

Active Mothers Postpartum: A Randomized Controlled Weight-Loss Intervention Trial

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Abstract:

Background- Pregnancy may contribute to overweight and obesity.

Purpose- The primary objective of Active Mothers Postpartum was to promote a reduction in BMI through 24-months postpartum via sustainable lifestyle changes.

Design- Behavioral intervention RCT to enhance postpartum weight loss.

Setting/participants- A total of 450 overweight or obese women, enrolled 6-weeks postpartum, were recruited through obstetrics clinics and community posters in the Durham NC area.

Intervention- Intervention participants were offered eight healthy-eating classes, ten physical-activity classes, and six telephone-counseling sessions over 9 months.

Main outcome measures- Changes from baseline (6-weeks postpartum) to 1-month post-intervention (12-months postpartum) in: (1) diet (caloric intake, calories from fat, intake of certain foods); (2) physical activity (self-reported physical activity, television time); and (3) weight (collected 2004–2007, analyzed 2007–2008).

Results- Mean weight loss was 0.90 kg (± 5.1 kg) in the intervention group and 0.36 kg (± 4.9 kg) in the control group; this difference was not significant. There were also no significant group differences in improvement of diet or increased physical activity. In secondary analyses, there was a positive bivariate relationship between classes attended and weight loss ($p=0.01$).

Conclusions- There were no significant differences among the arms in diet, physical activity, or weight change. Home-based interventions via mail, telephone, or Internet/e-mail may be more feasible and successful in this population. The postpartum period is an important phase in women's lives with regard to weight retention, but engaging them during this busy period remains a challenge.

Trial registration- NCT00212251.

Article:

BACKGROUND

Pregnancy may contribute to obesity in women of reproductive age.¹ Up to 20% of women retain 5 kg or more in connection with pregnancy.² Women who enter pregnancy overweight or obese have a high risk of postpartum weight retention^{3, 4} and may even begin gaining weight after 6-weeks postpartum, whereas normal-weight women continue to lose.⁵

Poor diet and low physical activity also contribute to obesity. Only 20% of those aged 18–34 years report eating five servings of vegetables and fruits per day, and 21% report that they are completely sedentary.^{6, 7} Such behavioral factors are also associated with postpartum weight retention.⁸ In the Stockholm Pregnancy and Weight Study,^{9, 10} women who retained more weight 1-year postpartum were less likely to report regular exercise, and more likely to report inconsistent meals and between-meal snacking.

A number of interventions have resulted in short-term weight loss in the general population.¹¹ These interventions emphasize reductions in overall calories and dietary fat, along with moderate physical activity for 30 minutes a day, 3–5 days a week.¹² Also common to effective interventions are cognitive and behavioral strategies to support weight loss, including self-monitoring of food intake and physical activity, printed self-help materials, goal setting, and group-based educational sessions to enhance social support.¹³

New mothers in particular may be responsive to group formats; they report getting far less practical and social support postpartum than they had anticipated while pregnant.^{14, 15} Popular groups such as MOMS (Moms Offering Moms Support) Club International¹⁶ and La Leche League¹⁷ illustrate the desire to connect with other new moms. Interventions to increase postpartum social support¹⁸ and physical activity¹⁹ have utilized group formats with some success. Although the only previous postpartum weight-loss intervention using a group format²⁰ reported results from only 23 participants, it did demonstrate greater weight loss in the intervention group than in controls.

Our own survey of 161 pregnant and postpartum women showed that they were interested in weight-loss interventions and wanted opportunities to exercise with others and receive dietary advice in a general, educational setting.²¹ Intervention materials were also pilot-tested with ten postpartum women, and feedback from both the survey and the women in the pilot study guided overall intervention development.

Active Mothers Postpartum (AMP)²² was a behavioral intervention RCT to enhance weight loss in postpartum women who were overweight or obese prior to pregnancy. The objective was to provide a multicomponent intervention that can be widely disseminated and would promote and maintain a reduction in BMI via sustainable lifestyle changes, including reduction of caloric intake, reduction of calories from fat, and increased physical activity. The intervention is based on social cognitive theory,²³ stage of readiness,²⁴ and motivation models. The key assumptions are: (1) behavior change is motivated by feelings of self-efficacy, which are enhanced when individuals have the necessary skills to make lifestyle changes; (2) ongoing support can enhance the acquisition of skills needed to sustain behavior change; and (3) motivation and goal-setting elicited directly from the participant is most conducive to successful behavior change.²⁵

The primary endpoint of the AMP study is weight at 12-months post-intervention (24-months postpartum). In this paper, short-term changes in diet, physical activity, and weight are presented. It was hypothesized that the intervention group would demonstrate greater improvements in (1) diet and (2) physical activity than the control group, resulting in (3) greater weight loss from baseline to 1-month post-intervention (12-months postpartum).

