Lifestyle intervention reduces body weight and improves cardiometabolic risk factors in worksites[1–3]

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ABSTRACT

Background: Worksites are potentially effective locations for obesity control because they provide opportunities for group intervention and social support. Studies are needed to identify effective interventions in these settings.

Objective: We examined the effects of a multicomponent lifestyle intervention on weight loss and prevention of regain in 4 worksites (2 intervention and 2 control sites).

Design: Overweight and obese employees (n = 133) enrolled in this pilot worksite-randomized controlled trial with a 0–6-mo weight-loss phase and a 6–12-mo structured weight-maintenance phase. The intervention combined recommendations to consume a reduced-energy, low–glycemic load, high-fiber diet with behavioral change education. Outcome measurements included changes in body weight and cardiometabolic risk factors.

Results: The mean ± SEM weight loss was substantial in intervention participants, whereas control subjects gained weight (−8.0 ± 0.7 compared with +0.9 ± 0.5 kg, respectively; $P < 0.001$), and 89% of participants completed the weight-loss phase. Intervention effects were not significant at the 0.05 level but would have been at the 0.10 level ($P = 0.08$) in a mixed model in which the worksite nested within group was a random factor. There were also significant improvements in cardiometabolic risk factors in intervention compared with control subjects regarding fasting total cholesterol, glucose, systolic blood pressure, and diastolic blood pressure ($P \leq 0.02$ for each). No significant weight regain was observed in participants who enrolled in the structured weight-maintenance program (0.5 ± 0.7 kg; $P = 0.65$), and overweight and obese employees in intervention worksites who were not enrolled in the weight-loss program lost weight compared with subjects in control worksites (−1.3 ± 0.5 compared with +0.7 ± 0.2 kg, respectively; $P = 0.02$).

Conclusion: Worksites can be effective for achieving clinically important reductions in body weight and improved cardiometabolic risk factors. This trial was registered at clinicaltrials.gov as NCT01470222. *Am J Clin Nutr* doi: 10.3945/ajcn.112.046995.

INTRODUCTION

Rates of overweight and obesity remain at epidemic levels in the United States (1), and national health care costs are ∼$190 billion/y for the treatment of diseases associated with excess weight (2). Worksites have the potential to become a central element in national efforts to reduce obesity because the majority of adults work (3), and worksites offer naturally occurring social groups that, in theory, could facilitate weight control (4). However, the effectiveness of worksite-based weight-loss programs has been modest to date, and recidivism has been high (5–8). Because most obese persons are recommended to lose 5–10% of body weight to improve health (9), there is a recognized urgent need to identify weight-loss interventions that are both effective and sustainable in worksites (6, 7).

The majority of worksite-based weight-control interventions in the past 15 y have focused on the prevention of weight gain and have implemented environmental changes for physical activity and foods offered in cafeterias and vending machines but have usually documented no significant difference in body-weight change between control and intervention groups (10–12). In addition, some randomized controlled trials (RCTs)[4] conducted in North America have focused on weight loss in overweight and obese employees (13–18). A variety of published best practices for worksite interventions were used in interventions including recommendations to decrease energy intake and/or increase physical activity and, in some cases, lifestyle counseling, incentives, and/or weight-loss competitions (6, 19). Nevertheless, the mean (±SEM) weight change was low and ranged from +1.8 to −2.8 kg for trials with durations from 12 wk to 2 y. In contrast, the randomized trials of weight-management interventions conducted in research or health settings have frequently reported a higher mean weight loss of 3.4–7.0 kg over similar periods of time (20–26). Causes of low weight loss in worksite interventions are not known, but one possible

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[4] Abbreviations used: BP, blood pressure; RCT, randomized controlled trial; TC, total cholesterol.

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explanation may be the relatively greater focus on environmental factors rather than individual-level behavior changes.

The primary aim of this RCT was to pilot test a, to our knowledge, new multicomponent lifestyle intervention for weight loss in worksites that focused on changing both dietary-intake and eating-behavior patterns in overweight and obese employees. The primary outcome was the change in body weight, and secondary outcomes included changes in cardiometabolic risk factors. An additional post hoc analysis examined the effects of the weight-loss intervention on body weight in employees who did not participate in the weight-loss program.

SUBJECTS AND METHODS

Worksites and participants

Information on the study was sent to worksites with a reported company size of 80 to 800 employees in greater Boston, MA, by using a company profiling database (Capital IQ; https://www.capitaliq.com/), and interested worksites were interviewed to confirm eligibility. Worksites were eligible if they had not hosted a weight-loss program during the past 6 mo, were accessible by public transportation, had the infrastructure to hold onsite meetings, and >50% employees responded to an online survey about their willingness to participate in some aspect of the study. The first 4 worksites that completed all screening requirements and with the highest employee-interest responses were enrolled (**Figure 1**).

Subject inclusion criteria for the weight-loss component of the intervention were ≥21 y of age, BMI (in kg/m^2) ≥25.0, and a letter from the primary care physician with approval for weight loss. Exclusion criteria included being pregnant or having any medical condition that could influence nutrient absorption or restrict the intake of food. The study was approved by the Institutional Review Board at Tufts Medical Center, and all participants provided written informed consent.

