

## Technical Skills for Weight Loss: Preliminary Data from a Randomized Trial<sup>1</sup>

David L. Katz, M.D., M.P.H.,\*†<sup>2</sup> Wendy Chan, M.P.H.,\* Maura Gonzalez, M.S., R.D.,\* David Larson,† Haq Nawaz, M.D., M.P.H.,\* Mustapha Abdulrahman, M.D.,\* and Ming-Chin Yeh, Ph.D.\*

\*Yale Prevention Research Center and †Department of Epidemiology and Public Health, Yale University School of Medicine

**Background.** Optimal behavioral interventions for sustainable weight loss are uncertain. We therefore conducted a study among overweight/obese women comparing conventional dietary counseling of individuals (counseling-based intervention) to a novel, group-based skill-building intervention.

**Methods.** Eighty subjects were randomly assigned to either the counseling-based or to the skill-building intervention. Outcomes included weight loss, dietitian hours per group and per unit weight loss, and dollars spent per group and per unit weight lost.

**Results.** Weight loss at 6 months (follow-up rate 61.3%) in the counseling-based group was 8.8 lb ( $P = 0.0001$ ), and in the skill-building group was 3.8 lb ( $P = 0.01$ ). A total of 160 dietitian hours were required for the counseling-based group, and 131 for the skill-building group. The counseling-based group cost an average of \$21 per pound lost, while the skill-building cost an average of \$48 per pound lost ( $P = 0.16$ ).

**Conclusions.** At 6 months, individualized office-based counseling produced more weight loss than a skill-building approach and cost less than half as much per pound of weight loss. Longer-term follow-up is required to determine if, as hypothesized, the skill-building intervention produces more sustainable weight loss. © 2002 American Health Foundation and Elsevier Science (USA)

**Key Words:** weight loss; body mass index; weight loss changes; programs; counseling; randomized controlled trial.

<sup>1</sup> The authors gratefully acknowledge the assistance of Mrs. Jennifer Ballard and Mrs. Michelle Larovera in preparation of the manuscript. This study was supported by Grant U48/CCU115802-03 from the Centers for Disease Control and Prevention.

<sup>2</sup> To whom reprint requests should be addressed at Director, Yale Prevention Research Center, 130 Division St., Derby, CT 06418. Fax: (203) 732-1264. E-mail: katzdl@pol.net or david.katz@vale.edu, with copy to shelli.larovera@yalegriffinprc.org.

### INTRODUCTION

Obesity and overweight are increasing at alarming rates in the United States; 97.1 million adults over age 20, or more than half of the U.S. adult population, are currently overweight (body mass index (BMI) between 25 and 29.9 kg/m<sup>2</sup>) or obese (BMI  $\geq$  30.0 kg/m<sup>2</sup>) [1,2]. Nationally representative data gathered by the Third National Health and Nutrition Examination Survey (NHANES III) indicate that 20% of men and 25% of women age 20 or older are obese (BMI  $\geq$  30) [3,4], while 63% of men and 55% of women age 25 or older are overweight (25  $\leq$  BMI  $\leq$  29.9) [1].

Obesity is associated with increased mortality risk [5] and significant morbidity, acting as an important risk factor for cardiovascular disease, diabetes, cancer, and arthritis [1,6–11]. Loss of weight decreases cardiovascular risk [12] and cardiovascular mortality [13] in overweight persons, and produces a variety of additional health benefits [13–15].

Behavioral interventions for obesity have been limited by both cost [16] and lack of sustainable results [17]. Siggaard *et al.* have demonstrated that 12 weeks of a carbohydrate-rich, low-fat diet produces weight loss at a cost of \$14.70 per kilogram per person [18]. The optimal approach to weight management, and cost-effective approaches to sustained weight loss remain to be demonstrated [19]. There is strong support for innovative behavioral interventions among experts in the fields of obesity and nutrition. The Institute of Medicine has included instruction in technical nutrition skills, such as shopping and cooking, among strategies recommended to improve the dietary health of Americans [20]. The relative efficacy and cost-effectiveness of implementing such recommendations compared to conventional office-based dietary counseling has not been reported to date [19,21].

We therefore conducted a randomized pilot trial to compare conventional dietary counseling to a novel intervention, emphasizing competency in technical skills for purchasing, ordering, and preparing food in a

sample of overweight/obese women. Outcome measures of interest include initial weight loss, maintenance of weight loss, and costs per unit weight loss. Study methods and results at 6-month follow-up are reported.

## METHODS

### *Subjects*

For purposes of this pilot study, recruitment was limited to women. Subjects were recruited from the Lower Naugatuck Valley, Connecticut, a primarily middle-class community located in Southwestern Connecticut. Eligibility required that subjects be between 30 and 65 years old; obese or overweight, as defined by a BMI (body mass index = weight in kg/height in m<sup>2</sup>) greater than 25 and the primary person in the household who purchases groceries and prepares meals. Original plans called for exclusion of women with a BMI greater than 40, but the criteria were revised to include this population due to expressed interest in the study. Women were excluded if they had any unstable medical condition affecting their ability to participate fully in the study protocol; were participating in another weight reduction program at the time of enrollment; had pharmacologically treated diabetes; or were using medications known to affect weight gain or loss, such as phenothiazines or selective serotonin reuptake inhibitors (SSRIs).