MATERIALS AND METHODS

Study Population, Recruitment, and Randomization

Women who had recently delivered babies were recruited from the three largest obstetrics clinics in Durham NC, by prescreening records for patients likely to be eligible (pre-pregnancy BMI \geq 25). These women were sent an introductory letter 2-weeks postpartum stating that they might be contacted by phone regarding the study. Recruitment posters featuring an 800 number were also placed in grocery stores, smaller obstetrics clinics, and libraries. At 4-weeks postpartum, potential participants were assessed for eligibility via telephone, following a description of the study and verbal consent for the survey. Women who did not speak English, were aged <18 years, or had any health conditions that prevented them from walking a mile unassisted (consistent with previous criteria²⁶) were excluded.

If women were eligible and interested, a member of the study staff met them at their 6-week postpartum obstetrics appointment and measured their height and weight. If BMI was \geq 25, the participant was considered eligible, and written informed consent for trial participation was obtained.

Women completed baseline assessments via telephone within 2 weeks of enrollment and prior to randomization. These assessments included a survey of demographic information and psychosocial variables, a physical-activity recall and a brief food-frequency questionnaire (FFQ), conducted by a contracted survey firm; and two 24-hour dietary recall interviews, conducted by the Human Nutrition Laboratory, University of North Carolina at Greensboro (UNC-G). Women were then randomized 1:1 to the intervention or control group (stratified by black versus other and primiparous versus multiparous) using block randomization. The study was approved by the IRBs of Duke University Medical Center and UNC-G.

Intervention

Women in the AMP intervention group ($n=225$) were asked to participate in eight healthy-eating sessions (Mom's Time Out [MTO] classes); ten physical-activity group sessions (ACTIVMOMS classes); and six telephone-counseling sessions over a 9-month period. They were also provided with a study notebook with exercises, recipes, and other intervention-related information; and a pedometer. Given the intervention's strong emphasis on walking, a sport stroller was provided to encourage walking for exercise outside of class and after the end of the intervention. The stroller was introduced approximately halfway through the intervention period, when infants were able to support their own heads (6-months postpartum); this timing also helped sustain interest in the AMP program. All intervention components were designed to enhance the sustainability of healthy behavior changes beyond the intervention period.

Emphasis was placed on reducing total caloric intake through a decrease in calorie-dense foods (soda, sweetened beverages, fast food) and an increase in fruit and vegetable consumption, and on increasing physical activity to the recommended 30 minutes a day, five times a week. In the MTO classes, women were taught practical skills shown to facilitate weight loss,²⁷ including making choices that decrease consumption of high-fat, high-sugar foods and beverages; learning appropriate portion sizes; cooking easy, low-fat meals; making appropriate choices at fast-food restaurants; and avoiding overeating in stressful situations. Other topics included structured meal plans and grocery lists, regular meals to reduce between-meal snacking, slowing the pace of

eating, and identifying cues of fullness. The ACTIVMOMS classes encouraged walking and demonstrated activities designed to enhance recovery from pregnancy, including aerobics, strength and flexibility training, and pelvic-floor exercises. Using a front-facing baby carrier, mothers could exercise with their babies in a mom-and-tot format if desired.

Every 6 weeks, women received one of six counseling sessions from a trained counselor, lasting about 20 minutes each. These sessions were delivered primarily over the phone, but occasionally in person (e.g., when the woman received her stroller). Consistent with motivational interviewing,^{25, 28} the counselor utilized reflective listening techniques, self-motivational statements, and change talk to elicit participants' personal behavioral goals and troubleshoot barriers to achieving them. The women in the control group received biweekly newsletters with general tips for postpartum mothers. Women in both groups received monetary incentives on completion of each follow-up assessment.

Measures

Dietary intake was measured at baseline and 1-month post-intervention using the Nutrition Data System for Research (NDS-R), a telephone-administered, multiple-pass, 24-hour dietary recall technique.²⁹ Recalls were collected on 2 days over a 2-week period. Prior to the interviews, the participant was mailed two-dimensional food portion visuals to assist in determining portion sizes. This method is reliable for estimating energy intake of groups and has a relatively low respondent burden.³⁰ Further, telephone-administered dietary recalls have been shown to be comparable to in-person recall interviews.³¹ Data from the NDS-R were used to calculate daily total caloric intake and percent of calories from fat. Servings of soda, other sweetened beverages, fries and chips, fast-food meals, and fruits and vegetables were also assessed in a separate FFQ.

The 7-day physical-activity recall (PAR) was used to capture the number (bouts) and duration (minutes) of periods of moderate, hard, and very hard activity in the morning, afternoon, and evening of each day of the previous week^{32, 33} (e.g., *Did you do any physical activity MONDAY in the morning? For how long? Was that moderate, hard, or very hard activity?*). Intensity was described as follows: *The moderate category is similar to how you feel when you're walking at a normal pace. The very hard category is similar to how you feel when you're running. The hard category falls just in between.* The PAR has shown high reliability and validity across multiple and diverse samples,³³ and because it utilizes a 1-week time frame, it is generally considered representative of typical activity patterns.^{34, 35} Correlation coefficients between PAR and accelerometry-derived energy expenditures range between 0.85 and 0.95, and the PAR is sensitive to change.³⁶ Sedentary behavior (*How many hours of television do you watch on a typical weekday/weekend day?*) was also assessed.