This study compared a multicomponent intervention with a wait-listed control (delayed intervention) in 4 worksites. The intervention included a group-based weight-loss program for overweight and obese employees and a low-intensity health and nutrition education program open to all employees. A 6-mo structured maintenance program was also offered to employees who completed the weight-loss program. All program components were provided cost free to participants.

Enrolled worksites completed baseline outcome assessments, and participants in the weight-loss program were required to enroll in their program before worksite-level random assignment to the intervention or control. Worksites were each assigned a number and a random order of numbers was generated (SAS 9.2; SAS Institute Inc). The first 2 numbers in the output were

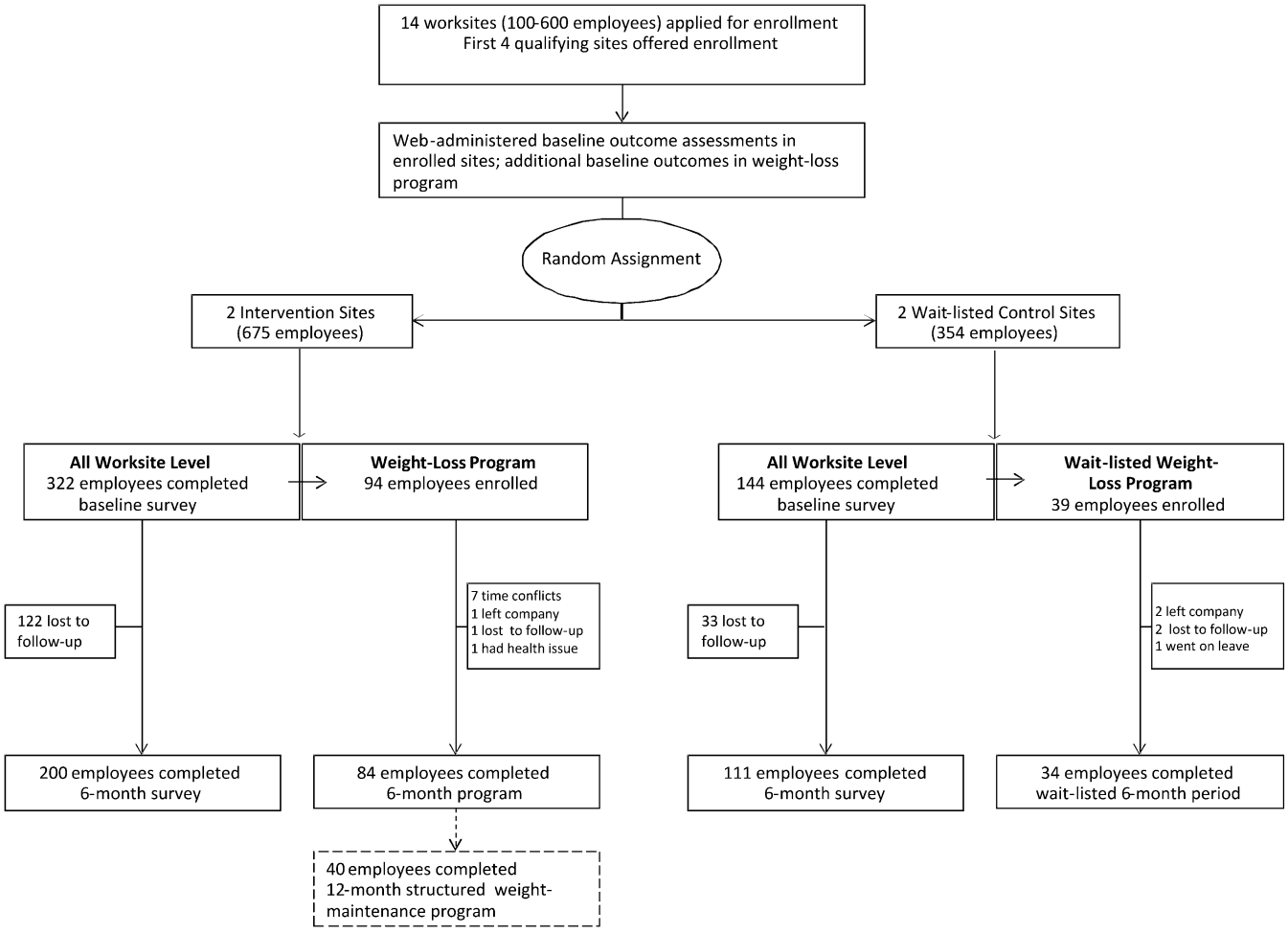

FIGURE 1. Flow of site and participant recruitment, screening, and assessment.

assigned to the intervention, and the second 2 numbers were assigned to the control. Control sites were wait-listed for a weight-loss intervention as described below. To facilitate worksite and employee retention in control sites, 2 informal social events were held that did not involve the discussion of nutrition or weight.

