

Can Individuals Meet Multiple Physical Activity and Dietary Behavior Goals?

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Objectives: To examine whether participants with the most behavioral goals to achieve were more likely to meet more goals than those given fewer goals. **Methods:** Eight hundred ten participants were randomly assigned to advice-only, established guidelines for blood pressure control (reduced sodium, increased physical activity), or established guidelines plus the DASH diet (increased fruits, vegetables, low-fat dairy, reduced

fat). **Results:** At 6 months, 11.7% of Advice-Only, 19.3% of Established, and 44.6% of Established plus DASH met at least 3 goals ($P < 0.0001$). At 18 months, 33.5% of Established plus DASH met at least 3 goals. **Conclusions:** Those with the most goals to achieve reached the most goals.

Key words: health behaviors, physical activity, DASH dietary pattern, blood pressure

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National guidelines and professional scientific organizations recommend individuals maintain a normal weight; eat a diet low in saturated fat and sodium and high in fruits, vegetables, and whole grains; and participate in regular physical activity to reduce risk of cardiovascular disease,^{1,2} hypertension,^{3,4} diabetes,⁵ and cancer⁶ and to maintain

health.⁷ Results from the Diabetes Prevention Program, an intervention trial conducted with persons at high risk for developing diabetes, showed that a lifestyle intervention that targeted multiple behaviors was superior to medication for preventing diabetes.⁸ Relative to the placebo condition, the lifestyle intervention with goals of a 7% loss in body

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weight and at least 150 minutes per week of physical activity resulted in a 58% reduction in diabetes incidence – an amount significantly greater than the 31% reduction found from the use of metformin, an antihyperglycemic agent.⁸ Other multicomponent interventions have resulted in regression of coronary atherosclerotic plaques^{9,10} and lowered incidence of cardiovascular disease,¹¹ although not all have positively influenced cardiovascular disease outcomes.^{12,13} Interventions targeting multiple behaviors are thought to be efficacious for disease prevention; the continuing challenge is to promote the adoption and maintenance of these positive health behaviors.

Although the success of multiple lifestyle interventions in preventing disease suggests that individuals are able to make and sustain multiple lifestyle changes, it is unclear how best to design interventions to modify multiple lifestyle behaviors.¹⁴ Change in one health behavior may foster additional changes or, conversely, may impede change in other behaviors. For example, a physical activity intervention increased the rate of continuous abstinence from smoking¹⁵; but an intervention that combined physical activity, caloric reduction, and behavioral self-management resulted in smoking relapse.¹⁶ Given that most middle-aged Americans have at least one major behavioral risk factor¹⁷ and only 3% simultaneously meet recommendations for nonsmoking, normal weight, 5+ fruits and vegetable intake per day, and 5+ days per week of 30 minutes of physical activity,¹⁸ strategies for promoting multiple behavior change require more attention.

PREMIER was a randomized clinical trial that tested the effects of 2 multicomponent lifestyle interventions on blood pressure control among adults with prehypertension and stage 1 hypertension.¹⁹ Individuals with above-optimal blood pressure were randomized to (1) a group to implement established guidelines of weight loss, sodium reduction, increased physical activity, and limited alcohol intake; (2) a group to implement these established guidelines plus the Dietary Approaches to Stop Hypertension (DASH) dietary pattern (ie, diet high in fruits, vegetables, low-fat dairy products, and reduced intake of saturated and total fat); or (3) a group given only advice on nonpharmacologic factors that can affect

blood pressure. Previous reports documented that these interventions resulted in improved lifestyle behaviors and, when compared with advice only, improved blood pressure control.²⁰⁻²² At 6 months relative to Advice-Only, the net reduction in blood pressure was 3.7 mmHg in the Established group and 4.3 mmHg in the Established plus DASH group.²⁰ Blood pressure reductions in both intervention groups were significantly greater than in Advice-Only, but not different from each other.