Measured height and weight were obtained using a Seca portable stadiometer and a Tanita BWB-800 scale, with participants in street clothing with shoes removed. Women who had moved away or were otherwise unavailable at follow-up assessments reported weights obtained at doctor's offices. Intervention participation was assessed through program records of attendance at classes and completion of counseling calls.

Statistical Analysis

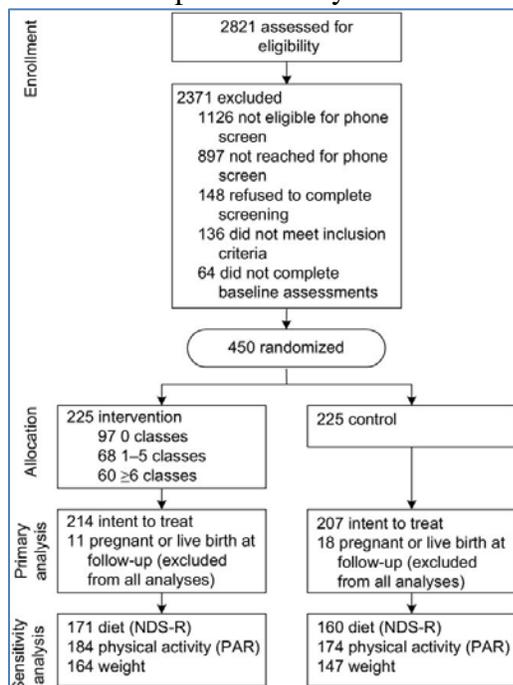
Mean group differences in behavior and weight change from baseline to post-intervention were assessed using intent-to-treat analyses; all participants were considered part of the group to which they were randomized regardless of their level of participation, and if a follow-up measurement was not available, the baseline value for that participant was assumed to be unchanged. Sensitivity analyses, including only those participants for whom a follow-up measure was collected, were also conducted. Mean group differences were tested for significance with *t*-tests from linear regression models adjusting for the baseline value of the outcome, age, race, education, parity, and weight at baseline. Unadjusted and covariate-adjusted regression models were used to test associations between program participation (number of classes attended, counseling calls completed) and behavior and weight change. A two-sided alpha of 0.05 was used for all statistical tests. All analyses excluded women who were pregnant at follow-up assessments or had had a second live birth since baseline. With the group sample sizes available, the *t*-test of mean group difference has 80% power when the true standardized mean group difference is 0.27. For example, because change in weight across time has an observed SD of 5 kg, the *t*-test has 80% power for a mean group difference of 1.37 kg (i.e., 5×0.27).

RESULTS

Participant Disposition

Of the 2821 women prescreened from patient records, 1695 were eligible for screening. Of the 798 reached by phone, 148 refused screening and 136 did not meet inclusion criteria (Figure 1). Of the 514 who signed the study consent form, 64 did not complete the baseline assessments. The final 450 participants (15 from community call-ins, the remainder from clinic recruitment) were randomized between September 2004 and April 2006, with follow-up measures collected from September 2005 to April 2007 and analysis performed in 2007–2008.

Figure 1: CONSORT diagram showing the flow of participants through each stage of the Active Mothers Postpartum Study



Baseline Characteristics

The mean age of the women was 31 years (Table 1). Most were well educated and married, and they expected to go back to work full time by 6-months postpartum. About 40% reported household incomes of >\$60,000, though lower-income households were also represented. There was a high proportion of black participants (45%), reflecting the community from which they were recruited.