Intervention

A group weight-loss program that was based on a published book was the main intervention component (27) and had the goal of reducing energy intakes to achieve a weight loss of 0.5–1.0 kg/wk through a lifestyle-modification program (28, 29) that was adapted to facilitate the use of portion-controlled menus that contained ≥40 g dietary fiber/d and had a low glycemic load. Macronutrient targets were 25% protein, 27% fat, and 48% low–glycemic index carbohydrates (30), and thus, dietary recommendations were within acceptable macronutrient distribution ranges of Dietary Reference Intakes (31) except for dietary fiber, which was higher and similar to amounts reported to lower cardiometabolic risk factors (32). Participants were initially encouraged to maintain their usual levels of physical activity and, over time, were encouraged to increase physical activity.

The group program was based on an ecological model (33) that emphasized both individual and environmental factors as areas to identify practical tools for reducing energy intakes and changing macronutrient and fiber intakes. There were a total of 19 sessions (15 consecutive sessions followed by biweekly sessions), and one intervention site completed all sessions, whereas the other site completed 17 sessions (2 sessions were missed because of a snow day and holiday). The 60-min didactic sessions, which were held during the lunch hour, had up to 20 participants and were led by nutritionists with experience in behavior modification. The nutritionist addressed a variety of topics that are standard in lifestyle interventions (34) as well as some topics specific to this program, including dietary composition recommendations, portion control, self-monitoring, stimulus control, dietary variety, holidays, eating out, social support, goals, and weight maintenance. In addition to group sessions, participants received a weekly e-mail for individual support.

A structured maintenance program was implemented for 6 mo after the end of the weight-loss program on the basis of requests from worksites. Employees who completed the weight-loss program were invited to reenroll in the 6-mo program, which was identical to the original program except that the groups met once per month.

In addition to the weight-loss program, there was a low-intensity health and nutrition education program at intervention sites that was open to all employees. The program consisted of 6 newsletters on healthy eating and monthly, open-access seminars on general-interest topics including cardiovascular health, physical activity, and childhood nutrition. This intervention component was designed to facilitate a supportive atmosphere for participants in the weight-loss program and provide advice on healthy nutrition to the whole worksite.

Study outcomes

The primary outcome was the change in body weight from baseline to 6 mo in employees enrolled in the weight-loss program (intervention sites) or the wait-listed weight-loss program (control sites). Measurements were made with subjects wearing light indoor clothing at baseline and 1.5, 2.5, 4, 5, and 6 mo at intervention worksites and at baseline and 6 mo in control worksites by team members not responsible for intervention delivery. Weight was also measured at the end of the 6-mo structured maintenance program. The same calibrated scales were used at each time point (UC-321PL Precision Health Scale; A&D Medical) and were accurate to 0.05 kg. One control participant and one intervention participant did not have baseline weight measurements, and thus, self-reported weights were used in these cases. Height was measured only at baseline for employees interested in enrolling in the weight-loss program by using a portable stadiometer (Model HM200P, Portstad Portable Stadiometer; Quick Medical). Self-reported height was used for employees who did not enroll in the weight-loss program and was collected as part of an electronically administered demographic and health-history questionnaire that was sent to all worksite employees at baseline. In addition, electronic questionnaires for self-reported weight were administered at intervention sites at baseline and 2.5 and 6 mo and at baseline and 6 mo at control sites. Participants in the weight-loss program were also asked to report weekly changes in health or medications for safety surveillance.

Secondary outcomes were also measured at worksites and included changes in blood pressure (OMRON HEM-907XL Digital Blood Pressure Monitor; Omron Healthcare), fasting glucose, total cholesterol (TC), LDL cholesterol, HDL cholesterol, the TC:HDL ratio, non-HDL cholesterol, and triglycerides [Cholestech LDX System; Alere (a Clinical Laboratory Improvement Amendments–waived, validated point-of-care device)] from baseline to 6 mo (35).

Statistical analysis

Primary objectives of this study were to compare weight changes between intervention subjects who were completing the weight-loss program and control subjects who were completing the wait-listed period and to obtain data for power calculations for a future study to assess the variability in weight loss between worksites. Statistical significance was set at a 2-sided $P < 0.05$, and analyses were performed with SAS version 9.3 software (SAS Institute Inc).

Baseline characteristics and differences between intervention completers and dropouts were compared between groups by using chi-square or Fisher's exact tests for categorical variables, and t tests were used for continuous variables. The change in weight was the primary outcome and was skewed; therefore, the log of the ratio of 6-mo to baseline weight was used for analyses.

The secondary objective of the study was to compare changes in cardiometabolic risk factors between groups; subjects who discontinued or started new medications that potentially affected blood pressure ($n = 4$), cholesterol ($n = 4$), or fasting glucose ($n = 1$) were removed from those individual analyses. One subject was removed from all blood analyses because of a technical error in measurement.

