



## Physical activity and weight loss: does prescribing higher physical activity goals improve outcome?<sup>1-3</sup>

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### ABSTRACT

**Background:** Recommending increased physical activity facilitates long-term weight loss, but the optimal level of physical activity to recommend is unknown.

**Objective:** The objective of the study was to evaluate the efficacy for long-term weight loss of recommendations for much higher physical activity than those normally used in behavioral treatments.

**Design:** Overweight men and women ( $n = 202$ ) were randomly assigned to either a standard behavior therapy (SBT) for obesity, incorporating an energy expenditure (EE) goal of 1000 kcal/wk, or to a high physical activity (HPA) treatment, in which the goal was an EE of 2500 kcal/wk. To help HPA treatment group participants achieve this high exercise goal, their treatment included encouragement to recruit 1–3 exercise partners into the study, personal counseling from an exercise coach, and small monetary incentives.

**Results:** The HPA treatment group reported achieving higher mean ( $\pm$ SD) physical activity levels than did the SBT group at 6 mo (EE of  $2399 \pm 1571$  kcal/wk compared with  $1837 \pm 1431$  kcal/wk), 12 mo (EE of  $2249 \pm 1751$  kcal/wk compared with  $1565 \pm 1309$  kcal/wk), and 18 mo (EE of  $2317 \pm 1854$  kcal/wk compared with  $1629 \pm 1483$  kcal/wk) (all  $P < 0.01$ ). Mean ( $\pm$ SEM) cumulative weight losses at 6, 12, and 18 mo in the HPA treatment group were  $9.0 \pm 7.1$ ,  $8.5 \pm 7.9$ , and  $6.7 \pm 8.1$  kg, respectively. In the SBT group, the corresponding weight losses were  $8.1 \pm 7.4$ ,  $6.1 \pm 8.8$ , and  $4.1 \pm 7.3$  kg, respectively. Between-group differences in weight loss were significant at 12 and 18 mo.

**Conclusion:** These results suggest that recommendations of higher levels of physical activity (EE of 2500 kcal/wk) promote long-term weight loss better than do conventional recommendations. *Am J Clin Nutr* 2003;78:684–9.

**KEY WORDS** Obesity, weight loss, physical activity, exercise goals, social support, treatment

### INTRODUCTION

The importance of physical activity in successful intervention programs for weight control has been recognized for many years (1, 2). Randomized trials showed that weight-loss interventions incorporating strong exercise components are more effective in promoting long-term weight loss in overweight persons than are interventions that rely on dietary instruction alone (3, 4). Increased physical activity also stands out in correlational studies involving clinic- and population-based samples as one of the best predictors of long-term success in weight reduction (5, 6). As a result, it is

standard practice in behavior therapy programs for weight reduction to encourage and support increases in energy expenditure (EE) of  $\approx 1000$  kcal/wk (7). Current population-level recommendations for levels of physical activity from the Centers for Disease Control and Prevention are in the same range, ie, 150 min of exercise of moderate or greater intensity/wk (8).

Despite wide acceptance of an EE of 1000 kcal/wk as an appropriate physical activity target in both clinical and public health approaches to weight control, we are aware of no empirical basis for selecting these EE levels. Moreover, data from several sources suggest that considerably higher exercise targets may be achievable by many overweight people and may be more beneficial for long-term weight loss. For example, several behavioral weight-control programs (9, 10) showed larger weight losses at 18 mo in participants who reported  $>200$  min of physical activity/wk or an EE of  $>1600$  kcal/wk than in participants with lower activity levels. Moreover, persons who successfully maintained weight loss for periods of  $\geq 1$  y reported average EEs of  $<2800$  kcal/wk rather than those of 1000 kcal/wk (11). In addition, one experimental study using exercise alone to promote weight loss found that 30 min of walking/d had little effect on body weight, but substantial long-term weight losses were produced by walking  $>120$  min/d (12).