In this secondary analysis of PREMIER, we examined in detail the extent to which participants were able to achieve the multiple behavioral lifestyle goals promoted in the intervention conditions. We were particularly interested in examining whether participants in the treatment condition with the most targeted goals were more likely to meet multiple goals compared with those in the treatment condition with fewer targeted goals, or if the condition associated with high goal expectation was associated with less goal attainment. Previous reports documented that PREMIER participants made behavior changes consistent with their randomized assignment.^{20,22,23} However, mean changes in nutrients, food groups, and physical activity were reported in the context of documenting adherence to a given treatment condition, and the primary outcome of interest was blood pressure. We have not specifically examined if participants were able to meet the multiple behavioral goals promoted by the interventions. This analysis can provide information regarding whether and how achieving success in one health behavior is associated with success in changing other behaviors.²⁴

METHODS

PREMIER participants were men and women age 25 years or older with prehypertension and stage 1 hypertension at 4 clinical centers (Baltimore, MD, Baton Rouge, LA, Durham, NC, and Portland, OR). Kaiser-Permanente Center for Health Research served as the coordinating center, and the National Heart, Lung, and Blood Institute project office also participated. The study was approved by each site's human subjects institutional review board, and all participants provided written informed consent. Trial methods and main results are published.²⁰⁻²²

Eligibility Criteria

Blood pressure eligibility was systolic blood pressure between 120 and 159 mmHg and diastolic blood pressure between 80 and 95 mmHg.³ Body mass index (kg/m²) (BMI) criteria were 18.5 to 45. Major exclusion criteria included use of antihypertensive medications, insulin, or oral hypoglycemic drugs; previous cardiovascular event or cancer diagnosis; and congestive heart failure or symptoms of angina or peripheral vascular disease.

Measurements

Physical activity. Change in physical activity was assessed by self-report. Total daily energy expenditure was assessed with the Stanford 7-Day Physical Activity Recall (PAR).^{25,26} Participants estimated the number of hours spent over the last 7 days in sleep and in moderate, hard, and very hard activity. Light activity was calculated as the remaining time. The mean intensity value from each category was multiplied by hours spent in the category and summed across categories to estimate energy expenditure as total kilocalories per kilogram body weight per day (kcal/kg/day). For purposes of this manuscript, the number of weekly minutes spent in moderate, hard, and very hard activity was determined and divided by 7 to determine daily minutes in moderate to vigorous physical activity.

Dietary intake. The Diet Assessment Center of Pennsylvania State University conducted 2 unannounced 24-hour recalls collected by telephone interview, one on a weekday and one on a weekend day. Nutrients and food-group intake were calculated using the Nutrition Data System for Research NDS-R 1998 (University of Minnesota). One 24-hour urine collection was obtained to measure excretion of sodium.

Interventions

After baseline measurements were completed, participants were randomized into one of 2 lifestyle interventions or an advice-only group. The Established intervention included guidelines from the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure VI.²⁷ The Established plus DASH intervention included the same established guidelines plus the DASH dietary pattern.²⁸ The 2 interventions were similar in all respects except for the DASH

dietary pattern. In total, the Established intervention targeted 4 behaviors that had specific, standard goals; and the Established plus DASH intervention targeted 6 behaviors.

Participant goals for both interventions are displayed in Table 1. The weight-loss goal was specific to those with a BMI ≥ 25 kg/m² and was encouraged by reduced energy intake and increased physical activity. The physical activity goal was 180 minutes per week of moderate-intensity aerobic activity, consistent with national physical activity guidelines²⁹ and was a targeted goal irrespective of a participant's need to lose weight. Reduced sodium intake to less than or equal to 2400 mg/day was also targeted. In addition to the previous goals, the Established plus DASH intervention included a target of at least 9 servings per day of fruits and vegetables. Both interventions consisted of 18 face-to-face contacts during the first 6 months of the intervention and 12 face-to-face contacts during the remaining 12 months.³⁰ Intervention strategies and materials were identical except for the dietary recommendations. Session content included behavioral skills training, self-monitoring, social support, group accountability, and goal setting. All intervention behaviors were addressed during each intervention contact; thus, multiple behavior changes were simultaneously targeted.

Participants assigned to the Advice-Only comparison condition received verbal advice and materials on lifestyle modifications at the time of randomization and after completion of the 6-month data collection. Recommendations included limiting alcohol and dietary sodium intake, engaging in regular physical activity, losing weight if needed, and eating a healthful diet for general cardiovascular health.