Table 1: Baseline characteristics, *n* (%) unless otherwise indicated

Variable	Intervention (<i>n</i> =225)	Control (<i>n</i> =225)
Age (years; M [SD])	30.6 (5.8)	31.2 (5.3)
Race		
White	118 (52.4)	119 (52.9)
Black	101 (44.9)	102 (45.3)
Asian/Other	6 (2.7)	4 (1.8)
Education		
High school or less	45 (20.0)	48 (21.3)
Some college	54 (24.0)	56 (24.9)
College or more	126 (56.0)	121 (53.8)
Household income (\$)		
≤15,000	19 (8.8)	9 (4.0)
15,001–30,000	48 (22.3)	46 (20.6)
30,001–45,000	28 (13.0)	37 (16.6)
45,001–60,000	30 (14.0)	36 (16.1)
>60,000	90 (41.9)	95 (42.6)
Marital status		
Single	43 (19.1)	33 (14.7)
Living with partner	19 (8.4)	30 (13.3)
Married	157 (69.8)	152 (67.6)
Divorced/separated/widowed	6 (2.7)	10 (4.4)
Expected employment (at 6 months)		
Full-time	136 (61.0)	146 (65.5)
Part-time	44 (19.7)	37 (16.6)
Not work for pay	43 (19.3)	40 (17.9)
Parity		
First child	93 (41.3)	92 (40.9)
Second child	82 (36.4)	80 (35.6)
Third or subsequent child	50 (22.2)	53 (23.6)
Weight		
Self-reported pre-pregnancy weight (kg; M [SD])	84.1 (20.0)	84.3 (19.5)
Self-reported pregnancy weight gain (kg; M [SD])	15.4 (8.4)	14.6 (8.7)
Baseline BMI (M [SD])	33.1 (6.7)	32.9 (6.0)
BMI category at baseline		
25–29.9	88 (39.1)	92 (40.9)
30–34.9	77 (34.2)	64 (28.4)
35–39.9	29 (12.9)	41 (18.2)
40+	31 (13.8)	28 (12.4)
Delivery type		
Vaginal	129 (59.5)	141 (64.7)
Caesarean section	88 (40.6)	77 (35.3)
Breastfeeding		
Full breastfeeding	85 (37.8)	75 (33.3)
Breastfeeding and formula feeding	58 (25.8)	70 (31.1)
Formula feeding only	82 (36.4)	80 (35.6)
General health		
Excellent/very good	131 (58.2)	137 (60.9)
Good/fair/poor	94 (41.8)	88 (39.1)
Smoking status		
Smoker	10 (4.4)	16 (7.1)
Nonsmoker	215 (95.6)	209 (92.9)
Depression (EPDS_{≥13})^a		
Yes	23 (10.2)	16 (7.1)
No	202 (89.8)	209 (92.9)

^aEPDS, Edinburgh Postnatal Depression Scale³⁷

Follow-Up Assessments at 1-Month Post-Intervention

Seventy percent of participants completed all three sets of follow-up measures. At the follow-up assessment, 24 women were pregnant again, and five had delivered a second baby; these 29 women were excluded from all analyses. Figure 1 shows the number of women available for the sensitivity analyses of weight (69%); dietary recall (74%); and physical activity and the brief FFQ (collected in the telephone survey; 80%). Nine percent of weights recorded at the follow-up assessment were self-reported.

Participation

In the intervention group, participants attended a mean of 3.8 classes and completed a mean of 3.3 counseling calls. Ten completed no classes or calls. These women, along with any others who attended no classes, were mailed the workbook (usually handed out at the first nutrition session). Those who took part in the classes were more likely to be older, white, and married, and have more education and higher income than those who did not participate.

Change in Diet, Physical Activity, and Weight

The main outcomes are presented in Table 2. Mean caloric intake and percent calories from fat, as measured by the NDS-R, decreased from baseline to follow-up assessment for both groups, and both groups increased their bouts of activity per week and their total minutes of activity per week. Women in both groups experienced weight loss, though this loss was modest (-0.90 kg [intervention] vs -0.36 [control]). The groups were not significantly different on any of the main outcomes. There were also no significant differences between the two groups in other measures of weight change, including return to pre-pregnancy weight, percent weight loss, change in BMI category from baseline to follow-up assessment, and proportion losing ≥ 4.5 or 1.0 kg (data not shown).

Observed group differences were slightly greater when the analyses included only those participants with follow-up measures available, but these differences also were not significant (Table 2). Further, no intervention effects were found in subgroup analyses based on race, age, education, parity, or BMI category at baseline (data not shown).

Class participation was significantly associated with weight change in bivariate analysis ($p=0.01$; Figure 2), but not with change in diet or physical activity. Multivariable analysis controlling for age, race, education, income, and baseline BMI attenuated the effect of class participation on weight change ($p=0.57$). Completion of counseling calls was not associated with weight or behavior outcomes.

In response to open-ended questions posed at follow-up assessments, participants reported that they had difficulty attending classes because of problems securing childcare and coordinating schedules, including the mother's own schedule (full-time work or school) and those of other children in the family. "Getting some place at a scheduled time" and "getting [the children] ready to take with me" were common problems. When asked what could be done to improve the study, women said they enjoyed and benefited from the intervention, but that they "just didn't have time to do everything."

Table 2: Group differences in diet, physical activity, and weight change from baseline to 1-month post-intervention^a