On the basis of the evidence noted above, the present study was designed to evaluate whether prescribing higher exercise levels in behavioral weight-loss programs would enhance short- and long-term weight-loss outcomes. Two groups were compared: a standard behavior therapy (SBT) group with a prescribed EE of 1000 kcal/wk and a high physical activity (HPA) treatment group that received the same behavior therapy treatment but with a prescribed EE of 2500 kcal/wk. It was hypothesized that subjects in the HPA treatment group would achieve higher levels of physical activity and, consequently, greater weight losses than would those in the SBT group.

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## SUBJECTS AND METHODS

### Subjects

This study was a collaborative, 2-center investigation between the University of Minnesota School of Public Health, where RW Jeffery was the Principal Investigator, and Brown University Medical School/Miriam Hospital, where RR Wing was the Principal Investigator. A total of 202 subjects (half at each institution) were recruited for the study in 2 cohorts spaced 6 mo apart. Subjects were recruited by public advertisement. Eligibility requirements were age 25–50 y, overweight of 14–32 kg according to actuarial norms, and freedom from serious concurrent medical or psychological problems thought to interfere with treatment. An effort was made to recruit equal numbers of male and female participants. Depending on age, sex, and other health risk factors, all prospective participants were required to complete a submaximal exercise stress test as recommended by the American College of Sports Medicine. The study was approved by the Institutional Review Boards of Miriam Hospital and the University of Minnesota, and all participants gave written informed consent.

### Treatment groups

Participants were randomly assigned to 1 of 2 study groups. Subjects in the SBT group were instructed in a state-of-the-art behavior therapy program for weight loss. Treatment was conducted in groups of <20 people and was led by trained interventionists with expertise in both content area (ie, physical activity and nutrition) and behavioral therapy. Treatment meetings were held weekly for the first 6 mo, biweekly from 6 to 12 mo, and monthly from 12 to 18 mo. Group sessions included didactic presentations of material needed to develop obesity management skills, group discussions, and problem solving. Session content was adapted from prior research (13). Topics included diet, physical activity, stimulus control, problem solving, goal setting, social support, motivation, and relapse prevention. Participants were asked to keep complete diet and exercise records daily for the first 6 mo and for 1 wk/mo thereafter. Dietary goals were to reduce daily energy intake to 1000–1500 cal depending on initial body weight and to consume <20% of energy as fat. Participants in the SBT group were also instructed to initiate a regular physical activity program, beginning with an EE goal of 250 kcal/wk and increasing by 250 kcal/wk at 2-wk intervals to a final EE goal of 1000 kcal/wk. This amount of exercise is roughly equivalent to walking for 30 min/d.

Participants in the HPA treatment group met on the same schedule as did those in the SBT group and received identical training in diet and behavior-control skills. However, they were given an EE goal of 2500 kcal/wk to achieve by the end of the first 6 mo of intervention. This level of activity can be achieved by walking <75 min/d. To facilitate adherence to this higher exercise goal, 3 extra elements were introduced for the HPA treatment group only. First, all participants in that group were strongly encouraged to recruit friends or family members to participate in the study with them. Because prior research suggested the benefits of social support for exercise and maintenance of weight loss (14), participants were encouraged to recruit 1–3 partners. Overall, 54% of study participants assigned to this group recruited  $\geq 1$  support partners. Compared with the subjects, support partners were allowed wider age (21–50 y) and weight (7–32 kg overweight) ranges as entry criteria. They went through the same screening as regular study participants, participated in the same outcome assessments, and

received the same intervention. The second element of the intervention that was different in the HPA treatment group than in the SBT group was the use of exercise coaches. Exercise coaches who were skilled in exercise science and prescription met with small groups of study participants before or after each group session. Coaches reviewed exercise progress with each participant individually and provided encouragement, support, and problem-solving strategies for participants who were having difficulty reaching their physical activity goals. The third extra element was the use of small monetary incentives of \$3 for each week that participants achieved or exceeded the EE goal of 2500 kcal/wk during the last 6 mo of active intervention.

### Study data

The following data were collected at baseline and at 6-, 12-, and 18-mo assessment visits.

#### *Demographic and body-composition data*

The demographic data collected (at baseline only) were those for age, sex, education (% college graduate), and ethnicity (% white). For weight-status data, body weight was measured with the use of a calibrated scale while the subject was in a hospital gown and not wearing shoes. Height was measured at baseline with the use of a wall-mounted ruler. Body mass index (in kg/m<sup>2</sup>) was computed.