Subjects were prescreened over the telephone to assess eligibility. Those who qualified for the study based on the telephone screen were scheduled for a physical examination within 1 to 2 weeks at the Yale-Griffin Prevention Research Center (YG-PRC) in Derby, Connecticut. Enrollment required that measured rather than self-reported height and weight fall within the specified BMI range; discrepancies between self-reported and measured BMI have been previously reported [22]. The physical examination included determination of blood pressure and pulse rate and measurements of height, weight, hip circumference, and waist circumference. Weight was measured without shoes and with only undergarments permitted while weighing. Height was measured in inches without shoes with subjects standing erect and facing the measurer. All measures were performed by trained members of the research team, using identical methods and calibrated equipment.

### *Enrollment*

Study enrollment took place over a 4-month period. Women who met the inclusion criteria were enrolled in the study after completing an informed consent form. Initial physical exam measures obtained during enrollment were then recorded as baseline values. In order to obtain accurate baseline measures, subjects were re-

measured prior to the start of the study if the period of time between their initial exam and the beginning of the intervention was greater than 6 weeks.

Enrolled study participants completed a demographic survey that supplied information on their marital status, educational level, income, employment status, physical activity levels, perceptions of weight loss, and previous history of weight loss attempts. A semi-quantitative food frequency questionnaire (FFQ) was also completed by all participants at the time of their initial evaluation with follow-up planned at 12 and 24 months. All subjects underwent repeat clinical assessments at 6 and 12 months. Information was recorded on a standard intake form.

### *Study Design*

Subjects were randomly assigned to one of two behavioral interventions using SAS software [23]. Assignment to treatment group was made by a data analyst who had no contact with study subjects. Subjects and investigators neither knew of treatment assignment in advance of eligibility assessment nor exercised any control over treatment assignment. Outcome measures were obtained by research assistants blinded to all subjects' treatment assignment.

The skill-based intervention (SBI) was developed to provide skills useful in overcoming impediments to a dietary pattern in accord with recommendations, and thereby to test the recently published Pressure System Model of behavior change [24]. The SBI consisted of two 90-min didactic sessions delivered to groups of approximately 20 subjects at a time, followed by skill-building sessions over a 4-month period. Each didactic session consisted of 60 min for presentation and 30 min for question and answer. The content of the sessions was based on material prepared for the Yale University School of Medicine's Human Nutrition Lecture Series, and included in a recently published text [25]. The first session provided an overview of factors influencing dietary preference and behavior. The second session summarized strategies for successfully modifying diet given the physiologic, genetic, cultural, and environmental impediments to change [25]. Following the didactic sessions, subjects began technical skill building sessions including:

- Two 2-h trips to the supermarket in groups of 10 supervised by the dietitian in which subjects received aisle-by-aisle instruction in the selection of healthful items, and in the interpretation of food labels.
- Two dinners at local restaurants. Each of the dinners was attended by 5 subjects and the dietitian. Subjects received instruction in the selection of healthful dishes from the menu, and in obtaining information from restaurant staff about menu options.
- A 2-h private session at each of the subjects' homes with the dietitian supervising the preparation of a

meal. The dietitian provided instruction in ingredient selection, pantry stocking, food preparation methods, and portion sizing.

Following completion of the skill-building phase of the intervention, subjects had telephone and E-mail access to the dietitian for the remainder of the year. The frequency and extent of such contact was recorded by the dietitian.

The control consisted of standard, office-based dietary counseling (counseling-based intervention; CBI) provided by a licensed dietitian employed by the Yale-Griffin Prevention Research Center in Derby. Each subject received a total of two 1-hour sessions and four one-half-hour sessions distributed over the first 6 months of the intervention period. The content of the counseling sessions was determined by the dietitian based on interactions with each subject, as is standard practice, and closely followed published guidelines of the American Dietetic Association [26]. Methods for the CBI were adapted from the American Dietetic Association's Medical Nutrition Therapy Protocol for Weight Management [27]. Each subject received individualized diet counseling based upon their diet history, medical history, and psychosocial concerns. Clients were offered six monthly sessions, with the option to add up to four more sessions. During the initial session the clients were instructed in a low-calorie meal plan based upon the 1995 Exchange Lists for Meal Planning from the American Diabetes Association and the American Dietetic Association [27]. Over the course of subsequent sessions, clients received instruction regarding meal planning, food label reading, recipe modification, dining out, and physical activity. Clients were also weighed at each session.

