coach after randomization and conduct an initial in-person visit, the immediate postintervention was scheduled 14 months after the date of randomization. Immediate postintervention follow-up data collection was completed in October 2013.

Measures

Assessments were collected at study entry ("baseline") and postintervention ("follow-up"). Standardized, measured weights and heights were collected using a Seca (Hamburg, Germany) portable stadiometer (baseline only) and a Tanita (Tokyo, Japan) BWB-800 scale. Participants were weighed and measured wearing minimal street clothing and without shoes. Weights of 2% ($n = 10$) at follow-up were self-reported (participants moved away or otherwise unavailable); these weights were either measured by a doctor ($n = 8$) or collected from another calibrated scale ($n = 2$).

Dietary intake was measured at baseline and follow-up using self-reported measures. Daily intake of fruits and vegetables was assessed with the National Cancer Institute fruit and vegetable screener,[30,31] and the estimated percentage of energy intake derived from fat was measured using the National Cancer Institute fat screener questions.[32,33] Participants also reported on estimated intake of sodas and other sweetened beverages (daily frequency and serving sizes), as these beverages were specifically targeted in both intervention arms as a means to decrease sugar and caloric intake.

Physical activity was assessed at baseline and follow-up using Actical accelerometers (model #198-0302, Mini-Mitter Co. Inc, Bend, Oregon). Participants were asked to wear the monitors during waking hours for 7 days. Participants were included in the analysis if they wore monitors for at least 8 hours on 4 days. Data reduction programs were used to determine the mean number of minutes of moderate-to-vigorous physical activity and sedentary time per day. These programs were based on the National Health and Nutrition Examination Survey[34] using the cut points of 1535 counts or more per epoch for moderate-to-vigorous physical activity and less than 100 counts per epoch for sedentary time.[35]

Social-Cognitive Factors

Self-regulation of physical activity was assessed using the Exercise Goal-Setting and Planning scales.[36] We created a similar scale to measure self-regulation for healthy eating through goal-setting and planning behaviors. All four measures were composed of 10 items each, scored on a five-point Likert-type scale ranging from 1 (does not describe) to 5 (describes completely), and a mean score was calculated for each scale. Cronbach α values for the scales at follow-up were all found to be at least in the acceptable range, and most were highly reliable (physical activity goals: $\alpha = 0.94$;

physical activity plans: $\alpha = 0.77$; healthy eating goals: $\alpha = 0.93$; healthy eating plans: $\alpha = 0.66$).

Intervention Participation

Data about participation in the intervention were collected by coaches in both arms. Coaches recorded the number of completed intervention activities and mode of completion (face-to-face visit, phone call, or material mailing). The WM program included a total of seven possible coaching sessions (including the four optional diet and physical activity consultations), whereas the WM± arm included a total of 12 possible coaching contacts. Because each program has a different potential number of coaching sessions and activities, the percentage of intervention participation was calculated for each participant by dividing the completed number of coaching contacts (either face-to-face sessions or phone calls, sessions that only involved mailings of materials were excluded, as receipt of and engagement with these could not be assessed) by the number possible (eg, if a participant in WM completed four of the seven possible contacts, they would have completed 57% of the intervention).

Statistical Methods

The statistical design of this study was described in detail previously.[21] The *t* test was to be used with a one-sided α of 0.025 to test for a program difference in BMI change from baseline to 36-month follow-up. With 275 participants per arm, the *t* test has 90% power when the true standardized mean arm difference is 0.29. According to Cohen,[37] this effect size is "small" in size.

The purpose of this article is to estimate arm differences in change in BMI and several behavioral outcomes from baseline to 14 months. One hundred ten of the 550 randomized subjects (20%) did not have BMI measured at 14 months, and these subjects were not used in the analysis of the BMI outcome. On psychosocial outcomes, if a subject missed no more than one question on a scale, we used the mean of the rest of the questions from that scale to impute the missing item; if multiple questions were skipped then the subject was not used in the analysis. For the diet and physical activity outcomes, subjects who missed even one question on a scale were not used in the analysis. Arm differences on all endpoints were estimated in general linear regression models controlling for the baseline value of the outcome variable, race (white vs others), sex, and age. These same variables were also assessed in a general linear regression model for their association with percentage of participation. The association between change in weight and percentage of participation was graphically displayed. *P* values are presented without judging their statistical significance. In a sensitivity analysis of BMI, we included individuals with missing weight at the 14-month follow-up by carrying their baseline measurement forward (ie, assuming no change in weight).