#### *Physical activity data*

The primary behavioral variable targeted for change in the study was physical activity. Physical activity was assessed at 6-mo intervals with the use of the Paffenbarger Physical Activity Questionnaire (15). This instrument asks subjects to indicate the number of city blocks walked in the previous week, the number of flights of stairs climbed, and the light- (EE of 5 kcal/min), medium- (EE of 7.5 kcal/min), and heavy-intensity (EE of 10 kcal/min) leisure-time activities that were performed. The EEs for each of these forms of activity are then summed to estimate the total number of kilocalories used in the previous week. The Paffenbarger questionnaire was shown to have satisfactory reliability (16) as well as predictive validity (17). It also was shown to be sensitive to physical activity change in intervention studies (9).

#### *Dietary data*

Dietary intake was assessed with the use of the 60-item version of the Block Diet Questionnaire (18). Respondents were asked to indicate how frequently they consumed each of 60 listed foods or food groups over the past 6 mo. This information was used to estimate energy intake per day.

### Analysis

Data analyses for this study were done by using SAS statistical software (version 8.0; SAS Institute Inc, Cary, NC). The primary comparisons of interest were between treatment groups. Analyses of the primary dependent variables (ie, weight, total EE, and total energy intake) were performed in 2 steps. First, we conducted repeated-measures analysis of variance (ANOVA) by using PROC.MIXED (SAS Institute Inc), a procedure that uses restricted maximum likelihood methods and is capable of including data from respondents who do not provide data at all points in time. Because the validity of treatment group comparisons in this analysis assumes that data are missing randomly with respect



to treatment assignment, we compared weight losses at 6 mo among subjects who had complete data through 18 mo with those among subjects who did not. This analysis showed that, in the HPA treatment group, subjects with complete data ( $n = 84$ ) had average weight losses of 9.8 kg at 6 mo, whereas those whose later data were incomplete had average losses of 4.9 kg ( $P < 0.02$ ). In the SBT group, however, the opposite pattern was observed: there was less average weight loss at 6 mo in those who completed the study (7.6 kg,  $n = 74$ ) than in those with missing data (11.8 kg,  $n = 10$ ;  $P < 0.10$ ). A test of the interaction between treatment group and missing data status yielded an  $F$  value of 8.94 ( $P < 0.01$ ). Although subsequent weight losses or regains in subjects missing later visits are unknown, these data strongly suggest the assumption that loss to follow-up is unbiased may not be correct in this case. Moreover, they suggest that the overall repeated-measures ANOVA is likely to be biased toward the null hypothesis (ie, subjects with missing data in the HPA treatment group will be assumed to have lost less weight than average, and subjects with missing data in the SBT group will be assumed to have lost more weight than average). Thus, readers should be aware that, although the time  $\times$  treatment group term in our repeated-measures ANOVA at least provides a general guideline for assessing whether a comparison of treatment groups at each follow-up time point is justified, there is probably a conservative bias toward the null hypothesis. The second stage of the analyses was to use general linear modeling procedures (PROC.GLM; SAS Institute Inc) to compare treatment groups with respect to mean change from baseline at each follow-up point by using all available data at each point.

Several variables were considered as covariates for the analyses above: ie, age, sex, baseline weight, treatment center, and cohort. Sex was significantly related to weight change at 6 mo (men lost more than women), but not at 12 or 18 mo. Sex did not interact with treatment group in affecting weight loss or any of the other outcomes. None of the other covariates were significantly related to weight loss alone or in interaction with treatment group. Because of the weak relations between the potential covariates and outcomes of interest, data are presented below without any statistical covariate adjustments. Analyses are restricted to primary subjects (ie, support partners of subjects in the HPA treatment group were excluded).

## RESULTS

The mean ( $\pm$ SD) age of the study sample was  $42.2 \pm 6.4$  y; 58% were women, 43% reported being college graduates, 80% reported white ethnicity, and mean body mass index was  $31.7 \pm 2.6$ . There were no significant differences between treatment groups in these characteristics.