### *Data Management*

Weight, waist-to-hip ratio, and blood pressure measurements were recorded manually on paper forms and then transferred by a dedicated data manager to an electronic spreadsheet using standard spreadsheet software (Microsoft Excel, 1997, Microsoft Corp.). All data were confirmed and double-checked for coding errors. To protect the identity of subjects, all personal data were stored in password-protected files accessible only to designated study staff.

### *Statistical Methods*

The main clinical outcome variables of interest included the proportion of subjects in each group with a 5% decrease or more in body weight (based on criteria established by the Institute of Medicine of the National Academy of Sciences) [21]; absolute weight difference measured in pounds; the proportion of subjects in each group with a weight loss of greater than or equal to 10 lb; and absolute change in body-mass index. Changes

in systolic blood pressure and waist-to-hip measurements were also assessed during the study. The study was powered at the 80% level to detect an absolute between-group difference of 30% in the rate of weight loss maintenance at 2 years, with a higher rate of weight loss maintenance in the SBI group hypothesized.

Two-factor repeated-measures analysis of variance (ANOVA) was used to compare average absolute weight in pounds between the intervention and the control groups from 6 months to baseline accounting for group  $\times$  time effects. The Mantel-Haenszel chi-square test was used to compare proportional changes in weight loss and body weight between the intervention and the control groups. Stepwise multiple regression was performed to assess the association of demographic and clinical variables (such as age, income, employment status, marital status, attitude toward weight loss, baseline weight) on weight loss at 6 months. Paired *t* tests were used to determine within-group changes in weight and BMI.

An intention-to-treat analysis was performed, where subjects who were lost to follow-up were treated as though they had no absolute weight change at 6 months postintervention compared to baseline. Intention-to-treat analyses were performed on all cost data to compare the CBI with the SBI in terms of total dietitian costs (in hours and in dollars); the cost in dollars per unit weight lost; and dollars spent for dietitian time per subject. Intention-to-treat analysis for cost was based on all 80 subjects (40 per group), and the expected number of hours of registered dietitian (RD) contact (i.e., direct patient contact only) for each group. With full subject participation and compliance with the study protocol, a total of 131 contact hours were projected for the SBI group and 160 h for the CBI group (exclusive of the last four half-hour counseling sessions, which were optional). Dietitian time was billed at a standard rate of \$35/hour for both groups.

Statistical significance was based on a two-tailed  $\alpha$  of 0.05. SAS [23] was used to perform all statistical analyses.

## **RESULTS**

### *Baseline Characteristics*

A total of 272 women responded to the study advertisement and were interviewed by telephone to assess eligibility status. Of these women, 136 met the eligibility criteria based on the telephone interview and were invited to be screened in person. Of these 136 women, 99 (73%) accepted the invitation and chose to have an initial assessment of their baseline clinical measures. During initial enrollment and assessment, 4 women were determined to be ineligible for the study, while 15 women declined participation prior to the start of the study due to time conflicts. The remaining