Statistical Analyses

For this report, participants from all 3 randomized groups were classified according to whether they did or did not meet predetermined intervention behavioral goals for physical activity and for dietary intake of sodium, fruits and vegetables, dairy products, and total fat. Although total fat and saturated fat were each separate behavioral targets, we report meeting only the goal of saturated fat because of the high correlation ($\rho = 0.80$,

Table 1
Intervention Goals and Delivery Approaches for PREMIER Treatment Groups

	Advice-Only	Established	Established + DASH
Intervention Goals:			
Weight loss	As Needed	≥15 lb ^a	≥15 lb ^a
Total calories/day	No Target	Individual Target ^b	Individual Target ^b
Physical activity/week	Increase	180 minutes	180 minutes
Sodium/day	Reduce	≤ 2400 mg	≤ 2400 mg
Alcohol/day	≤1 oz. Men	≤1 oz. Men	≤1 oz. Men
	≤.5 oz. Women	≤.5 oz. Women	≤.5 oz. Women
Dietary Variables:			
	Food Guide Pyramid	JNC V	DASH
% Kcal Fat	Food Guide Pyramid	≤ 30%	≤ 25%
% Kcal Saturated Fat	Food Guide Pyramid	≤ 10%	≤ 7%
Fruits & Vegetables servings	Food Guide Pyramid	Not emphasized	9-12 servings
Dairy servings	Food Guide Pyramid	Not emphasized	2-3 servings
Self-Monitoring Recommendations:			
Number days per week	None	≥3	≥3
Behavioral targets monitored	None	Sodium, Physical Activity	Sodium, Physical Activity, Fat, Fruits & Vegetables, Dairy
Intervention Delivery Approach:			
Number individual sessions	2	7	7
Number group sessions	0	26	26

Note.

Intervention goals specifically targeted indicated in bold.

a Weight loss target for those with BMI ≥ 25

b Individual target set for caloric intake to achieve weight loss

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DASH Dietary Approaches to Stop Hypertension (Appel et al, 1997)

P<0.001) between the 2 variables. Thus, although there was a maximum of 6 goals targeted, for our analyses we used a total of 5 goals. We classified participants based on the Established plus DASH goals because reaching these targets is most efficacious for reducing cardiovascular disease risk.³ Separate classifications were made at each time point (baseline, 6 months, and 18 months). Prevalence of meeting a specific goal and number of goals met were calculated.

Differences between groups in the number of goals met (0, 1, 2, ≥3) at 6 and 18 months were tested using the Pearson chi-square test. Pearson correlations examined the correlations between change in the behavioral targets to determine which behaviors tended to co-occur.

Due to the limited range of values for the number of dairy servings, this variable was excluded from the correlation analysis.

Analyses were conducted using SAS version 8.2 (SAS, Cary, NC, USA). All P-values are 2-sided and the term *significant* is used to describe a P-value less than 0.05.

RESULTS

Eight hundred ten (n=810) participants were enrolled in the trial. The average age was 50 years, 62% of participants were women, 34% were African American, 95% were overweight or obese, and more than 1/3 met the definition for stage 1 hypertension. At study onset, approximately 40% of participants reported

Table 2
Percent of All Participants (n=810) by Treatment Group Meeting Dietary and Physical Activity Goals of Established + DASH at Baseline, 6 Months, and 18 Months

Behavioral Goal	Baseline			6 months			18 months		
	Advice-Only N=270-273 ^a	Established N=266-268	Established + DASH N=262-268	Advice-Only N=219-243	Established N=220-233	Established + DASH N=222-237	Advice-Only N=235-252	Established N=225-241	Established + DASH N=227-247
≥180 minutes of weekly moderate to vigorous physical activity ^b	106(38.8%) ^d	106(39.6%)	109(40.7%)	123(51.0%)	139(59.9%)	149(62.9%)	123(50.8%)	127(54.0%)	130(54.2%)
≤100 mmol/d of daily sodium intake	35(13.0%)	48(18.0%)	38(14.5%)	43(19.6%)	81(36.8%)	64(28.8%)	49(20.9%)	69(30.7%)	57(25.1%)
≥2 daily servings of dairy intake	84(31.1%)	84(31.3%)	93(34.6%)	79(32.5%)	66(28.3%)	140(59.3%)	83(32.9%)	61(25.3%)	126(51.0%)
≥9 daily servings of fruits and vegetables intake	8(3.0%)	11(4.1%)	19(7.1%)	16(6.6%)	14(6.0%)	79(33.5%)	13(5.2%)	13(5.4%)	74(30.0%)
≤25% kcal of daily total fat intake	42(15.6%)	40(14.9%)	41(15.2%)	45(18.5%)	68(29.2%)	135(57.2%)	49(19.4%)	68(28.2%)	113(45.7%)

Note.