Retention of study participants was good over 18 mo of follow-up in both study conditions. Expressed as a percentage of randomly assigned subjects who returned for follow-up visits, retention rates at 6, 12, and 18 mo of the study were 90%, 82% and 87% in the SBT group and 94%, 79% and 80% in the HPA treatment group, respectively. Examination of the baseline characteristics of study completers ( $n = 168$ ) and study dropouts ( $n = 34$ ) at 18 mo indicated no significant differences in body weight, sex, exercise level, energy intake, or percentage of energy from fat.

### Physical activity levels

The effectiveness of the intervention program in producing differential levels of physical activity is shown in **Table 1**. At

**TABLE 1**  
Reported weekly energy expenditure (EE), daily energy intake, and percentage of dietary fat intake by treatment group<sup>1</sup>

	Treatment group	
	SBT group	HPA group
EE (kcal/wk)		
Baseline	1286.0 $\pm$ 1258.0 [93]	1278.0 $\pm$ 1369 [109]
6 mo	1837.0 $\pm$ 1431.0 [82]	2399.0 $\pm$ 1571 [100] <sup>2</sup>
12 mo	1565.0 $\pm$ 1309.0 [72]	2249.0 $\pm$ 1751 [85] <sup>2</sup>
18 mo	1629.0 $\pm$ 1483.0 [80]	2317.0 $\pm$ 1854 [85] <sup>2</sup>
Total energy intake (kcal/d)		
Baseline	2071.0 $\pm$ 1058.3 [93]	2189.3 $\pm$ 1066.0 [109]
6 mo	1525.6 $\pm$ 619.1 [66]	1507.9 $\pm$ 485.5 [76]
12 mo	1636.0 $\pm$ 658.0 [52]	1697.8 $\pm$ 741.2 [70]
18 mo	1641.1 $\pm$ 742.2 [73]	1631.2 $\pm$ 670.3 [77]
Fat intake (% of energy from fat)		
Baseline	35.4 $\pm$ 7.0 [93]	35.9 $\pm$ 7.5 [109]
6 mo	28.7 $\pm$ 7.0 [66]	28.1 $\pm$ 6.3 [76]
12 mo	33.1 $\pm$ 7.0 [52]	31.1 $\pm$ 7.0 [70]
18 mo	32.7 $\pm$ 7.6 [73]	32.2 $\pm$ 7.3 [77]

<sup>1</sup> $\bar{x} \pm$  SD.  $n$  in brackets. Statistical analysis was performed with the GLM (SAS Institute Inc, Cary, NC) procedure. SBT, standard behavior therapy; HPA, high physical activity.

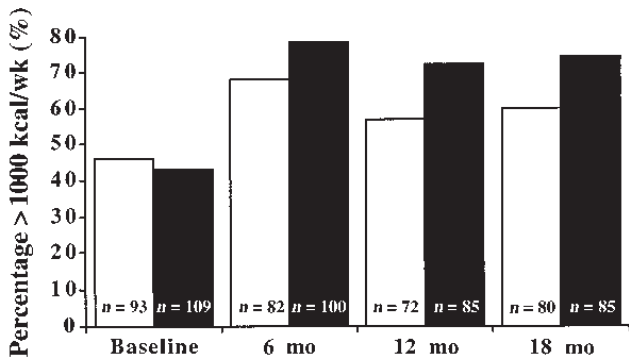
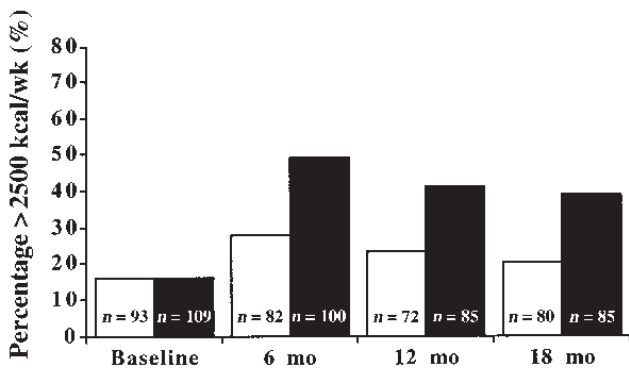
<sup>2</sup>Significantly different from SBT group,  $P = 0.01$ .