RESULTS

Participants

Of the 876 employees approached about the study, 550 were randomized (see Fig. 1 for CONSORT diagram). Two participants who completed the 14-month follow-up were excluded from these analyses because of having had bariatric surgery between the baseline and follow-up assessment, and an additional three were excluded because of pregnancy. Of the remaining 545 participants, 435 (80%) provided at least a weight measurement at the 14-month assessment (220 WM; 215 WM+), and were included in the primary analyses. Eighty-four percent of the participants (367 of the 435) completed all follow-up measures.

Baseline Characteristics (Tables 1 and 2)

Table 1 describes the baseline characteristics of the 550 randomized subjects, whereas Table 2 describes the baseline characteristics of the analysis sample ($n = 435$). The demographic characteristics of the analysis sample closely approximated those of the randomized sample and were primarily female (84%), with a majority African American/Black (53%) and a mean age of 45 years.

Follow-Up Assessments Postintervention

The mean BMI reduction for the two arms combined was only 0.30 units (standard error [SE] = 0.10); however, 16% of participants ($n = 71$) had a reduction in their BMI of 2 units or more. Although the mean weight loss was 1.9 lb (standard deviation, 13.0), 25 participants (6%) *lost* 10% or more of their baseline body weight, and 12 participants (3%) had a weight *gain* of 10% or more. The WM participants lost 0.25 BMI units (95% confidence interval [CI], −0.53 to 0.02), and the WM+ participants lost 0.36 BMI units (95% CI, −0.66 to 0.05). Nevertheless, there was no clinically and statistically meaningful difference between the two arms in change in BMI (mean difference of 0.10 units; SE, 0.21; $P = 0.65$).

In secondary sensitivity analyses, assuming no change in weight from baseline for those participants who were missing a weight measurement at follow-up, participants in the WM arm lost 0.21 BMI units (95% CI, −0.43 to 0.01), and the WM+ participants lost 0.28 BMI units (95% CI, −0.52 to −0.04). The mean difference between the two arms in change in BMI was 0.08 units (SE, 0.17; $P = 0.69$).

There were no statistically or clinically meaningful differences between the arms in change in diet or in physical activity measures (Table 3). On the other hand, both arms showed a decrease in mean daily ounces of sugar-sweetened beverages consumed: 6.49 ounces in WM (95% CI, −9.35 to −3.63; $P < 0.0001$) and 5.66 ounces in WM+ (95% CI, −2.09 to 0.94; $P = 0.0001$). The WM+ arm showed a decrease in mean BMI of 0.36 units (95% CI, −0.66 to −0.05; $P = 0.02$), an increase in mean daily servings of fruit and vegetables of 0.30 servings (95% CI, 0.04 to 0.57; $P = 0.02$), and a decrease in mean percentage of energy intake of fat of 1.52% (95% CI, −2.09 to −0.94; $P < 0.0001$). The WM arm showed an increase in mean moderate-to-vigorous physical activity of 0.17 min/hr/d (95% CI, 0.05 to 0.30; $P = 0.007$) and a reduction in mean sedentary time of 1.3 min/hr/d (95% CI, −2.4 to −0.2; $P = 0.02$).

Mean participation in the intervention, defined as the number of completed coaching contacts, was 2.74 visits (out of a possible 7 total) or 39.2% in the WM arm and 6.76 visits (out of a possible 12 total) or 56.3% in the WM± arm. Figure 2 presents the association between intervention participation and weight change in pounds. Mean weight change in both arms was lower with lower participation in the program. In the WM arm, the mean weight change was −3.8 lb in those with 0% participation ($n = 21$), and −4.7 lb in those with 100% participation ($n = 7$), whereas in the WM+ arm the mean weight change was +3.3 lb in those with 0% participation ($n = 23$), and −5.8 lb in those with 100% participation ($n = 44$). The univariate *P* value for the association between participation (percentage of completed out of total possible sessions in each arm) and mean weight change was 0.004 for both arms combined.