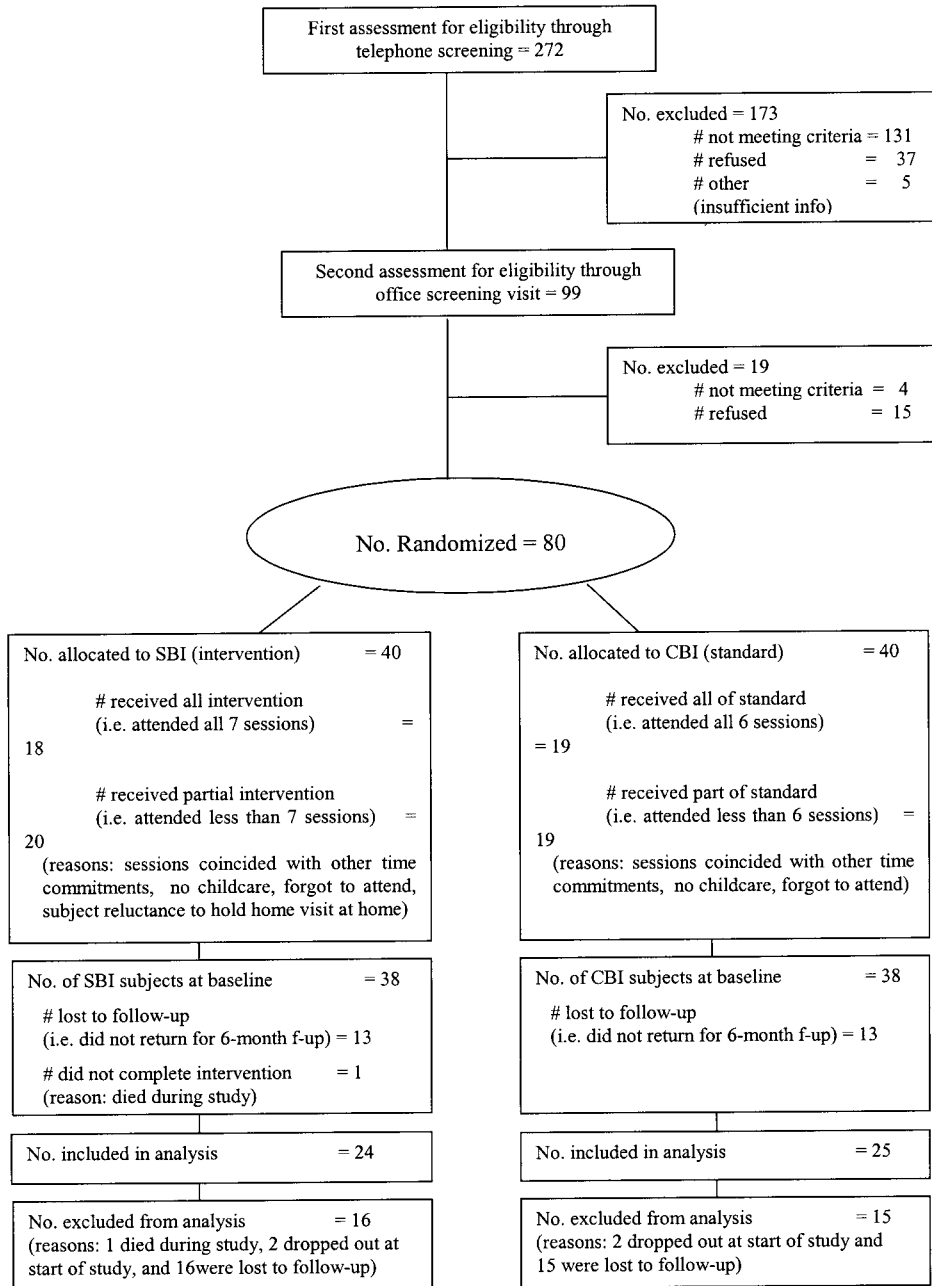


FIG. 1. Subject flow diagram.

80 subjects were randomly assigned to one of the two interventions. Following randomization, an additional 4 women dropped out. One woman in the intervention group died prior to follow-up; therefore, this subject's baseline data were excluded from the study. Thus, there was a final total study population of 75 women: 37 subjects in the intervention (SBI) group and 38 subjects in the control (CBI) group. A summary of the randomization scheme is provided in Fig. 1.

Baseline clinical variables, demographic characteristics, and activity profiles of the participating subjects by group assignment are available for 72 subjects and

are presented in Tables 1 and 2. Baseline mean systolic blood pressure was 127.5 mm Hg in the CBI group and 119.9 mm Hg in the SBI group ( $P < 0.05$ ). Women in the SBI group were more likely to be married than women in the CBI group (80 versus 54.1%, respectively;  $P < 0.02$ ). There were no other differences between the two groups' baseline clinical or demographic characteristics.

*Group Analysis*

Forty-nine women (61.3% of the initial study population: 24 women from the SBI group and 25 women

TABLE 1

## Baseline Clinical Characteristics by Study Group

Variable <sup>a</sup>	Control group (counseling-based intervention, CBI) n = 37	Intervention group (Skill-based intervention, SBI) n = 35
BMI (kg/m <sup>2</sup> )	36.3 ± 5.4	37.9 ± 6.70
Weight (lb)	212.9 ± 33.9	218.6 ± 41.9
SBP (mm Hg)	127.5 ± 13.0	119.9 ± 11.9*
DBP (mm Hg)	80 ± 8.4	77.3 ± 7.8
Waist-hip ratio	0.84 ± 0.1	0.84 ± 0.1
Mean age (years)	51.0 ± 11.0	48 ± 9.0

<sup>a</sup> Mean ± SD at baseline.

\*  $P < 0.05$  compared to conventional counseling group.

from the CBI group) returned for their 6-month follow-up measurements. To assess potential bias due to subject attrition, comparisons were made between subjects who returned for their measurements and subjects who dropped out of the study prior to the 6-month measurement. No differences in age, height, baseline weight, systolic and diastolic blood pressure, or waist-to-hip ratio were detected between the two groups.

At baseline, SBI and CBI group subjects had similar mean weights (absolute mean weight = 218.6 vs 212.9 lb, respectively;  $P = 0.53$ ). Six months after the intervention period, both groups had mean declines in absolute weight compared to baseline. The SBI group lost an average of 3.8 lb ( $P = 0.01$ ) while the CBI group had an average weight loss of 8.8 lb ( $P = 0.0001$ ). BMI also decreased in the CBI group (mean BMI difference from 6 months to baseline = 1.28 kg/m<sup>2</sup>,  $P = 0.0003$ ). There was no statistical difference in BMI in the SBI group, although there was a trend toward a reduction in BMI (mean BMI difference from 6 months to baseline = 0.30 kg/m<sup>2</sup>,  $P > 0.05$ ).