Changes in outcome measures are expressed as means ± SEMs. For all outcomes, ANCOVA models adjusted for age (categorized by tertiles), sex, level of education (categorized as high

school, college, or graduate school), and baseline values were used to compare mean changes between intervention and control groups. The same analyses were repeated by using a mixed linear model with the worksite nested within the randomly assigned group as the random factor because persons within a worksite may have been correlated. In a post hoc analysis, data for dropouts was imputed by using the fully conditional specification multiple-imputation method so that all subjects could be included in the primary weight-change analysis. Imputation was not necessary for the mixed model because it failed to reach significance by using only completers. In another post hoc test, the weight change of overweight and obese employees who did not participate in the weight-loss program or wait-listed control group was examined by using the log of the ratio of 6-mo to baseline weight as the dependent variable in an ANCOVA model adjusted for the covariates previously listed.

RESULTS

Worksites were office-based companies that enrolled in May 2010 and were studied between October 2010 and October 2011. As summarized in **Table 1**, 466 employees (45% of the workforce) completed the online surveys at baseline and 6 mo, and 133 employees enrolled in the weight-loss program ($n = 94$) or wait-listed program at control sites ($n = 39$). In the all-worksite surveys, intervention worksites differed from control sites in the percentage of employees who completed the baseline survey (48% compared with 41%, respectively; $P = 0.03$), age (44.7 ± 0.6 compared with 39.3 ± 1.1 y, respectively; $P < 0.0001$), mean self-reported BMI at baseline (29.3 ± 0.4 compared with 27.9 ± 0.6, respectively; $P = 0.02$), sex (58% compared with 74% women, respectively; $P = 0.001$), education ($P < 0.001$), income ($P = 0.05$), and marriage status ($P = 0.05$). Enrollees in the weight-loss program also differed from nonenrollees in intervention sites (**Table 2**). Compared with nonenrollees, enrollees were more likely to be women (78% compared with 49%, respectively; $P < 0.0001$), be older (47.9 ± 1.1 compared with 43.3 ± 0.7 y, respectively; $P < 0.001$), have a higher BMI (33.2 ± 0.7 compared with 27.7 ± 0.4, respectively; $P < 0.0001$), and be slightly less educated ($P = 0.005$).

Weight-loss program

The retention of subjects during the initial period of the 6-mo weight-loss program was high with 89% of subjects in the intervention group and 87% of subjects in the control group (Figure 1); therefore, results are presented for completers unless noted. Compared with control subjects, subjects who completed the weight-loss program were well matched for age, BMI, sex balance, race, ethnicity, education, and family income (Table 1), and characteristics of dropouts did not differ from those of completers (Table 2). After the 6-mo weight-loss program, 48% of completers reenrolled in the requested 6-mo structured maintenance program. One subject attended most group weight-loss sessions and participated in the intervention but did not provide an outcome assessment at 6 mo; this person was included in the retention numbers ($n = 84$) because they were not lost to follow-up but not for outcome data shown in **Table 3** ($n = 83$). Compared with nonenrollees in the structured maintenance program, enrollees were, on average, 5 y older ($P = 0.05$) and lost 3.9 kg more body weight ($P < 0.001$) but were not different in baseline BMI, sex, race, marriage status, education, or income (Table 2).

Attendance of group program sessions averaged 84%. The mean weight change from baseline to 6 mo was −8.0 ± 0.7 kg in subjects who completed the weight-loss program compared with +0.9 ± 0.5 kg in control subjects ($P < 0.001$). This difference remained significant after we input values for and including dropouts ($P < 0.0001$); in a mixed model that accounted for the nested worksite variable, the difference was not significant at the 0.05 level but would have been at the 0.10 level ($P = 0.08$) (**Figure 2**A). Mean BMI decreased by −2.8 ± 0.2 compared with +0.3 ± 0.2 in the intervention and control groups, respectively ($P < 0.0001$ and $P = 0.07$, respectively, in the mixed model). Participants continued to lose weight throughout the intervention period, which included Thanksgiving, Christmas, and the New Year. Individual variability in weight loss from baseline to 6 mo is shown in Figure 2B. There was also no significant gain in body weight during the structured maintenance program (0.5 ± 0.7 kg; $P = 0.65$) as shown in Figure 2A.

Weight loss in support-group participants in the intervention group was accompanied by significant improvements in most measured cardiometabolic risk factors, including fasting serum TC, non–HDL cholesterol, glucose concentrations, and systolic and diastolic blood pressures; all effects except for TC remained significant when the nested worksite variable was included as a random factor in the model (Table 3).

Employees who did not participate in the weight-loss program

In a post hoc analysis, there was a significant difference in the weight change from baseline to 6 mo in overweight and obese employees in intervention sites who did not participate in the weight-loss program compared with the change in those who did not participate in the wait-listed weight-loss program at control sites (−1.3 ± 0.5 compared with +0.7 ± 0.6 kg, respectively; $P = 0.02$; **Table 4**).

DISCUSSION

This RCT, which evaluated a worksite weight-loss intervention that was offered free of cost to overweight and obese employees, measured significant effects of the intervention on body weight and cardiometabolic risk factors over 6 mo. In addition, the worksites requested to continue the program, and 48% of subjects reenrolled in a structured maintenance program from 6 to 12 mo that documented no significant weight regain. In contrast to relatively small changes documented in previous worksite interventions (6, 7), mean changes in body weight and cardiometabolic variables were substantial in this study, which suggested that worksites have the potential to become effective dissemination points for weight-management programs that reduce disease risk and health care costs associated with excess body weight (22, 24, 36).