Table 4 presents the predictors of percentage of participation in the intervention. Significant predictors were younger age ($\beta = 0.46$; SE, 0.14; $P = 0.001$), a smaller baseline BMI ($\beta = -0.49$; SE = 0.22; $P = 0.02$), and being in the WM+ arm ($\beta = 17.12$; SE, 2.71; $P < 0.0001$).

DISCUSSION

There were no clinically or statistically meaningful changes in BMI or diet and physical activity measures between the more intensive, behavioral, intervention arm (WM+) and the less intensive, educational, arm (WM). Nevertheless, the positive, although modest, changes observed in both arms were encouraging. There was a reduction in mean BMI in both arms, which corresponded to $P \leq 0.05$ in the WM+ arm. There were also changes in the weight-related

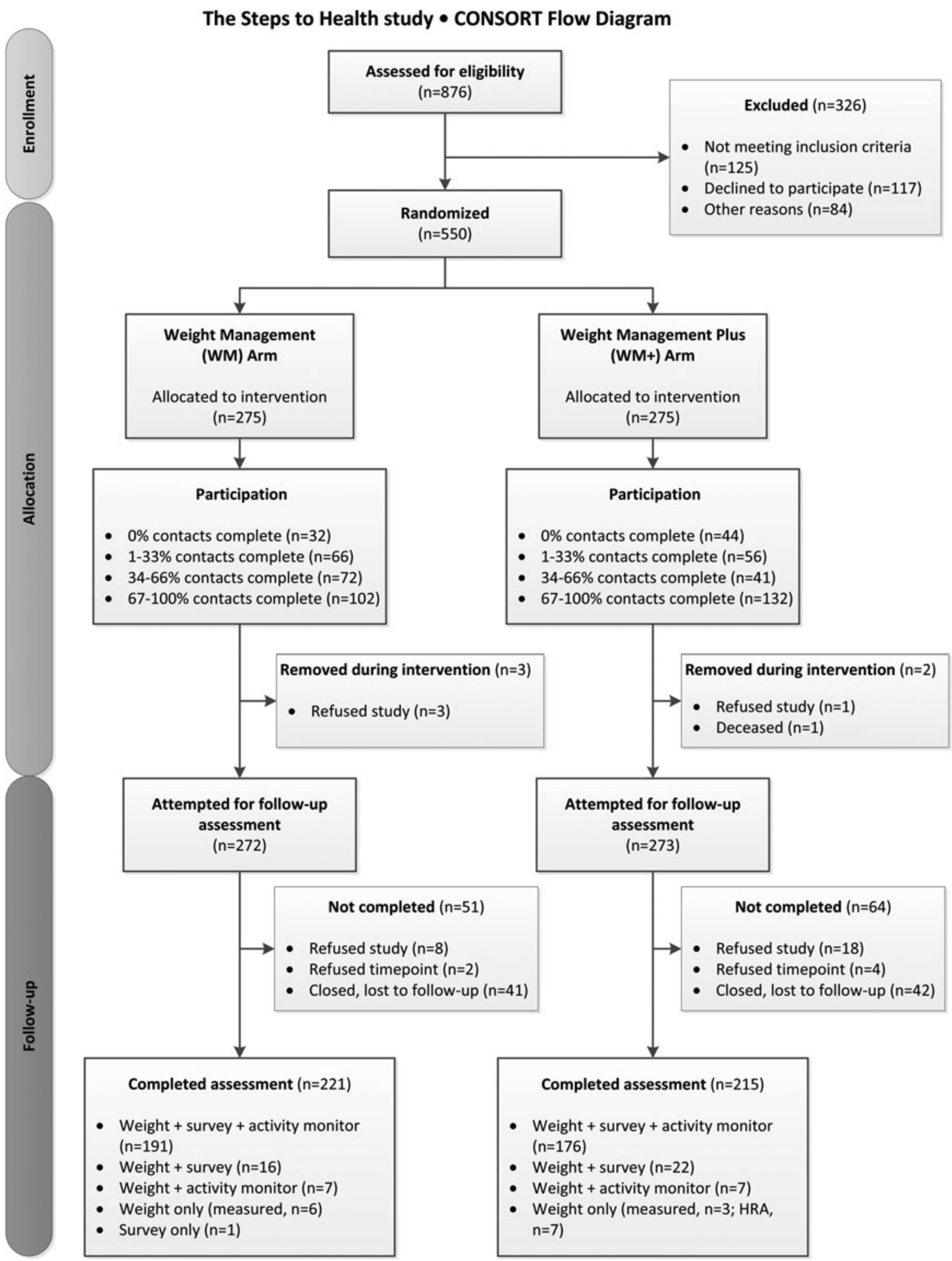


FIGURE 1. CONSORT.

health behaviors (diet and physical activity) for both arms. There was a clinically significant trend indicating greater reductions in weight with greater participation in the intervention.