Variable	Intervention			Control			Adjusted <i>p</i> -value ^b
	Baseline (6-weeks postpartum)	1-month post-intervention (12-months postpartum)	Change	Baseline (6-weeks postpartum)	1-month post-intervention (12-months postpartum)	Change	
PRIMARY ANALYSIS^c							
Dietary recall (NDS-R)							
Total calories/day	1865 (667)	1658 (559)	-207 (544)	1849 (632)	1681 (588)	-168 (538)	0.37
Percent calories from fat/day	33.9 (7.9)	33.6 (8.1)	-0.3 (8.5)	34.4 (7.2)	34.0 (8.1)	-0.4 (8.2)	0.77
Brief FFQ (daily servings)							
Soda/day	0.71 (1.08)	0.60 (0.97)	-0.12 (0.87)	0.74 (0.99)	0.61 (0.90)	-0.13 (0.75)	0.79
Sweetened drinks/day	0.93 (1.08)	0.64 (0.93)	-0.29 (0.90)	0.93 (1.08)	0.75 (1.00)	-0.18 (0.94)	0.11
Fast food/per week	2.31 (1.32)	2.17 (1.31)	-0.14 (1.26)	2.12 (1.37)	2.16 (1.27)	0.03 (1.05)	0.28
Fries or chips/day	0.77 (0.92)	0.60 (0.80)	-0.17 (0.92)	0.75 (0.92)	0.65 (0.85)	-0.10 (0.85)	0.39
Fruits and vegetables/day	3.35 (1.42)	3.51 (1.40)	0.17 (1.29)	3.33 (1.43)	3.43 (1.39)	0.11 (1.24)	0.53
Physical-activity recall							
Hard+very hard bouts/week	1.39 (2.78)	1.68 (2.70)	0.29 (3.36)	0.83 (1.46)	1.18 (1.81)	0.35 (2.00)	0.12
Hard+very hard mins/week	55.4 (121.4)	77.2 (148.7)	21.8 (143.6)	34.2 (64.5)	65.3 (149.1)	31.1 (146.6)	0.99
Sedentary behavior							
TV hours/day	3.07 (1.47)	2.48 (1.38)	-0.59 (1.03)	3.01 (1.44)	2.28 (1.35)	-0.73 (1.12)	0.08
Weight (kilograms)	88.7 (18.8)	87.8 (20.7)	-0.90 (5.1)	88.4 (18.5)	88.1 (20.2)	-0.36 (4.9)	0.25
SENSITIVITY ANALYSIS^d							
Dietary recall (NDS-R) [Int=171; Con=160]							
Total calories/day	1907 (653)	1647 (519)	-259 (598)	1883 (605)	1665 (549)	-217 (604)	0.51
Percent calories from fat/day	34.0 (8.3)	33.5 (8.5)	-0.4 (9.6)	34.3 (7.0)	33.7 (8.1)	-0.6 (9.4)	0.86
Brief FFQ [Int=183; Con=173]							
Soda/day	0.68 (1.07)	0.54 (0.93)	-0.14 (0.93)	0.70 (0.96)	0.54 (0.83)	-0.15 (0.81)	0.93
Sweetened drinks/day	0.89 (1.06)	0.55 (0.84)	-0.33 (0.97)	0.88 (1.07)	0.67 (0.95)	-0.21 (1.03)	0.16
Fast food/per week	2.30 (1.33)	2.14 (1.33)	-0.16 (1.36)	2.04 (1.39)	2.09 (1.28)	0.04 (1.14)	0.48
Fries or chips/day	0.76 (0.92)	0.56 (0.77)	-0.20 (0.99)	0.70 (0.89)	0.58 (0.80)	-0.12 (0.92)	0.68
Fruits and vegetables/day	3.32 (1.41)	3.38 (1.34)	0.07 (0.98)	3.37 (1.43)	3.35 (1.36)	-0.03 (0.99)	0.47
Physical-activity recall [Int=184; Con=174]							
Hard+very hard bouts/week	1.38 (2.85)	1.71 (2.76)	0.34 (3.63)	0.83 (1.47)	1.25 (1.87)	0.42 (2.17)	0.14
Hard+very hard mins/week	48.2 (98.4)	73.6 (136.2)	25.4 (154.6)	33.3 (62.6)	70.3 (159.0)	37.0 (159.3)	0.95
Sedentary behavior [Int=184; Con=174]							
TV hours/day	3.02 (1.45)	2.33 (1.29)	-0.69 (1.08)	2.97 (1.39)	2.10 (1.19)	-0.87 (1.17)	0.03
Weight (kilograms; Int=164; Con=147)	87.5 (17.3)	86.3 (19.8)	-1.17 (5.8)	87.0 (17.4)	86.5 (19.9)	-0.51 (5.9)	0.49

Con, control; FFQ, food-frequency questionnaire; Int, intervention; NDS-R, Nutrition Data System for Research

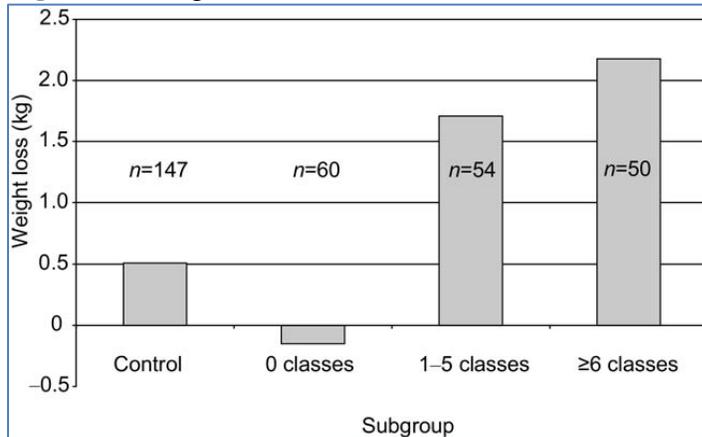
^aM (SD), unless otherwise indicated; pregnant/live birth at follow-up assessment excluded