The net loss of body weight of participants in this weight-loss program averaged −8.0 kg, and the intervention also appeared to be favorably received as judged by the 89% retention of participants in the weight-loss program through 6 mo and an 84% session attendance. One possible explanation for the substantial weight loss observed in this study compared with in

TABLE 1
Baseline characteristics of worksite employees[1]

Characteristics	All employees at intervention sites (n = 322)[2]	All employees at control sites (n = 144)[2]	P	Completed 6-mo weight-loss program (n = 84)	Enrolled in delayed weight-loss program (n = 34)	P
Age (y)	44.7 ± 0.6[3]	39.3 ± 1.1	<0.0001	48.6 ± 1.2	49.9 ± 2.1[4]	0.57
Baseline BMI (kg/m^2)	29.3 ± 0.4	27.9 ± 0.6	0.02	33.3 ± 0.7	33.3 ± 1.2	0.97
Completed baseline survey [n (%)]						NA
Yes[5]	322 (48)	144 (41)	0.03	84 (100)	34 (100)	
No	353 (52)	210 (59)		0 (0)	0 (0)	
Sex [n (%)]						0.87
F	184 (58)	103 (74)	0.001	63 (75)	26 (76)	
M	135 (42)	37 (26)		21 (25)	8 (24)	
Race [n (%)]						0.57
African American	36 (11)	8 (6)	0.14	16 (19)	3 (9)	
American Indian/Alaska Native	1 (0.3)	0 (0)		0 (0)	0 (0)	
Asian	29 (9)	7 (5)		5 (6)	1 (3)	
White	228 (71)	119 (83)		57 (68)	26 (76)	
More than one race	13 (4)	5 (3)		3 (4)	2 (6)	
Unknown	15 (5)	5 (3)		3 (4)	2 (6)	
Ethnicity [n (%)]						0.71
Hispanic	13 (4)	5 (3)	0.45	5 (6)	2 (6)	
Non-Hispanic	270 (84)	127 (88)		69 (82)	30 (88)	
Unknown	39 (12)	12 (8)		10 (12)	2 (6)	
Marriage status [n (%)]						0.05
Married or living with partner	189 (59)	78 (54)	0.05	46 (55)	23 (68)	
Divorced, separated, or widowed	42 (13)	10 (7)		17 (20)	5 (15)	
Never married	86 (27)	51 (35)		21 (25)	4 (12)	
Not reported	5 (3)	5 (2)		0 (0)	2 (6)	
Education [n (%)]						0.08
High school or GED[6]	29 (9)	3 (2)	<0.001	11 (13)	2 (6)	
College	225 (70)	90 (63)		56 (67)	20 (59)	
Graduate degree	64 (20)	45 (31)		17 (20)	10 (29)	
Not reported	4 (1)	6 (4)		0 (0)	2 (6)	
Family income [n (%)]						0.44
≤$20,000–$39,999	31 (10)	9 (6)	0.05	5 (6)	3 (9)	
$40,000–$59,000	44 (14)	37 (26)		17 (20)	7 (21)	
$60,000–$79,999	35 (11)	11 (8)		11 (13)	1 (3)	
$80,000–$99,999	40 (12)	15 (10)		8 (10)	3 (9)	
≥$100,000	119 (37)	49 (34)		36 (43)	14 (41)	
Not reported	53 (16)	23 (16)		7 (8)	6 (18)	

[1] t tests were used for continuous variables, and chi-square or Fisher's exact tests were used for categorical variables. Percentages may not add to 100% because of rounding.

[2] Data are for employees who completed the baseline survey. In intervention sites, 9 employees did not report age, 6 employees did not report BMI, and 3 employees did not report sex. In control sites, 5 employees did not report age, 5 employees did not report BMI, and 4 employees did not report sex.

[3] Mean ± SEM (all such values).

[4] Two participants in the control site did not report age.

[5] Completed ≥2 items on the baseline survey.

[6] GED, General Educational Development.

TABLE 2
Characteristics of participants within intervention worksites[1]