baseline, the 2 treatment groups did not differ significantly in mean EE ( $\approx$ 1280 kcal/wk). On average, subjects in the SBT group increased their EE by  $596 \pm 1527$  kcal/wk in the first 6 mo and maintained an increase in EE of  $328 \pm 1351$  and  $334 \pm 1766$  kcal/wk at 12 and 18 mo, respectively. Subjects in the HPA treatment group increased their EE by  $1079 \pm 1767$  kcal/wk over 6 mo, to an EE level of  $2399 \pm 1571$  kcal/wk, and they maintained these high levels through 18 mo. Repeated-measures ANOVA indicated that the time  $\times$  treatment interaction had a  $P$  value of 0.04. Subsequent tests at individual follow-up points indicated that the difference between the 2 treatment conditions was statistically significant at the 6-, 12-, and 18-mo assessment points (Table 1).

Group differences in physical activity expressed in terms of the proportion of subjects reaching the exercise goals of the 2 treatments, ie, EEs of 1000 and 2500 kcal/wk, are shown in **Figure 1**. With the HPA treatment group goal of an EE of 2500 kcal/wk used as the criterion for intervention success, 49% of those in the HPA treatment group and 28% of those in the SBT group reached that goal after 6 mo, and 41% and 39% of HPA treatment group subjects continued to report these levels at 12 and 18 mo, respectively, compared with 23% and 20% of the SBT group subjects. The proportion of HPA treatment group subjects exceeding the standard 1000-kcal activity goal also tended to be greater than the proportion from the SBT group at 6, 12, and 18 mo.

Analyses were also conducted to determine what types of exercise differed between the 2 groups and accounted for their overall difference in EE. Averaging over the 6, 12, and 18-mo assessments, participants in the HPA treatment group reported significantly greater EE from light-intensity activity (HPA treatment group: EE of  $165 \pm 428$  kcal/wk; SBT group: EE of  $97 \pm 293$  kcal/wk;  $P < 0.04$ ) and heavy-intensity activity (HPA treatment group: EE of  $610 \pm 1112$  kcal/wk; SBT group: EE of  $347 \pm 709$  kcal/wk;  $P < 0.002$ ) than did participants in the SBT group. No significant group differences were observed for flights of





**FIGURE 1.** Proportion of participants exceeding an energy expenditure (EE) of 2500 or 1000 kcal/wk by treatment group (□, standard behavior therapy group; ■, high physical activity treatment group). Significant difference between treatment groups: EE > 1000 kcal/wk,  $P < 0.04$ ; EE > 2500 kcal/wk,  $P < 0.002$ .

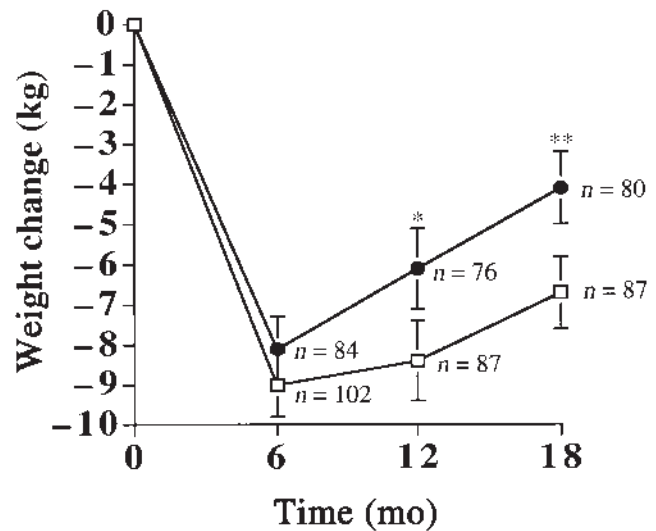
stairs walked, blocks walked (includes all walking), or medium-intensity EE.