^bAdjusted for baseline value of the outcome variable, age, race, education, parity (primiparous vs multiparous), and baseline weight

^c*n*=214 intervention; *n*=207 control; lost-to-followup=baseline value carried forward

^dLost-to-follow-up excluded

Figure 2: Weight loss associated with class attendance



DISCUSSION

In this weight-loss intervention RCT, there were no significant differences among the arms in diet, physical activity, or weight change from baseline to 1-month post-intervention. The trial was successful at recruiting and maintaining contact with participants. It had a relatively large sample size, particularly for a postpartum weight-loss trial,³⁸ and enrollees maintained involvement through the 12-month postbaseline assessments. Additional strengths of the study include a comprehensive and standardized assessment battery, and a diverse population.

Participation in the intervention components that were offered, however, was lower than expected. This raises concerns about the ability of women in this challenging, transitional period of life to attend classes or other group-format interventions while caring for an infant. It was encouraging that weight change in the intervention group was associated with number of classes attended, but this relationship was confounded by underlying factors such as education, race, and income. Class attendance was likely a proxy for having the financial resources and social support to help balance the women's own needs with the demands of infant care.

Six prior weight-loss trials were identified that were conducted among women in the postpartum period.^{38, 39, 40} Three of these were primarily focused on the effect of diet, exercise, and weight loss on lactation performance.³⁸ In the fourth study,³⁹ health-behavior counseling for weight loss delivered by nurses at the newborn's preventive health clinic visits showed no effect on behavior changes or weight loss. The two remaining studies^{20, 41} were most comparable to the current study in that they were RCTs with a focus on postpartum weight loss in a community setting.⁴⁰ Both resulted in greater weight loss among intervention subjects, but neither found group differences in diet and physical activity.

These latter two studies had much smaller sample sizes ($n=90$ and $n=40$, respectively) and lower rates of follow-up participation among those few participants. These studies also targeted women with lower BMIs; mean BMI at baseline in both was approximately 30, as compared to 33 in the current study. Also, their participants were almost exclusively white. Black participants in the current study (45%) were less likely to lose weight postpartum, a finding that has been noted previously.^{42, 43, 44} The one common element in the two other interventions was the use of food diaries for self-monitoring, which have been shown to aid in weight loss.^{45, 46} Although the AMP intervention also encouraged the use of self-monitoring tools, both for diet (e.g., diaries, calorie equivalencies) and physical activity (diaries, pedometers), these were not required and results were not systematically reported to the study staff.

As in the AMP trial, women in one of these two studies²⁰ had difficulty attending the weekly group sessions required of the structured intervention group, and more than 40% of participants dropped out, as compared to 27% in the other, which was a mail-based intervention.⁴¹ These findings indicate that mail- or other home-based interventions are likely to be more manageable for postpartum women than class-based interventions outside the home.⁴⁷

It is possible that the measures of behavioral change used may have had limited sensitivity in postpartum women.^{20, 41} Recall methods such as the NDS-R are considered the gold standard for self-reported dietary intake, but did not show significant changes by group in the current study. However, weight also did not change significantly by group, and both the diet and weight

measures showed similar, nonsignificant reductions by group. It can be argued that the NDS-R provided an accurate measure of change in caloric intake that is reflected in the resulting weight change, the only issue being that neither caloric intake nor weight was significantly affected by the intervention.

The PAR measure of physical activity is also widely used, but it did present certain limitations. It is based on self-report, and especially in women with small children to care for, the instructions for assessing “moderate” intensity may lead to over-reporting of this type of activity.⁴⁸ The excessive amount of moderate activity reported by AMP participants (up to 8 hours a day every day of the week) led us to use in the analyses only the “hard” and “very hard” categories, which were meant to reflect intentional leisure-time activity and not everyday household duties.

Maintaining healthy weight is a challenge for most Americans.⁴⁹ The presence of a newborn in the home makes it especially hard for postpartum women to prioritize their own health behavior efforts; at this time, the child's well-being is the primary and often overwhelming concern. Previous research among postpartum women,^{14, 15} and a pilot study for the current trial,²¹ indicated a desire for social support in weight loss efforts. Further, enthusiasm for the program was evident in the relative ease of completing enrollment and the initial level of interest among those enrolled. Attendance was made as easy as possible by providing sessions multiple times a week, at various times during the day and evening and on weekends, and scheduling physical-activity and nutrition sessions back-to-back so that with one effort, mothers could attend two classes. Despite these efforts, and the women's own motivation and interest, the realities of getting to class with a baby simply overwhelmed many participants.