Characteristics	Enrolled in 6-mo weight-loss program (n = 94)[2]	Did not enroll in 6-mo weight-loss program (n = 228)[3]	P	Completed 6-mo weight-loss program (n = 84)	Dropped out of 6-mo weight-loss program (n = 10)[4]	P	Enrolled in 6-mo structured maintenance program (n = 40)	Did not enroll in 6-mo structured maintenance program (n = 44)[5]	P
Age (y)	47.9 ± 1.1[6]	43.3 ± 0.7	<0.001	48.6 ± 1.2	41.8 ± 3.0	0.07	51.0 ± 1.5	46.4 ± 1.7	0.05
Baseline BMI (kg/m^2)	33.2 ± 0.7	27.7 ± 0.4	<0.0001	33.3 ± 0.7	37.3 ± 3.1	0.06	33.7 ± 1.0	32.9 ± 0.9	0.49
Change in weight at 6 mo (kg)	—	—	—	—	—	—	−10.0 ± 1.1	−6.1 ± 0.9	<0.001
Sex [n (%)]									0.61
F	73 (78)	111 (49)	<0.0001	63 (75)	10 (100)	0.20	29 (73)	34 (77)	
M	21 (22)	114 (51)		21 (25)	0 (0)		11 (28)	10 (23)	
Race [n (%)]									0.39
African American	18 (8)	18 (19)	0.10	16 (4)	2 (20)	0.60	6 (15)	10 (23)	
American Indian/ Alaskan Native	0 (0)	1 (0.4)		0 (0)	0 (0)		0 (0)	0 (0)	
Asian	6 (6)	23 (10)		5 (6)	1 (10)		3 (8)	2 (5)	
White	63 (67)	165 (72)		57 (68)	6 (60)		30 (75)	27 (61)	
More than one race	3 (3)	10 (4)		3 (4)	0 (0)		0 (0)	3 (7)	
Unknown	4 (4)	11 (5)		3 (4)	1 (10)		3 (8)	2 (5)	
Ethnicity [n (%)]									0.21
Hispanic	5 (5)	8 (4)	0.72	5 (6)	0 (0)	0.79	1 (3)	4 (9)	
Non-Hispanic	77 (82)	193 (85)		69 (82)	8 (80)		36 (90)	33 (75)	
Unknown	12 (13)	27 (12)		10 (12)	2 (20)		3 (8)	7 (16)	
Marriage status [n (%)]									0.11
Married or living with partner	50 (53)	139 (61)	0.11	46 (55)	4 (40)	0.15	26 (65)	20 (45)	
Divorced, separated, or widowed	19 (20)	23 (10)		17 (20)	2 (20)		8 (20)	9 (21)	
Never married	24 (26)	62 (27)		21 (25)	3 (30)		6 (15)	15 (34)	
Not reported	1 (1)	4 (2)		0 (0)	1 (10)		0 (0)	0 (0)	
Education									0.99
High school or GED[7] [n (%)]	11 (12)	18 (8)	0.005	11 (13)	0 (0)	0.10	5 (13)	6 (14)	
College	64 (68)	161 (71)		56 (67)	8 (80)		27 (68)	29 (66)	
Graduate degree	18 (19)	46 (20)		17 (20)	1 (10)		8 (20)	9 (20)	
Not reported	1 (1)	3 (1)		0 (0)	1 (10)		0 (0)	0 (0)	
Family income [n (%)]									0.98
≤$20,000–$39,999	8 (9)	23 (10)	0.05	5 (6)	3 (30)	0.17	2 (5)	3 (7)	
$40,000–$59,000	19 (20)	25 (11)		17 (20)	2 (20)		8 (20)	9 (20)	
$60,000–$79,999	12 (13)	23 (10)		11 (13)	1 (10)		5 (13)	6 (14)	
$80,000–$99,999	9 (10)	13 (14)		8 (10)	1 (10)		3 (8)	5 (11)	
≥$100,000	38 (40)	81 (36)		36 (43)	2 (20)		18 (45)	18 (41)	
Not reported	8 (9)	45 (20)		7 (8)	1 (10)		4 (10)	3 (7)	

[1] t tests were used for continuous variables, and chi-square or Fisher's exact tests were used for categorical variables. Percentages may not add to 100% due to rounding.

[2] One enrollee did not report age and BMI.

[3] Six nonenrollees did not report age and BMI, and 3 nonenrollees did not report sex.

[4] One dropout did not provide age and BMI.

[5] One participant who did not enroll in the structured maintenance program did not provide 6-mo outcome measures.

[6] Mean ± SEM (all such values).

[7] GED, General Educational Development.

TABLE 3
Body weight and cardiometabolic risk factors[1]