Our findings are similar to other recent analyses of employee weight management programs.[4,15–17] In a randomized study of a weight management program for overweight and obese hotel workers, Williams et al[17] demonstrated weight loss in the intervention arm, which was not significant when compared with the control arm. A smaller pilot program offering a behaviorally-based change education program also found nonsignificant reductions in BMI for participants in the intervention arm.[4] One recent study evaluating a behavior-change program offered to teachers and state employees did find significant reductions in BMI,[16] but that program did not include a randomized control arm.

TABLE 1. Distribution of Baseline Characteristics by Arm for All Randomized Participants

Variable	WM (*n* = 275)	WM+ (*n* = 275)	Total (*n* = 550)
Sex, female, *n* (%)	227 (83)	230 (84)	457 (83)
Age group, yrs, *n* (%)			
<35	53 (19)	42 (15)	95 (17)
35–50	134 (49)	133 (48)	267 (49)
>50	88 (32)	100 (36)	188 (34)
Race, *n* (%)			
White	115 (42)	112 (41)	227 (41)
Black	144 (52)	149 (54)	293 (53)
Other races	16 (6)	14 (5)	30 (5)
Ethnicity, Latino/a	9 (3)	6 (2)	15 (3)
Job classification, *n* (%)			
Housekeeping, maintenance, and other service	27 (10)	31 (11)	59 (11)
Office support	75 (28)	84 (31)	161 (29)
Nursing and patient care	64 (23)	65 (24)	129 (23)
Research and technology support	53 (19)	51 (19)	104 (19)
Management and faculty	54 (20)	41 (15)	97 (18)
Baseline values for outcome variables, mean (SD)			
BMI	37.02 (6.14)	37.37 (6.61)	37.20 (6.38)
Daily servings of fruit and vegetables (*n* = 548)	2.52 (2.14)	2.22 (1.92)	2.37 (2.03)
Daily percentage of energy from fat (*n* = 530)	32.97 (4.91)	33.76 (5.75)	33.36 (5.35)
Daily ounces of sugar-sweetened beverages (*n* = 539)	18.05 (26.55)	17.64 (25.12)	17.85 (25.82)
MVPA, min/hr/d (*n* = 492)	0.87 (0.73)	0.90 (0.81)	0.89 (0.77)
Sedentary, min/hr/d (*n* = 492)	47.18 (3.28)	46.82 (3.52)	47.00 (3.40)
Baseline values for psychosocial measures, mean (SD)			
Exercise goals (*n* = 543)	2.10 (0.89)	2.16 (0.92)	2.13 (0.90)
Exercise plans (*n* = 543)	2.26 (0.64)	2.29 (0.78)	2.28 (0.72)
Healthy eating goals (*n* = 544)	2.20 (0.95)	2.29 (0.92)	2.25 (0.93)
Healthy eating plans (*n* = 544)	2.36 (0.78)	2.37 (0.62)	2.27 (0.70)

BMI, body mass index; MVPA, moderate-to-vigorous physical activity; SD, standard deviation; WM, Weight Management; WM+, Weight Management Plus.

TABLE 2. Distribution of Baseline Characteristics by Arm for Participants Used in the Analyses*

Variable	WM (*n* = 220) *n* (%)	WM+ (*n* = 215) *n* (%)	Total (*n* = 435) *n* (%)
Sex, female	185 (84)	180 (84)	365 (84)
Age group, yrs			
<35	41 (19)	28 (13)	69 (16)
35–50	111 (50)	103 (48)	214 (49)
>50	68 (31)	84 (39)	152 (35)
Race			
White	95 (43)	87 (40)	182 (42)
Black	115 (52)	117 (54)	232 (53)
Other races	10 (5)	11 (5)	21 (5)
Ethnicity, Latino/a	5 (2)	3 (1)	8 (1)
Job classification			
Housekeeping, maintenance, and other service	18 (8)	24 (11)	42 (10)
Office support	63 (29)	65 (30)	128 (29)
Nursing and patient care	51 (23)	50 (23)	101 (23)
Research and technology support	41 (19)	41 (19)	82 (19)
Management and faculty	47 (21)	35 (16)	82 (19)

*Must have provided at least a weight at the time of the follow-up visit to be included in the analysis sample.
WM, Weight Management; WM+, Weight Management Plus.