**Dietary intake**

Analyses similar to those done with the exercise data were also done with dietary intake data. As shown in Table 1, although participants on average did not reach energy- or fat-intake goals, both treatment groups reported significant ( $P < 0.001$ ) declines in energy intake and in the percentage of energy from fat between baseline and each of the follow-up assessment points. The treatment groups did not differ from each other. The treatment  $\times$  time interactions for total energy intake ( $P = 0.80$ ) and percentage of fat intake ( $P = 0.59$ ) did not differ significantly, nor were follow-up tests at individual follow-up points (Table 1). These dietary analyses suggest that differences in weight loss between groups are not likely to be due to differences in energy intake.

**Weight loss**

The key outcome in the study was weight loss. Mean weight losses at 6, 12 and 18 mo were  $8.1 \pm 7.4$ ,  $6.1 \pm 8.8$ , and  $4.1 \pm 8.3$  kg in the SBT group and  $9.0 \pm 7.1$ ,  $8.5 \pm 7.9$ , and  $6.7 \pm 8.1$  kg in the HPA treatment group, respectively (Figure 2). Repeated-measures ANOVA using PROC.MIXED produced a time  $\times$  treatment coefficient with a  $P$  value of 0.06. Subsequent analyses at



**FIGURE 2.** Mean ( $\pm$ SEM) weight change over time by treatment group (●, standard behavior therapy group; □, high physical activity treatment group). \*\*Significantly different from the HPA treatment group (SAS GLM procedure): \* $P = 0.07$ , \*\* $P = 0.04$ .

individual follow-up points indicated that differences in weight loss between treatments were not significant at 6 mo ( $P = 0.45$ ); at 12 mo, they approached significance ( $P = 0.07$ ); and at 18 mo, they achieved conventional criteria for establishing significance ( $P = 0.04$ ).

Correlational analyses were done on the combined groups to explore the relations between weight change and reported changes in diet and exercise. The correlations between changes in reported energy intake and changes in weight from baseline to 6, 12, and 18 mo were  $r = 0.23$  ( $P < 0.006$ ),  $r = 0.10$  ( $P < 0.27$ ), and  $r = 0.15$  ( $P < 0.07$ ), respectively. In contrast, correlations between changes in exercise and changes in weight at the same time periods were  $r = 0.44$  ( $P < 0.001$ ),  $r = 0.42$  ( $P < 0.001$ ), and  $r = 0.27$  ( $P < 0.001$ ), respectively.

Correlations were also computed between the changes in the different types of exercise averaged across the 3 follow-up time points and the 18-mo weight changes. Across all participants, significant associations between weight change and changes in the energy expended by walking ( $r = -0.20$ ,  $P < 0.01$ ) and in the energy expended in heavy-intensity exercise ( $r = -0.24$ ,  $P < 0.01$ ) were observed. Among participants in the SBT group, the total change in exercise energy expended was significantly associated with weight change ( $r = -0.22$ ,  $P < 0.05$ ), and the change in energy expended by walking ( $r = -0.20$ ,  $P < 0.07$ ) was marginally associated with weight change. Among participants in the HPA treatment group, the total change in exercise energy expended ( $r = -0.37$ ,  $P < 0.01$ ) and the change in heavy-intensity exercise energy expended ( $r = -0.30$ ,  $P < 0.01$ ) were significantly associated with weight change.

**Adverse effects**

Participants in both treatment groups were asked monthly if they had experienced any injuries or illnesses in the past month and, if so, whether they had been caused in part by their exercise program. The mean number of injuries or illnesses of all

kinds reported per month by SBT and HPA treatment groups, respectively, were  $1.4 \pm 1.3$  and  $1.6 \pm 1.6$  at 6 mo ( $P = 0.27$ ),  $1.8 \pm 1.5$  and  $2.3 \pm 2.0$  at 12 mo ( $P = 0.036$ ), and  $2.0 \pm 1.5$  and  $2.6 \pm 2.2$  at 18 mo ( $P = 0.039$ ). Further examination of the data on injuries indicated that they derived mainly from exercise-related injuries, ie, the HPA treatment group consistently reported more exercise-related injuries or illnesses than did the SBT group, and the average difference between the 2 groups at 18 mo was significant.