Outcome measures	Weight-loss program	Control	*P*	*P* (mixed model)
Weight				
n	83[2]	34	—	—
Baseline (kg)	93.6 ± 2.3[3]	90.2 ± 3.9	—	—
6 mo (kg)	85.7 ± 2.0	91.1 ± 4.2	—	—
Difference (6 mo – baseline) (kg)	−8.0 ± 0.7	0.9 ± 0.5	<0.0001	0.08
BMI				
n	83[2]	34	—	—
Baseline (kg/m^2)	33.3 ± 0.7	33.3 ± 1.2	—	—
6 mo (kg/m^2)	30.5 ± 0.6	33.6 ± 1.3	—	—
Difference (6 mo – baseline) (kg/m^2)	−2.8 ± 0.2	0.3 ± 0.2	<0.0001	0.07
Systolic blood pressure				
n	74	27	—	—
Baseline (mm Hg)	132 ± 2	125 ± 2	—	—
6 mo (mm Hg)	123 ± 2	130 ± 3	—	—
Difference (6 mo – baseline) (mm Hg)	−9 ± 2	6 ± 2	<0.0001	0.01
Diastolic blood pressure				
n	74	27	—	—
Baseline (mm Hg)	84 ± 1	82 ± 2	—	—
6 mo (mm Hg)	75 ± 1	81 ± 2	—	—
Difference (6 mo – baseline) (mm Hg)	−8 ± 1	−1 ± 1	0.001	0.001
Total cholesterol				
n	72	25	—	—
Baseline (mg/dL)	197 ± 4	196 ± 9	—	—
6 mo (mg/dL)	183 ± 4	197 ± 9	—	—
Difference (6 mo – baseline) (mg/dL)	−13 ± 3	1 ± 4	0.02	0.09
LDL cholesterol				
n	68	20	—	—
Baseline (mg/dL)	125 ± 4	133 ± 7	—	—
6 mo (mg/dL)	112 ± 4	128 ± 7	—	—
Difference (6 mo – baseline) (mg/dL)	−13 ± 3	−5 ± 4	0.06	0.06
HDL cholesterol				
n	72	25	—	—
Baseline (mg/dL)	47 ± 2	53 ± 3	—	—
6 mo (mg/dL)	49 ± 2	55 ± 4	—	—
Difference (6 mo – baseline) (mg/dL)	2 ± 1	1 ± 1	0.99	0.99
Non–HDL cholesterol				
n	66	23	—	—
Baseline (mg/dL)	149 ± 4	149 ± 8	—	—
6 mo (mg/dL)	134 ± 4	148 ± 7	—	—
Difference (6 mo – baseline) (mg/dL)	−14 ± 3	−1 ± 4	0.02	0.05
Triglycerides				
n	72	25	—	—
Baseline (mg/dL)	129 ± 7	107 ± 11	—	—
6 mo (mg/dL)	121 ± 8	110 ± 14	—	—
Difference (6 mo – baseline) (mg/dL)	−7 ± 7	3 ± 7.25	0.70	0.70
Total cholesterol:HDL cholesterol ratio				
n	72	23	—	—
Baseline	5 ± 0	4 ± 0	—	—
6 mo	4 ± 0	4 ± 0	—	—
Difference (6 mo – baseline)	−1 ± 0	0 ± 0	0.06	0.12
Glucose				
n	73	26	—	—
Baseline (mg/dL)	101 ± 2	107 ± 8	—	—
6 mo (mg/dL)	95 ± 1	113 ± 11	—	—
Difference (6 mo – baseline) (mg/dL)	−6 ± 2	6 ± 4	<0.001	0.04

[1] Data are presented for completers only. SI conversion factors are as follows: to convert total cholesterol, LDL cholesterol, HDL cholesterol, and non–HDL cholesterol values from milligrams per deciliter to millimoles per liter, multiply by 0.0259; to convert triglyceride values from milligrams per deciliter to millimoles per liter, multiply by 0.0113; and to covert glucose values from milligrams per deciliter to millimoles per liter, multiply by 0.0555. *P* values were calculated in a model controlled for age (tertiles), sex, education (categorical), and baseline values. Weight-difference *P* values were calculated by using the log of the ratio of 6-mo to baseline weight. Transformations of other variables were not required. The mixed model included worksite nested within randomly assigned group as a random factor.

[2] One intervention participant completed the weight-loss program but was not available for weight measurements.

[3] Mean ± SEM (all such values).