TABLE 3. Change in BMI, Health Behaviors, and Psychosocial Factors by Arm*

Variable	WM		WM+		Difference between arms	
	Baseline Mean (SE)	Change Mean (95% CI)	Baseline Mean (SE)	Change Mean (95% CI)	(WM+) − (WM) Mean (SE)	P†
Weight						
BMI (n = 220 in WM; n = 215 in WM+)	37.09 (0.41)	− 0.25 (−0.53 to 0.02)	36.94 (0.40)	− 0.36 (−0.66 to −0.05)	− 0.10 (0.21)	0.65
Health behaviors						
Dietary intake (FFQ)						
Fruit and vegetable servings (n = 206 in WM; n = 196 in WM+)	2.52 (0.15)	− 0.20 (−0.51 to 0.13)	2.25 (0.13)	0.30 (0.04 to 0.57)	0.50 (0.21)	0.07
Percentage of energy from fat (n = 201 in WM; n = 186 in WM+)	32.91 (0.34)	− 0.54 (−1.20 to 0.11)	33.88 (0.39)	− 1.52 (−2.09 to −0.94)	− 0.97 (0.45)	0.17
Ounces of sugar-sweetened beverages (n = 199 in WM; n = 193 in WM+)	18.85 (1.96)	− 6.49 (−9.35 to −3.63)	16.23 (1.76)	− 5.66 (−8.53 to −2.79)	0.83 (2.06)	0.58
Accelerometer activity‡						
MVPA, min/hr/d (n = 144 in WM; n = 140 in WM+)	0.83 (0.06)	0.17 (0.05 to 0.30)	0.90 (0.07)	0.04 (−0.10 to 0.19)	− 0.13 (0.10)	0.26
Sedentary, min/hr/d (n = 144 in WM; n = 140 in WM+)	47.52 (0.25)	− 1.31 (−2.42 to −0.20)	46.82 (0.30)	− 0.37 (−1.41 to 0.66)	0.94 (0.77)	0.54
Psychosocial measures						
Exercise goals (n = 196 in WM; n = 191 in WM+)	2.08 (0.06)	0.22 (0.09 to 0.35)	2.20 (0.07)	0.17 (0.05 to 0.30)	− 0.04 (0.09)	0.95
Exercise plans (n = 196 in WM; n = 190 in WM+)	2.23 (0.04)	0.12 (0.03 to 0.22)	2.29 (0.05)	0.16 (0.05 to 0.28)	0.04 (0.08)	0.34
Healthy eating goals (n = 197 in WM; n = 191 in WM+)	2.21 (0.07)	0.30 (0.15 to 0.44)	2.32 (0.07)	0.23 (0.10 to 0.37)	− 0.06 (0.10)	0.97
Healthy eating plans (n = 197 in WM; n = 191 in WM+)	2.38 (0.04)	0.13 (0.04 to 0.21)	2.40 (0.04)	0.12 (0.04 to 0.21)	− 0.01 (0.06)	0.92