Group comparison revealed that the CBI group had a greater change in absolute weight compared to the SBI group from baseline to 6-month follow-up ( $P = 0.02$ , Fig. 2). In intention-to-treat analysis, absolute weight change remained statistically different between the SBI and the CBI groups (mean weight change: SBI = 2.6 lb, CBI = 5.9 lb;  $P = 0.05$ ). Within-group differences in absolute weight change also remained statistically significant for both groups (SBI:  $P = 0.01$ , CBI = 0.0001). Absolute BMI change was also different from 6 months to baseline for the CBI group (absolute BMI change = 0.86 kg/m<sup>2</sup>;  $P = 0.0005$ ). The percentage of subjects who lost at least 5% of their body weight was 40% among the CBI group vs 16.8% in the SBI group ( $\chi^2 = 3.2$ ,  $P = 0.07$ ). The proportion of subjects who had a reduction of  $\geq 10$  lb was 40% among the CBI group vs 25% among the SBI group ( $\chi^2 = 1.23$ ,  $P = 0.27$ ).

Predictors of weight loss—baseline weight, age, income, educational status, marital status, and medica-

tion use—were entered into a stepwise multiple regression model along with the group variable and an interaction term for group and baseline weight. The final model containing initial weight, group, and medication use as predictors accounted for 50% of the variation in weight loss ( $R^2$  adjusted for variables in the model).

Absolute decreases in BMI at 6-month follow-up among the CBI and SBI groups by baseline BMI are provided in Fig. 3. For this histogram, baseline BMI was categorized according to the classifications developed by the International Obesity Task Force [4]. The histogram shows that for both groups in general, there was an increase in BMI loss as BMI obesity classification increased; that is, subjects with higher initial BMIs had greater weight loss at 6 months. This was evident for both the SBI and the CBI groups, although the association was more pronounced in the counseling group.

### Cost-Effectiveness

At a rate of \$35/h for dietitian services, the total cost savings associated with RD contact for the SBI compared to CBI was expected to be \$1,015, assuming complete subject participation. On a unit basis, the SBI was expected to cost \$117.25 per participant, while the CBI was expected to cost \$140 per participant. The actual amount of time that the registered dietitian spent on direct patient contact was 94 h for the SBI

TABLE 2

## Baseline Sociodemographic and Activity Characteristics

Variable	CBI group (n = 37) No. (%)	SBI group (n = 35) No. (%)
Employment		
Employed	25 (67.6)	21 (60.0)
Unemployed	12 (32.4)	14 (40.0)
Married	20 (54.1)	28 (80.0)*
Household income		
= \$50,000	19 (51.4)	13 (37.1)
> \$50,000	15 (40.5)	17 (48.6)
Refused	3 (8.1)	5 (14.3)
Living alone	9 (24.3)	4 (11.8)
Currently taking medication	22 (59.5)	22 (64.7)
Vigorous activity		
None	8 (21.6)	6 (17.1)
1–3 times/month	10 (27.0)	5 (14.0)
= 2 times/week	10 (27.0)	11 (31.4)
$\geq 3$ times week	6 (16.2)	12 (34.3)
Don't know	3 (8.11)	1 (2.9)
Nonvigorous walking		
None	7 (18.9)	5 (14.0)
1–3 times/month	11 (29.7)	7 (20.0)
= 2 times/week	10 (27.0)	10 (29.0)
$\geq 3$ times week	8 (21.6)	10 (29.0)
Don't know	1 (2.70)	3 (8.6)

\*  $P < 0.05$  compared to control group.

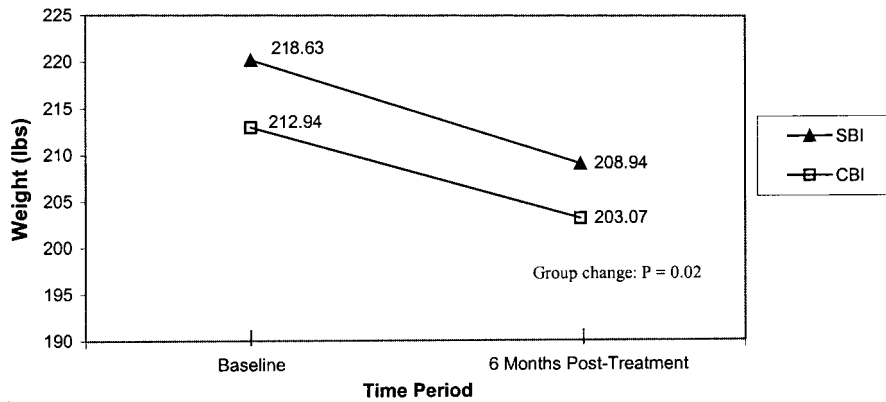


FIG. 2. Comparison of baseline and postprogram weight among the intervention and control groups.

group and 126 h for the CBI group, respectively. Based on this total time, the SBI resulted in a cost of \$46 per lb lost (range, \$18 to \$516), while the CBI led to a cost of \$21 per lb lost (range, \$12 to \$205). However, dollars spent per subject for RD contact were very similar, with a slightly lower cost for the SBI: \$137.08 versus \$141.40 for the CBI. Total combined time spent on administrative activities (appointment scheduling, meetings, cancellations, and correspondence) by the dietitian for both groups was 218.5 h.