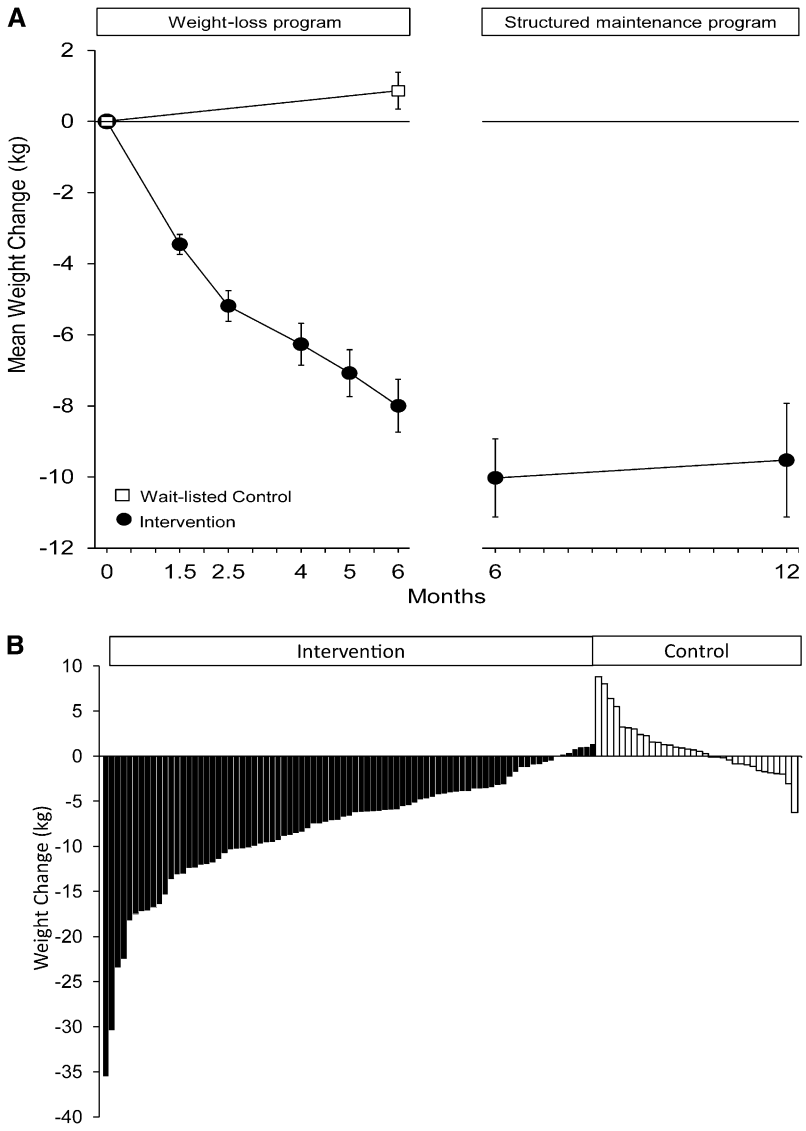

FIGURE 2. A: Mean (±SEM) changes in weight for intervention (n = 84) and control (n = 34) groups during the 6-mo weight-loss program and 6-mo structured weight-maintenance program (n = 40). P values were calculated by using the log of the ratio of 6-mo:baseline weight controlled for age, sex, and log-transformed baseline weight. Weights during the structured weight-maintenance (months 6–12) were obtained for a subset of subjects whose weight loss at month 6 was slightly greater than that of the full intervention group. The subset gained 0.5 ± 0.7 kg; P = 0.65) from months 6–12. B: Change in weight from baseline to 6 mo for each subject in intervention (filled bars) and control (open bars) groups.

previous worksite studies is that the lifestyle intervention was particularly effective in making changes to the energy balance that are necessary for weight loss (37). In addition, the office-based worksites that enrolled in the study may have been particularly receptive to on-site weight-management programs. In addition, important criterion for eligibility and selection of worksites was the requirement that >50% of employees had to respond to an online survey. It was possible that the worksites included in this study were representative of workplaces where there is substantial worker enthusiasm for weight loss, which, if so, may have limited the generalizability of our results. However, although both intervention worksites lost significant weight over time, the magnitude of weight loss differed between the 2 worksites, which suggested that worksite type alone does not predict uniform success. The inclusion of site in the statistical analysis removed the significance of the intervention effects on weight change and underscored the variability in weight loss. It may also have been relevant that there were notable differences in intervention components between this trial and previous ones. For example, our intervention prioritized a reduction of energy intake rather than both the reduction of energy intake and an increase in energy expenditure during the initiation of the intervention on the basis of a concern that the cognitive challenge and time requirement of targeting 2 goals at once might have reduced the ability of subjects to adhere to the requested dietary and behavioral changes. This intervention also recommended a dietary profile with higher fiber and a lower glycemic load than used in previous worksite interventions and had both a behavioral component and an all-worksite component. In terms of program effectiveness, the mean weight loss compared favorably to a weight loss of 0.6 kg (unweighted mean, values range from +1.8 to −2.8 kg) in RCTs conducted in worksites in the

TABLE 4
Self-reported body weight of overweight and obese employees not enrolled in the weight-loss program[1]

Weight	Intervention (n = 68)	Control (n = 41)	P
Baseline (kg)	92.3 ± 2.2	88.2 ± 2.4	—
6 mo (kg)	91.0 ± 2.1	88.9 ± 2.6	—
Difference (6 mo – baseline) (kg)	−1.3 ± 0.5	0.7 ± 0.6	0.02[2]

[1] All values are means ± SEMs.
[2] P value was calculated with the log of the ratio of 6 mo to baseline weight with age (categorical), sex, education (categorical), and log-transformed baseline weight controlled for.

United States over the past 15 y (13–18), and also resulted a comparable or greater mean weight loss than in most-effective nonworksite research trials that have used intensive lifestyle counseling in one-on-one or group settings (20–26).

An additional finding in this study was weight loss in employees at intervention sites who did not participate in the weight-loss program. Specifically, overweight and obese employees in intervention sites who did not participate in the weight-loss program reported a mean weight loss of 1.3 kg, whereas overweight and obese employees who did not sign up for the wait-listed weight-loss program in control worksites reported a mean weight gain of 0.7 kg. Although this finding was based on self-reported data, we have previously documented the accuracy of self-reported weight for adults with a similar demographic profile (38). If confirmed in a future study that measures weight, this result would constitute an additional benefit of conducting weight-management interventions at worksites. There are several possible explanations for the observed effects that range from a benefit of the low-intensity health and nutrition education program that ran in parallel to the weight-loss program to active sharing of weight-control strategies between program participants and nonparticipants. This latter suggestion is analogous to that seen in spouses of nonworksite weight-loss interventions (39) and is consistent with the observation that social networks tend to share similarities in BMI and presumably lifestyle practices (40).

In conclusion, this study shows that worksites can be successful locations for the implementation of interventions that cause substantial mean weight loss and improve cardiometabolic risk factors. Additional research is needed to study the sustainability of worksite programs beyond 12 mo and to identify predictors of success that will allow the targeting of worksites that can benefit most from on-site programs.

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