## DISCUSSION

This study tested the hypothesis that prescribing higher levels of physical activity than are conventional in weight-loss studies (ie, EE of 2500 kcal/wk rather than 1000 kcal/wk) will improve long-term weight loss. The results presented above support this hypothesis. Participants in the HPA treatment group were able to achieve increases in physical activity that were twice as high as those for participants in the SBT group, and the former group maintained these high activity levels over an 18-mo period. Although these higher exercise levels did not significantly affect weight in the short term (6 mo), the group with higher physical activity goals achieved larger weight losses at 18 mo.


The present study cannot distinguish the effects of the higher exercise level per se from the effects of the strategies used to promote adherence to the high exercise goal—namely, the involvement of friends, the use of exercise coaches, and monetary incentives. However, the relative strength of the individual level correlations between changes in physical activity and changes in weight versus those between changes in energy intake and changes in weight, and the fact that differences in reported physical activity differed significantly between groups although dietary intake did not, lends strength to the argument that it was differences in physical activity and not other aspects of the HPA intervention that produced these long-term weight-loss differences.

This study also provided instructive information regarding the role of exercise type in achieving higher levels of exercise and promoting weight loss. Analyses indicated that the higher exercise levels observed in the HPA treatment group were driven primarily by differences in light- and heavy-intensity exercise, although the mean values for all types of exercise were greater in the HPA treatment group than in the SBT group and contributed to the higher EE in the former. Similarly, correlational analyses showed that the total amount of exercise energy expended was most strongly correlated with weight change. However, heavy-intensity exercise was significantly correlated with weight loss among participants in the HPA treatment group only. Thus heavy-intensity exercise may have been more important than other levels of exercise for achieving the overall exercise level and improving weight loss in this group.

The evidence regarding potential benefits of higher physical activity goals raises questions regarding the manner in which physical activity is typically prescribed in behavioral weight-loss programs. Behavioral programs usually instruct participants to record their current daily activity and the expenditure associated with each activity and to work toward an EE goal of 1000 kcal/wk. Thus, the EE goal becomes a level of 1000 kcal/wk, whether or not that represents an increase in physical activity. Clinically speaking, it is hard to tell participants that exercises they currently perform do not count and difficult for subjects to remember at 12 or 18 mo what was or was not being done at baseline. However,

participants in the present study already had EE of  $> 1200$  kcal/wk in activity at baseline as assessed by the Paffenbarger questionnaire. Thus, even though the definition of exercise was more stringent for treatment than for the Paffenbarger questionnaire (a minimum of 10 min of continuous activity), the 1000-calorie goal we set may not actually represent an increase for some participants. More careful assessment of baseline activity level to obtain an estimate of baseline EE may also be needed to ensure that participants are given activity prescriptions that represent a substantial increase in their activity levels.

Participants in the HPA treatment group increased their activity gradually and achieved their highest physical activity level only at the 6-mo time point. Thus, it is not surprising that differences in weight loss did not emerge until after this time. Moreover, many studies have suggested that physical activity is more effective for maintaining weight loss than for increasing initial weight loss.

Despite the overall success of this intervention, there were 2 issues of concern. First, the injury rate was consistently greater in the HPA treatment group than in the SBT group throughout the study. Although this is not entirely unexpected and has been reported elsewhere (19), injuries may undermine the ability of participants to stick with an exercise program over time. Second, modest weight gains were observed in this study between 12 and 18 mo in the HPA treatment group, which suggests a deterioration of intervention effects over time, despite the maintenance of higher physical activity levels. Thus, even relatively heavy physical activity may not be absolutely protective against weight regain. The results of an additional follow-up at 30 mo should clarify whether higher levels of physical activity are sustainable for longer periods of time in the absence of active therapeutic support and whether the higher physical activity levels continue to be of value in preventing weight regain. 

RWJ was primarily responsible for drafting the manuscript, and NES was the primary data analyst. RRW and DFT provided detailed input at each stage, including conceptualization, data presentation, data analyses, and style. None of the authors had a financial or personal conflict of interest related to the funding of or outcomes of this research.

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