- a Sample size varies depending on variable
b Determined from 7-day physical activity recall (Blair et al 1986; Sallis et al 1985)
c Number meeting goal
d Percent meeting goal

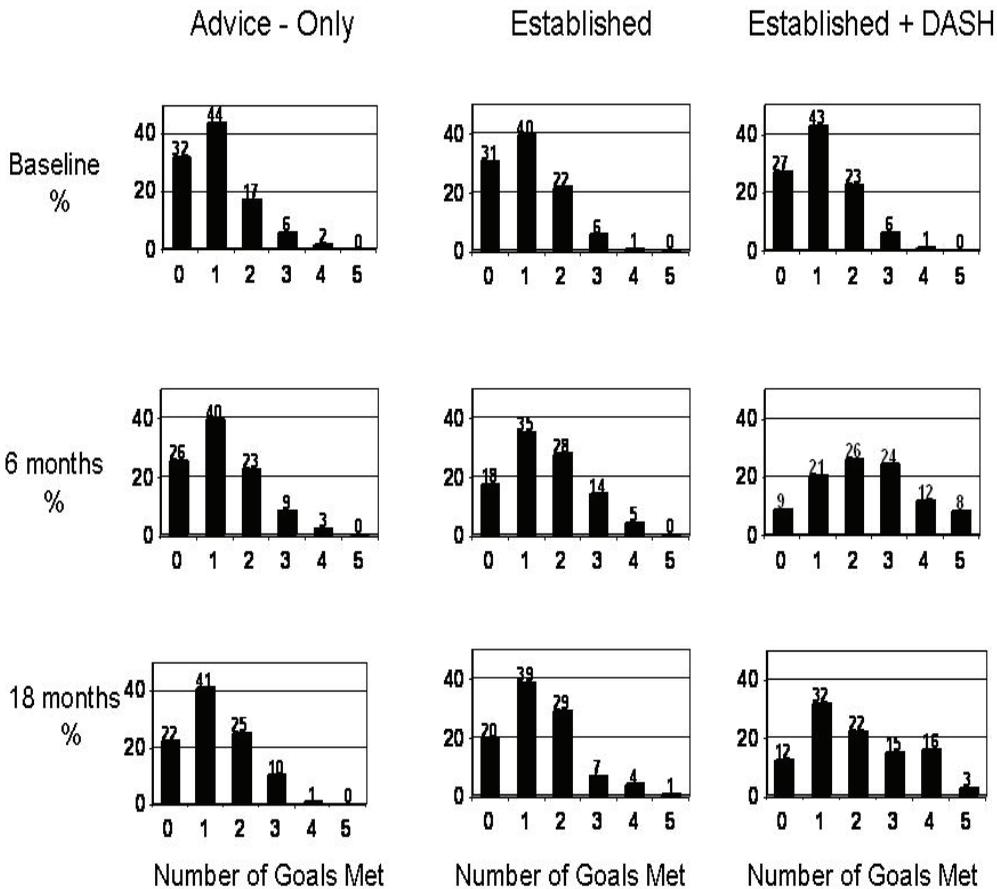
they engaged in at least 180 weekly minutes of moderate to vigorous physical activity, and 32% met the dairy goal of at least 2 daily servings. In contrast, only 5% met the fruit and vegetable goal of at least 9 daily servings. Six- and 18-month data were available for approximately 90% of participants.

The data displayed in Table 2 indicate a substantial improvement in the proportion of participants who met intervention goals at 6 and 18 months. The Established and Established plus DASH intervention groups had the highest prevalence of participants meeting goals, although higher prevalence of goal achievement was also noted for the Advice-Only group. Consistent with the intervention-specific behavioral goals, participants in Established plus DASH had greater prevalence of meeting the dairy, fruits and vegetables, and total fat goals than did the other groups. For example, at 6 months, 33.5% of those in the Established plus DASH group met the goal of at least 9 servings of fruits and vegetables compared with 6.0% and 6.6% in the Established and Advice-Only groups, respectively. Recidivism in

meeting goals was noted at 18 months in both intervention groups, but not Advice-Only.