DISCUSSION

While there has long been interest in group-based approaches to weight loss and control [28], there is little to suggest they offer any reliable advantage over other approaches. Group-based weight loss interventions do not figure among the strategies consistently reported by those succeeding at long-term maintenance of weight loss [29]. In this study, groups were used to support the intervention strategy of skill-building as a means of improving diet, in accord with decade-old recommendations by the Institute of Medi-

cine [20]. The results of this study suggest that among overweight and obese women, an individualized approach to dietary counseling produces more short-term weight loss than a skill-building approach aimed at small groups. While the individualized counseling required more dietitian time and was costlier, it produced weight loss at less cost per kilogram than the skill-building approach as of 6 months follow-up.

The weight loss results seen with dietitian counseling in this study are similar to those reported in prior work. For example, Hebert and colleagues [30] demonstrated that a dietitian-delivered nutrition counseling program led to a significant reduction in body weight. Subjects who attended three or four nutrition counseling sessions over a 6-week period had reduced their weight significantly compared to those who did not receive nutrition counseling sessions. Similar results using dietitian counseling for both male and female subjects have also been reported [31,32].

Various weight loss strategies have been subjected to cost-effectiveness analysis. Martin *et al.* compared surgical intervention strategies for weight loss to medical treatment and found that both treatment methods av-

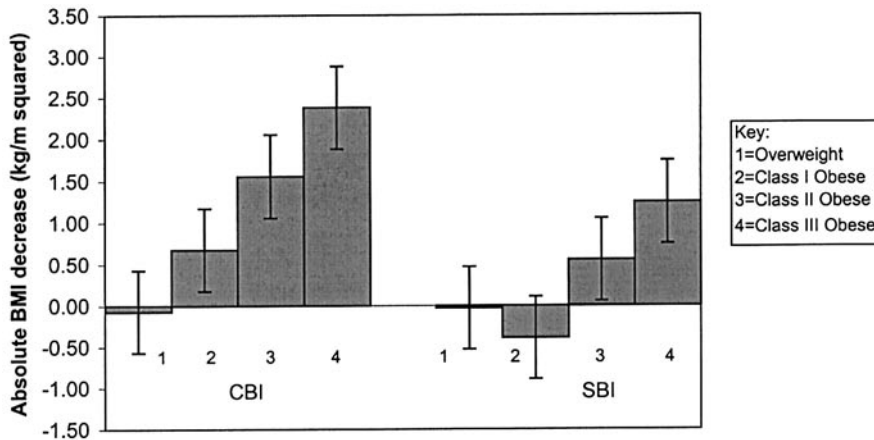


FIG. 3. Absolute BMI decrease at 6-month follow-up among the CBI and SBI groups, by baseline BMI.

eraged more than \$250 per pound of weight loss [33]. A review of 11 outpatient commercial weight-loss programs centered on dietary manipulation also showed that the cost of a 12-week program ranged from \$108 to \$2,120 [34]. A review of community-based approaches to weight control including worksite interventions, intervention by home correspondence, and multi-component community strategies has shown that community-based methods produce modest weight losses at lower costs compared to clinical interventions [35]. In this study, we found that the cost per pound of weight lost was relatively low for both the CBI (\$21 per pound lost) and the SBI (\$46 per pound lost), suggesting that dietitian-based or skills-based interventions may be effective at reducing weight without being cost prohibitive. Although the SBI cost more than twice as much as the CBI per pound lost, it is conceivable that the cost of the SBI may have been reduced if the number of subjects assigned to each subgroup session was increased to the maximum allowable without compromising the integrity of each session's message. For example, the number of subjects who were allotted to each supermarket session could have been increased from 10 to 15 to reduce the number of sessions that were held by the dietitian. Follow-up studies are warranted to determine the ideal number of subjects that can be accommodated during each skills-based study session to improve cost-efficiency while maintaining effectiveness.

While the early data suggest that individualized counseling may be more cost-effective than a skill-building approach in groups, achieving short-term weight loss has proved far easier than maintaining that weight loss [36,37]. The skill-building intervention in this study was designed specifically to empower subjects to control their own dietary and activity patterns and thereby their weight, over the long term. The rationale for this fairly novel skill-building approach is threefold. First, current obesity-control measures are largely ineffective [20,38–40] and innovative approaches are thus encouraged [20,36]. Second, an emphasis on the "toxic" environment in the etiology of obesity implies a need to change the environment and/or to impart skills for negotiating the current one [41]. Finally, some success has been seen in weight control with the application of problem-solving skills [42]. Long-term follow-up of the subjects in this study will be useful in determining whether a skill-building approach provides more lasting benefit than standard counseling.