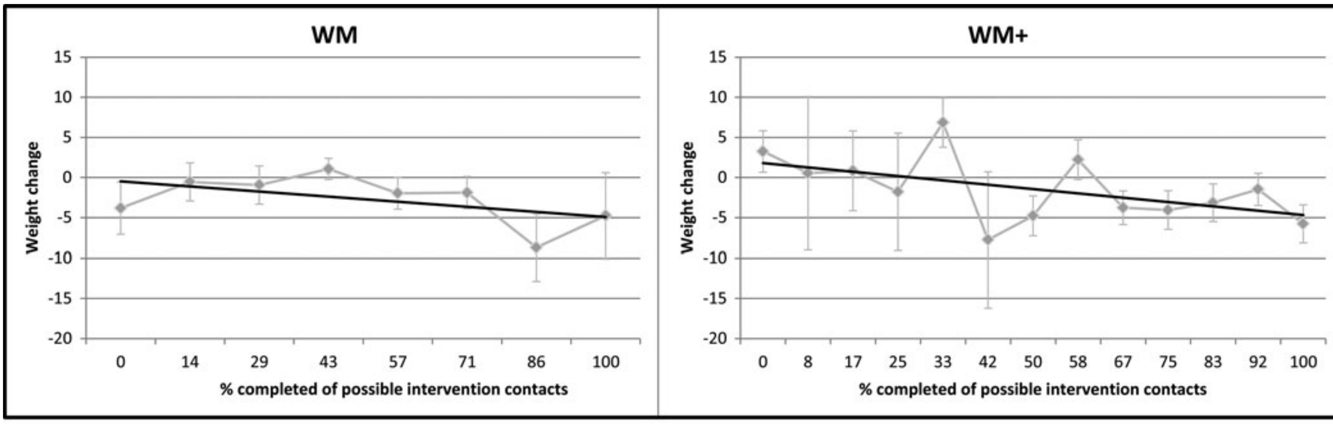
*Lost-to-follow-up excluded.
†Adjusted for age, sex, race (white vs nonwhite), and baseline value.
‡MVPA was defined as 715 counts or more per 15-second epochs, and sedentary time was defined as less than 12 counts per 15-second epoch.
BMI, body mass index; CI, confidence interval; FFQ, food frequency questionnaire; MVPA, moderate-to-vigorous physical activity; SE, standard error; WM, Weight Management; WM+, Weight Management Plus.

The changes observed are also comparable to findings from a recent review conducted by the RAND Corporation,[15] which found a mean reduction in BMI of about 0.15 units for same-year participation. The RAND review also found a mean reduction of 1.9 BMI units for employees who participated in weight management programs continuously over a 5-year period. This weight loss was compared with an *increase* of 0.5 units of BMI over the same time span for nonparticipants. Employees may reenroll in the WM or WM± programs in subsequent years. So, although we may only see modest reductions overall, the greatest impact of participation in these weight management programs may be in preventing weight gain in the employee population, especially over longer periods.

Strengths and Limitations

The strengths of the Steps to Health study include the relatively large sample size, the racial diversity of the sample, and the use of a randomized control study design. The results relating to BMI change were consistent whether the analysis included only those participants with BMI measured at follow-up or whether it also included those with missing BMI at follow-up (assuming no weight change). In addition, the evaluation of established programs, already embedded in the workplace and having support from management, was a strength.

The standardized assessment was comprehensive and included multiple measures for assessing diet and physical activity, which may have been both a strength and a weakness of this study. Although the study attempted to capture a broad spectrum of factors that may change evidence, this resulted in a large number of statistical comparisons, and potentially high participant burden. As in most weight loss studies, a self-selection bias is likely. The findings may also be limited by the fact that several outcomes are based on self-reported measures. In both arms, participants took part in only about half of the overall intervention activities offered. Sustained participation is an ongoing challenge for worksite interventions, and



Legend: indicates the mean and standard error (SE) of weight change in pounds, denotes the predicted value based on a regression model controlling only for baseline weight.

FIGURE 2. Association of weight change with participation.

TABLE 4. Predictors of Intervention Participation[a]

Predictor	Percentage of Participation β (SE)
Race (white = 1; others = 0)	− 2.20 (2.78)
Sex (female = 1; male = 0)	0.20 (3.63)
Age (mean centered)	0.46 (0.14)*
Baseline BMI (mean centered)	− 0.49 (0.22)*
Arm (WM+ = 1, WM = 0)	17.12 (2.71)*
Percentage of participation in intervention	–
Number of observations	545

[a]The table entries are regression coefficients, β (with their standard errors), which can be interpreted as the mean increase/decrease in the percentage of participation for a one-unit increase in the predictor.

*$P \leq 0.05$.

BMI, body mass index; SE, standard error; WM, Weight Management; WM+, Weight Management Plus.

according to the RAND study,[15] is seen by employers as an important obstacle to success of any worksite wellness program.

Implications and Conclusions

Although we saw some positive effects in both arms, these effects were modest. Our findings indicate that to achieve weight loss through worksite wellness programs, moderate behavioral interventions may not be enough, especially for workers who are not necessarily strongly motivated to take part in such programs. Future employee health programs focused on weight reduction may need to be more intensive, do more to encourage participation, and include or be coordinated with broader environmental and policy changes.

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