Future weight-loss interventions in the postpartum period should shift away from group formats, whose limitations outweigh their potential benefits in the form of social support, to home-based options using mail, telephone, or Internet/e-mail. Approaches to increasing social support in such programs could be to enroll women in pairs, as has been shown to enhance weight loss in other studies,²⁶ or to enroll them with their spouses, in order to encourage partners to actively support the new mothers' weight-loss efforts.⁵⁰

CONCLUSION

Active Mothers Postpartum was an ambitious trial; rather than taking highly motivated, treatment-seeking women, overweight and obese women were approached at a challenging time in their lives and invited to take part in a fairly complex intervention. Although there was a high level of interest, and the enrollment of a large number of participants was relatively easy to complete, class participation was difficult, and behavior change and weight loss were less than expected. These results indicate that community-based interventions delivered outside the home are not likely to affect postpartum weight loss. More individualized programs delivered in the home via telephone, mail, or Internet/e-mail may be more feasible and, potentially, more successful.

The postpartum period is an important period in a woman's life cycle, not only from the perspective of her own future risk of obesity, but also because it is a time when her child's behavioral risk factors for obesity are being formed. Engaging women in this very busy period in their lives remains a challenge.

REFERENCES

1. Williamson DF, Kahn HS, Remington PL, Anda RF. The 10-year incidence of overweight and major weight gain in U.S. adults. *Arch Intern Med.* 1990;150:665–672
2. Gunderson EP, Abrams B. Epidemiology of gestational weight gain and body weight changes after pregnancy. *Epidemiol Rev.* 1999;21:261–275
3. Crowell DT. Weight change in the postpartum period: a review of the literature. *J Nurse Midwifery.* 1995;40:418–423
4. Gore SA, Brown DM, West DS. The role of postpartum weight retention in obesity among women: a review of the evidence. *Ann Behav Med.* 2003;26:149–159
5. Gunderson EP, Abrams B, Selvin S. Does the pattern of postpartum weight change differ according to pregravid body size?. *Int J Obes.* 2001;25:853–862
6. Winkleby MA, Cubbin C. Changing patterns in health behaviors and risk factors related to chronic diseases, 1990–2000. *Am J Health Promot.* 2004;19:19–27
7. CDC. Behavioral risk factors surveillance system, 2000: USDHHS. www.cdc.gov/brfss
8. Oken E, Taveras EM, Popoola FA, Rich-Edwards JW, Gillman MW. Television, walking, and diet: associations with postpartum weight retention. *Am J Prev Med.* 2007;32:305–311
9. Ohlin A, Rossner S. Factors related to body weight changes during and after pregnancy: the Stockholm Pregnancy and Weight Development Study. *Obes Res.* 1996;4:271–276
10. Ohlin A, Rossner S. Trends in eating patterns, physical activity and socio-demographic factors in relation to postpartum body weight development. *Br J Nutr.* 1994;71:457–470
11. Jeffrey RW, Drewnowski A, Epstein LH, Stunkard AJ, Wilson GT, Wing RR, et al. Long-term maintenance of weight loss: current status. *Health Psychol.* 2000;19(1S):5–16
12. National Heart, Lung and Blood Institute (NHLBI). Obesity Education Initiative Expert Panel. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. NIH publication no. 98-4083. National Institutes of Health, 1998. www.nhlbi.nih.gov/guidelines/obesity/ob_gdlns.htm
13. Ammerman AS, Lindquist CH, Lohr KN, Hershey J. The efficacy of behavioral interventions to modify dietary fat and fruit and vegetable intake: a review of the evidence. *Prev Med.* 2002;35:25–41
14. Davis DW, Logsdon MC, Birkimer JC. Types of support expected and received by mothers after their infants' discharge from the NICU. *Issues Compr Pediatr Nurs.* 1996;19:263–274
15. Logsdon MC, McBride AB, Birkimer JC. Social support and postpartum depression. *Res Nurs Health.* 1994;17:449–457
16. MOMS Club International. www.momsclub.org/index.html
17. La Leche League. www.llli.org/
18. Scott D, Brady S, Glynn P. New mother groups as a social network intervention: consumer and maternal and child health nurse perspectives. *Aust J Adv Nurs.* 2001;18:23–29
19. Armstrong K, Edwards H. The effects of exercise and social support on mothers reporting depressive symptoms: a pilot randomized controlled trial. *Int J Ment Health Nurs.* 2003;12:130–138
20. O'Toole ML, Sawick MA, Artal R. Structured diet and physical activity prevent postpartum weight retention. *J Womens Health (Larchmt).* 2003;12:991–998
21. Østbye T, McBride C, Demark-Wahnefried W, et al. Interest in healthy diet and physical activity interventions peripartum among female partners of active duty military. *Mil Med.* 2003;168:320–325