Figure 1 displays the number of behavioral goals met at baseline, 6, and 18 months by intervention condition. Although all groups, including Advice-Only, increased the number of goals that were met at 6 and 18 months, the figure illustrates the gradient in adoption of behavioral goals from the Advice-Only to Established plus DASH. These differences were most evident at 6 months, but still persisted at 18 months. For the Established plus DASH group, 8% and 3% met all 5 behavioral goals at 6 and 18 months, respectively. The number of behavioral goals met (0 vs 1 vs 2 vs 3 or more) significantly differed between the Advice-Only group and each of the 2 active intervention groups at 6 months (P-values < 0.02), and between the Advice-Only and Established plus DASH groups at 18 months (Table 3) (P-values < 0.0001). At 6 months, 44.6% of participants in Established plus DASH met at least 3 behavioral goals, compared with 19.3% of those in Established and 11.7% in Advice-

Figure 1
The Percent of Participants by Treatment Group Meeting Behavioral Goals at Baseline, 6 Months, and 18 Months



Only. At 18 months, 33.5%, 11.9%, and 11.0% met at least 3 goals in Established plus DASH, Established, and Advice-Only, respectively.

Change in daily total fat intake was negatively correlated with daily number of fruit and vegetable servings ($\rho = -0.31$, $P < 0.001$) (Table 4). Change in estimated energy expenditure significantly correlated with change in daily sodium intake and change in daily total fat intake, although correlations were low ($-0.12 \leq \rho \leq 0.12$).

DISCUSSION

All groups were able to increase the

number of behavioral goals met at 6 and 18 months, and those who were asked to achieve the most goals (ie, Established plus DASH) succeeded in meeting the most goals. Consistent with concerns raised by Prochaska and Sallis,³¹ we were unsure if the Established plus DASH group would be able to make the number of behavioral changes required for this treatment arm. Although only a small percentage was able to meet all 5 intervention goals, the Established plus DASH group met more goals than did the Established intervention group. Interventions can successfully target multiple physical ac-

Table 3
The Number and Percent of Participants by Treatment Group Meeting 0, 1, 2, or 3 or More Behavioral Goals at Baseline, 6 Months, and 18 Months

Number of Behavioral Goals Met	Baseline			6 months			18 months		
	Advice-Only	Established	Established + DASH	Advice-Only	Established	Established + DASH	Advice-Only	Established	Established + DASH
0	87(31.9% ^a)	83(31.0%)	73(27.1%)	64(25.8%)	42(17.6%)	21(8.7%)	57(22.4%)	49(20.1%)	31(12.2%)
1	120(44.0%)	106(39.6%)	115(42.8%)	99(39.9%)	84(35.2%)	50(20.7%)	105(41.3%)	95(38.9%)	81(31.9%)
2	47(17.2%)	59(22.0%)	61(22.7%)	56(22.6%)	67(28.0%)	63(26.0%)	64(25.2%)	71(29.1%)	57(22.4%)
3 or more	19(7.0%)	20(7.5%)	20(7.4%)	29(11.7%)	46(19.3%)	108(44.6%)	28(11.0%)	29(11.9%)	85(33.5%)
Total	273(100.1%)	268(100.1%)	269(100.0%)	248(100.0%)	239(100.0%)	242(100.1%)	254(100.1%)	244(100.0%)	254(100.0%)

Note.

a Number meeting goal

b Percent meeting goal

Based on Pearson chi-square test, at 6 and 18 months Established + DASH different from both Advice-Only and from Established ($P<0.0001$); at 6 months Established different from Advice-Only ($P<0.02$).

tivity and dietary goals without negatively impacting goal attainment for those behaviors, at least for the type of patient population targeted in the current trial. Providing concurrent advice about physical activity and dietary changes can be an effective approach to reducing cardiovascular risk.

Although the expectations for the 3 treatment groups were different (no specific physical activity and dietary goals for the Advice-Only group and no formal goals for fruit, vegetable, or dairy intake for the Established group), we applied the most stringent goals (ie, Established plus DASH goals) for our analyses. Given that participants were motivated to enter the trial and were told about the health behavior changes they may have been asked to make, it is understandable that some participants from all 3 assignment groups were able to make the changes needed to meet the goals of the Established plus DASH intervention.