While this study represents a useful and valuable first step in assessing the role of skill-building, group-based approaches to weight loss, it has important limitations. First, the study was limited to women, and thus the relevance of the results to men is unknown. The study participants were predominantly non-

Hispanic White, and thus the relevance of these findings to ethnic minorities is similarly unknown.

The attrition in the study was high. Process evaluation suggests that this may be due to embarrassment on the part of women who did not lose weight. If so, the apparent efficacy of either intervention is likely exaggerated, although the between-group comparison remains valid. A comparison of those subjects presenting for 6-month follow-up and those lost to attrition revealed no differences in demographic variables, but many variables of potential importance could not be assessed. If attrition continues over time, obtaining the long-term data needed to determine the sustainable benefits of each approach to weight loss may be obviated. Further research is needed to evaluate reasons for recidivism among subjects.

Perhaps the most important limitation of the study is also its greatest strength, namely that it reports data based on previously unstudied methods. Because precedent was lacking, there were no clear guidelines in determining the timing, scope, intensity, and breadth of the skill-based intervention, whereas the counseling-based intervention could be based on methods endorsed by the American Dietetic Association [26]. Based on informal polling of study participants regarding the study methods, the skill-based intervention may have been too widely spaced; subjects were eager for detailed guidance at study enrollment. Further, subjects have suggested that more individualized guidance would be a useful counterpart to the group-based emphasis on skills. A formal process evaluation of the study to date is on-going. That evaluation will help determine whether limitations of the SBI were principally attributable to uptake of skills, or their utility.

Despite the limitations of this study, it provides important, preliminary information regarding the application of group-oriented, skill-based methods to weight loss. Such methods are clearly feasible, and do produce weight loss, and at potentially lower cost in time and dollars than conventional counseling. What remains to be determined is the optimal structure, composition, and distribution of such methods, and how skill-building efforts should be combined with individualized guidance for greatest effect. Long-term follow-up of the participants in this study may yield important information regarding the relative sustainability of weight loss based on dietary counseling versus a skill-building intervention.

Further study and longer-term follow up are required to determine optimal intervention methods, and the value of this approach to efforts at producing sustainable weight loss. The development of follow-up study is on-going in our lab, but given the variety of approaches that might be applied, the testing of diverse skill-building strategies is to be encouraged.