22. Østbye T, Krause KM, Brouwer RJN, et al. Active Mothers Postpartum (AMP): rationale, design and baseline characteristics. *J Womens Health (Larchmt)*. 2008;17:1567–1575
23. Bandura A. Social learning theory. Englewood Cliffs NJ: Prentice Hall; 1977;
24. Prochaska JO, DiClemente CC. Stages and processes of self-change of smoking: toward an integrative model of change. *J Consult Clin Psychol*. 1983;51:390–395
25. Miller WR, Rollnick S. Motivational interviewing. New York: Guilford Press; 1991;
26. Wing RR, Jeffery RW. Benefits of recruiting participants with friends and increasing social support for weight loss and maintenance. *J Consult Clin Psychol*. 1999;67:132–138
27. Hinton PS, Olson CM. Postpartum exercise and food intake: the importance of behavior-specific self-efficacy. *J Am Diet Assoc*. 2001;101:1430–1437
28. Resnicow K, DiIorio C, Soet J, et al. Motivational interviewing in medical and public health settings. In: Miller W, Rollnick S editor. Motivational interviewing. 2nd ed.. New York: Guilford Press; 2002;
29. Nutrition Coordinating Center, University of Minnesota. Nutrition data system for research. www.ncc.umn.edu
30. Jonnalagadda SS, Mitchell DC, Smiciklas-Wright H, et al. Accuracy of energy intake data estimated by a multiple-pass, 24-hour dietary recall technique. *J Am Diet Assoc*. 2000;100:303–308
31. Tran KM, Johnson RK, Soultanakis RP, Matthews DE. In-person vs telephone-administered multiple-pass 24-hour recalls in women: validation with doubly labeled water. *J Am Diet Assoc*. 2000;100:777–783
32. Sallis JF, Haskell W, Wood PD, Rogers T, Blair SN, Paffenbarger RS. Physical activity assessment methodology in the Five-City Project. *Am J Epidemiol*. 1985;121:91–106
33. Pereira MA, Fitzgerald SJ, Gregg EW, et al. A collection of physical activity questionnaires for health-related research. *Med Sci Sports Exerc*. 1997;29S:S89–S103
34. Blair SN, Applegate WB, Dunn AL, et al. Activity Counseling Trial (ACT): rationale, design, and methods. *Med Sci Sports Exerc*. 1998;30:1097–1106
35. Dunn AL, Marcus BH, Kampert JS, Garcia ME, Kohl HW II, Blair SN. Reduction in cardiovascular disease risk factors: 6-month results from Project Active. *Prev Med*. 1997;26:883–892
36. Dunn AL, Marcus BH, Kampert JB, Garcia ME, Kohl HW, Blair SN. Comparison of lifestyle and structured interventions to increase physical activity and cardiorespiratory fitness. *JAMA*. 1999;281:327–334
37. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression (Development of the 10-item Edinburgh Postnatal Depression Scale). *Br J Psychiatry*. 1987;150:782–786
38. Amorim W, Linne WF, Lourenco WF. Diet or exercise, or both, for weight reduction in women after childbirth. *Cochrane Database Syst Rev*. 2007;(3):CD005627
39. Kinnunen TI, Pasanen M, Aittasalo M, Fogelholm M, Weiderpass E, Luoto R. Reducing postpartum weight retention—a pilot trial in primary health care. *Nutr J*. 2007;6:21
40. Kuhlmann AK, Dietz PM, Galavotti C, England LJ. Weight-management interventions for pregnant or postpartum women. *Am J Prev Med*. 2008;34:523–528
41. Leermakers EA, Anglin K, Wing RR. Reducing postpartum weight retention through a correspondence intervention. *Int J Obes Relat Metab Disord*. 1998;22:1103–1109
42. Parker JD, Abrams B. Differences in postpartum weight retention between black and white mothers. *Obstet Gynecol*. 1993;81:768–774

43. Smith DE, Lewis CE, Caveny JL, Perkins LL, Burke GL, Bild DE. Longitudinal changes in adiposity associated with pregnancy—the CARDIA study. *JAMA*. 1994;271:1747–1751
44. Boardley DJ, Sargent RG, Coker AL, Hussey JR, Sharpe PA. The relationship between diet, activity, and other factors, and postpartum weight change by race. *Obstet Gynecol*. 1995;86:834–838
45. Baker RC, Kirschenbaum DS. Self-monitoring may be necessary for successful weight control. *Behav Ther*. 1993;24:377–394
46. Boutelle KN, Kirschenbaum DS. Further support for consistent self-monitoring as a vital component of successful weight control. *Obes Res*. 1998;6:219–224
47. Calfas KJ, Marcus BH. Postpartum weight retention: a mother's weight to bear?. *Am J Prev Med*. 2007;32:356–357
48. Wilkinson S, Huang CM, Walker LO, Sterling BS, Kim M. Physical activity in low-income postpartum women. *J Nurs Scholarsh*. 2004;36:109–114
49. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999–2004. *JAMA*. 2006;295:1549–1555
50. Lewis MA, McBride CM, Pollak KI, Puleo E, Butterfield RM, Emmons KM. Understanding health behavior change among couples: an interdependence and communal coping approach. *Soc Sci Med*. 2006;62:1369–1380