Previous studies have not been consistent regarding the relationship among physical activity and dietary behaviors. Cross-sectional analyses suggest that physical activity and a healthful dietary intake are correlated.³²⁻³⁵ However, comparing a physical activity-only intervention and a physical activity-plus-nutrition intervention in adolescents, Prochaska and Sallis³¹ found that both

interventions resulted in increased physical activity for boys, with only minimal change in fruit and vegetable intake. Others also found that changes in physical activity were not associated with naturally occurring dietary changes among middle-aged and older adults.³⁶

In contrast, our data indicate that making dietary changes was related to improvement in physical activity. We found significant correlations in the hypothesized direction between change in physical activity and change in daily sodium and total fat intake. Because the PREMIER participants had either prehypertension or stage 1 hypertension, they may have had greater motivation to make multiple lifestyle behavior changes than would otherwise healthy individuals. Such motivation may enhance the ability to make multiple behavior changes. When self-efficacy is low and there are numerous barriers to change, changing one behavior at a time may be more successful.³⁷ Multiple behavior change may also be easier with intensive counseling for extended periods of time, as was the case in PREMIER.

There were significant correlations in the hypothesized direction among change in daily intake of total fat and daily fruit and vegetable intake. Some participants may have replaced high-fat foods with additional fruits and vegetables, provid-

Table 4
Correlations of Baseline to 6 Month Change in PREMIER Intervention Health Behavior Targets

Baseline to 6-month Change in:	Baseline to 6-Month Change in:		
	Daily Sodium Intake (mmol/d)	Daily Servings of Fruit & Vegetables (number/day)	Daily Total Fat Intake (% kcal)
Estimated Energy Expenditure (kcal/kg/day)	-0.12 ^a n=645	0.04 n=694	-0.09 ^a n=694
Daily Sodium Intake (mmol/d)		-0.07 n=639	0.05 n=639
Daily Servings of Fruit & Vegetables (number/day)			-0.31 ^a n=710

a P <0.05

ing a partial explanation for the high prevalence of meeting 2 or more goals in all treatment groups at 6 and 18 months. However, because the correlations were only of moderate magnitude, other behaviors were combined to meet multiple goals.

We intentionally structured goal setting so the issue of sequence and combinations of targeted goals was determined by the participant. Although the intervention targeted multiple behaviors simultaneously, participants may have chosen to sequentially adopt behaviors. There is an emerging literature on adherence to multiple lifestyle behaviors. Although evidence is building that tailoring interventions to meet individual preferences is preferable to not tailoring intervention strategies,^{15,38-40} it has not been established if it is more effective for individuals to make multiple health behavior changes simultaneously or sequentially.⁴¹ Hyman and colleagues⁴² reported that intervening simultaneously to address smoking cessation, reduced dietary sodium, and increased physical activity was more effective than addressing each behavior sequentially.

Study Limitations and Strengths

There are several limitations to this study. Some participants were already meeting goals at baseline. Given that baseline goal attainment was comparable across treatment groups, this does not

compromise our results. Additionally, participants had to continue these behaviors to meet 6- and 18-month goals. The PREMIER interventions only promoted the health behaviors of physical activity and dietary intake. Estimated daily energy expenditure, daily servings of fruits, vegetables, and dairy, along with percent daily calories from fat were assessed by self-report, which is subject to recall bias. However, previous analyses from this trial indicate that biomarkers of dietary intake patterns from urine collection were consistent with the self-report increases in fruit, vegetable, dairy, and protein intake.²⁰ The dietary and self-reported physical activity measurements are imprecise. Additional measurements at each time point would have enhanced our power to detect associations.

Another limitation is we conducted a secondary analysis using PREMIER, a trial with blood pressure as its primary outcome — not behavioral goal attainment. Prochaska and Sallis³¹ randomized adolescents to a multifactor (physical activity and nutrition) or single-factor (physical activity) intervention and found no dietary change. Their trial differed in a number of respects, however, including age of participants, intervention delivery mode (computer based), contact frequency (one-time exposure). In contrast, we intervened in adults using multiple face-to-face contacts in group and individual set-

tings. A study design that directly tests the ability of participants to meet few versus many behavior goals would provide important information that our analysis cannot provide.

CONCLUSIONS

Participants were able to meet multiple behavioral goals. Participants in the intervention group who had the most goals to achieve were more likely to meet more goals than were those with fewer behavioral targets. Rather than being overwhelmed by targeting multiple health behaviors, participants were able to meet dietary and physical activity goals. Interventions can promote multiple health behavior change, particularly among motivated individuals at high risk for cardiovascular disease.

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