## REFERENCES

1. Must A, Spadano J, Coakley E, Field A, Colditz G, Dietz W. The disease burden associated with overweight and obesity. *JAMA* 1999;282:1523-9.
2. Kuczmarski R, Carroll M, Flegal K, and coauthors. Varying body mass index cutoff points to describe overweight prevalence among U.S. adults: NHANES III (1998 to 1994). *Obes Res* 1997; 5:542-8.
3. U.S. Department of Health and Human Services. Healthy people 2010. McLean, VA: International Medical Publishing, 2000.
4. Flegal K, Carroll M, Kuczmarski R, Johnson C. Overweight and obesity in the United States: prevalence and trends, 1960-1994. *Int J Obes Relat Metabol Disord* 1998;22:39-47.
5. Allison D, Fontaine K, Manson J, Stevens J, VanItallie T. Annual deaths attributable to obesity in the United States. *JAMA* 1999;282:1530-8.
6. Pi-Sunyer F. Comorbidities of overweight and obesity: current evidence and research issues. *Med Sci Sports Exerc* 1999;31: s602-8.
7. Sarlino-Lahteenkorva S, Stunkard A, Rissanen A. Psychological factors and quality of life in obesity. *Int J Obes Relat Metabol Disord* 1995;19:S1-5.
8. Foster W, Burton B. Health implications of obesity. *Ann Intern Med* 1985;103:977-1077.
9. Manson J, Colditz G, Stamper M, Willet W, Rosner B, Monson R, Speizer F, Hennekens C. A prospective study of obesity and risk of coronary heart disease in women. *N Engl J Med* 1990;322: 882-90.
10. Grundy S, Burnett J. Metabolic and health complications of obesity. *Dis Month* 1990;36:641-731.
11. Kelsey J, Gammon M. Epidemiology of breast cancer. *Epidemiology* 1990;12:228-40.
12. Pi-Sunyer F. Short term medical benefits and adverse effects of weight loss. *Ann Intern Med* 1993;119:722-6.
13. Goldstein D. Beneficial effects of modest weight loss. *Int J Obes Relat Metabol Disord* 1992;16:397-415.
14. Blackburn G. Effect of degree of weight loss on health benefits. *Obes Res* 1995;Suppl 2:211-6s.
15. Collins R, Anderson J. Medication cost savings associated with weight loss for obese non insulin dependent diabetic men and women. *Prev Med* 1995;24:369-74.
16. Buzzard I, Asp E, Chlebowski R, Boyar A, Jeffrey R, Nixon D, and coauthors. Diet intervention methods to reduce fat intake: nutrient and food group composition of self-selected low-fat diets. *J Am Diet Assoc* 1990;90:42-50.
17. Wadden T. Treatment of obesity by moderate and severe caloric restriction. Results of clinical research trials. *Ann Intern Med* 1989;119:688-93.
18. Siggaard R, Raben A, Astrup A. Weight loss during 12 weeks ad libitum carbohydrate-rich diet in overweight and normal weight subjects at a Danish work site. *Obes Res* 1996;347-56.
19. Harvey EL, Glenny A, Kirk SF, Summerbell CD. Improving health professionals' management and the organisation of care for overweight and obese people (Cochrane Review). *Cochrane Database Syst Rev* 2001;2.
20. Institute of Medicine. Improving America's diet and health: from recommendation to action/a report of the Committee on Dietary Guidelines Implementation, Food and Nutrition Board, Institute of Medicine. Washington, DC: Paul R. Thomas, 1991.
21. Committee to Develop Criteria for Evaluating the Outcomes of Approaches to Prevent and Treat Obesity. Weighing the options: criteria for evaluating weight-management programs. Institute of Medicine, 1995.
22. Nawaz H, Chan W, Abdulrahman M, Larson D, Katz D. Self-reported weight and height: implications for obesity research. *Am J Prev Med* 2001;20:294-8.
23. SAS I. SAS Release 6.12. Cary, NC.
24. Katz D. Behavior modification in primary care: the pressure system model. *Prev Med* 2001;32:66-72.
25. Katz D. Nutrition in clinical practice. Philadelphia, PA: Lippincott/Williams & Wilkins, 2000.
26. American Dietetic Association. Position of the American Dietetic Association: weight management. *J Am Diet Assoc* 1997;97: 71-4.
27. American Dietetic Association. Weight management medical nutrition therapy protocol. In: Inman-Felton A, Johnson E, Smith K, editors. Medical nutrition therapy across the continuum of care, Supplement 1. Chicago, 1997.
28. Adams SO, Grady KE, Wolk CH, Mukaida C. Weight loss: a comparison of group and individual interventions. *J Am Diet Assoc* 1986;86:485-90.
29. Wing RR, Hill JO. Successful weight loss maintenance. *Annu Rev Nutr* 2001;21:323-41.
30. Hebert J, Ebbeling C, Ockene I, Ma Y, Rider L, Merriam P, Ockene J, Saperia G. A dietitian-delivered group nutrition program leads to reductions in dietary fat, serum cholesterol, and body weight: the Worcester Area Trial for Counseling in Hyperlipidemia (WATCH). *J Am Diet Assoc* 1999;99:544-52.
31. Rhodes K, Bookstein L, Aaronson L, Mercer N, Orringer C. Intensive nutrition counseling enhances outcomes of National Cholesterol Education Program dietary therapy. *J Am Diet Assoc* 1996;96:1003-10.
32. Wood E. Weight loss maintenance 1 year after individual counseling. *J Am Diet Assoc* 1990;90:1256-60.
33. Martin L, Tan T, Horn J, Bixler E, Kauffman G, Becker D, Hunter S. Comparison of the costs associated with medical and surgical treatment of obesity. *Surgery* 1995;118:599-606.
34. Spielman A, Kanders B, Kienholz M, Blackburn G. The cost of losing: an analysis of commercial weight-loss programs in a metropolitan area. *J Am Coll Nutr* 1992;11:36-41.
35. Jeffery RW. Minnesota studies on community-based approaches to weight loss and control. *Ann Intern Med* 1993;119:719-21.
36. Jeffery R, Drewnowski A, Epstein L, Stunkard A, Wilson G, Wing R, Hill D. Long-term maintenance of weight loss: current status. *Health Psychol* 2000;19:5-16.
37. Rothman A. Towards a theory-based analysis of behavioral maintenance. *Health Psychol* 2000;19:64-9.
38. Mokdad A, Serdula M, Dietz W, Bowman B, Marks J, Koplan J. The continuing epidemic of obesity in the United States. *JAMA* 2000;284:1650-1.
39. Nawaz H, Katz D. American College of Preventive Medicine Practice Policy statement. Weight management counseling of overweight adults. *Am J Prev Med* 2001;21:73-8.
40. Campbell K, Waters E, O'Meara S, Summerbell C. Interventions for preventing obesity in children. *Cochrane Database Syst Rev* 2001;2:CD001871.
41. Poston WAS, II, Foreyt JP. Obesity is an environmental issue. *Atherosclerosis* 1999;146:201-9.
42. Perri M, Nezu A, McKelvey W, Shermer R, Renjilian D, Viegner B. Relapse prevention training and problem-solving therapy in the long-term management of obesity. *J Consult Clin Psychol* 2001;69:722-6.