Current Research

Predictors of Weight Loss in Low-Income Mothers of Young Children

KRISTINE K. CLARKE, PhD, MPH, RD; JEANNE FREELAND-GRAVES, PhD, RD; DEBORAH M. KLOHE-LEHMAN, PhD, RD; THOMAS M. BOHMAN, PhD

ABSTRACT

Objective To identify predictors of weight loss in a tri-ethnic population of low-income mothers.

Design An 8-week dietary and physical activity program was tested. Demographic data were collected at baseline; anthropometric, dietary, physical activity, and psychosocial data were measured at baseline and week 8.

Subjects/setting A convenience sample of 114 Hispanic, African-American, and white, low-income mothers with a body mass index ≥25 (calculated as kg/m^2) participated in the intervention.

Intervention Weight-loss classes that incorporated nutrition, physical activity, and behavior modification were administered for 8 weeks.

Main outcome measures Anthropometry (body weight, weight loss).

Statistical analyses performed Analysis of variance, χ^2 tests, and Spearman and Pearson correlations were used to test for associations between baseline and change data and total weight loss. Hierarchical regression was employed to assess the marginal importance of factors beyond socioeconomic influences.

Results Correlates of weight loss included less satisfaction with appearance (r=0.24), greater percentage of energy from protein (r=−0.22), enhanced nutrition knowledge (r=−0.23), and higher scores for benefits of weight loss (r=−0.20) at baseline; and the change in healthful eating attitudes (r=−0.28) and social support (r=−0.21) at 8 weeks. The predictive models of baseline and change variables represented 11.4% and 13.8% of the variance, respectively.

Conclusions Weight-management programs serving low-income mothers should provide techniques to enhance social support, attitudes toward healthful eating, benefits of weight loss, and nutrition knowledge.

J Am Diet Assoc. 2007;107:1146-1154.

K. K. Clarke is an assistant professor, Division of Nutrition, The University of Utah, Salt Lake City; at the time of the study, she was a graduate student in the Division of Nutritional Sciences, The University of Texas at Austin. J. Freeland-Graves is the Bess Heflin Centennial Professor, Division of Nutritional Sciences, The University of Texas at Austin. D. M. Klohe-Lehman is the state marketing coordinator for nutrition at the Texas Department of Agriculture, Austin; at the time of the study, she was a graduate student in the Division of Nutritional Sciences, The University of Texas at Austin. T. M. Bohman is a research scientist at the Center for Social Work Research, The University of Texas at Austin; at the time of the study, he was a manager at ITS Research Consulting, The University of Texas at Austin.

Address correspondence to: Jeanne Freeland-Graves, PhD, RD, Division of Nutritional Sciences, 1 University Station, A2700, The University of Texas at Austin, Austin, TX 78712. E-mail: jfg@mail.utexas.edu

0002-8223/07/10707-0002$32.00/0
doi: 10.1016/j.jada.2007.04.016

Annual expenditures on weight-loss products exceed $30 billion in the United States (1). Despite these costs, the prevalence of overweight and obesity continues to escalate. Approximately 47.4% of Americans were overweight and 15.1% obese during 1976 to 1980 (2), as compared to 65.1% and 30.4% during 1999 to 2002 (3). In particular, women, minorities, and people of low socioeconomic status are affected disproportionately by obesity (3). The prevalence rates among men do not differ by ethnicity; however, in women, more African Americans and Hispanics are obese (49.0% and 38.4%) than whites (30.7%) (3). Environmental contributors to weight loss include diet (4), physical activity (5), and psychosocial factors (6). Restriction of caloric intake and expenditure of calories via physical activity are the primary mechanisms for the promotion of energy deficits (7). Dietary components associated with weight loss include higher intakes of protein (8), complex carbohydrates (9), dietary fiber (10), and dairy products (11); and lower intakes of fat (12-14).

Physical activity represents the expenditure side of caloric balance. The Institute of Medicine recommends 1 hour per day of physical activity (15), based on evidence that this amount may be needed to maintain a healthy weight. A study by Jakicic and colleagues (5) observed trends in weight loss with increasing duration of exercise over 12 months. Subjects who reported <150 minutes/week lost 4.7% of their body weight, as compared to 9.5% for 150 minutes/week and 13.6% for 200 minutes/week. Consequently, Lee (16) recommended the less-stringent Centers for Disease Control and Prevention guideline of 30 minutes per day (17) as a general rule, but stated that greater weight losses could be obtained by adhering to Institute of Medicine guidelines.

Psychosocial influences on weight loss may be especially pertinent for women. Higher rates of depression and deteriorating body image have been associated with increased weight after pregnancy, resulting in lowered self-esteem (18). Strategies to enhance weight loss focus on improved self-efficacy (19) and reduced stress levels (20). Other potential correlates and predictors include age (21), body image (22), body weight (23), decisional balance (ratio of pros to cons of weight loss) (19), depression (24), nutrition attitudes (25), nutrition knowledge (26,27), and socioeconomic status (28).

Models for weight management for low-income mothers are limited. A recent intervention by Martin and colleagues (23) investigated the psychosocial predictors of depression, self-efficacy, and stress on weight change in low-income, African-American women who participated in a tailored intervention (n=48) or received standard care (n=58). In the tailored program, a high baseline self-efficacy was associated with weight gain and its improvement was related to greater weight loss. This variance was explained by the premise that initial overconfidence may be related to increased difficulty in coping with the demands of a treatment program. Hierarchical regression modeling revealed that baseline self-efficacy and positive self-efficacy change were important predictors in separate analyses; however, depression and stress variables had minimal influence. Clearly, insufficient data are available on the factors associated with weight loss in underserved populations. This study aims to identify predictors of weight loss in a sample of low-income mothers of young children.

METHODS

Study Design

Mothers (n=114) of 1- to 4-year-old children participated in an 8-week dietary and physical activity program (Table 1). This intervention assessed pre- and postmeasurements of body weight, diet, physical activity, and psychosocial factors (body image, decisional balance, depression, nutrition attitudes, nutrition knowledge, exercise self-efficacy, social support, and stress). Demographics and health and dieting history were evaluated at baseline.

Table 1. Baseline demographic profile of participants in an 8-week dietary and physical activity program for low-income mothers (n=114)

Variable	n	%
Age (y)		
18-29	81	71.1
30-39	26	22.8
40-44	7	6.1
Body mass index[a]		
25-29.9	24	21.1
30-39.9	68	59.6
40-56.5	22	19.3
Ethnicity		
African American	22	19.3
White	19	16.7
Hispanic	73	64.0
Income		
<$15,000	25	21.9
$15,000-29,999	61	53.5
$30,000-44,999	28	24.6
Educational level		
<High school	22	19.3
High school graduate	34	29.8
>High school	58	50.9
No. of children in household		
1	38	33.3
2-3	64	56.2
4-8	12	10.5
Cohabitation		
Yes	84	73.7
No	30	26.3

[a]Calculated as kg/m^2.

Subjects

Mothers were recruited from community centers, public health clinics, and Special Supplemental Nutrition Program for Women, Infants, and Children clinics in central Texas. Subject qualifications included: age 18 to 45 years; body mass index (BMI) ≥25; African-American, white, or Hispanic ethnicity; ability to speak and read English; and income <200% federal poverty index. Pregnant, lactating (breastfeeding ≥5 minutes/day), and seriously ill subjects were excluded. Further details regarding subject characteristics and the intervention are available (29). Participants gave informed consent prior to their involvement in the program. This study was approved by the Institutional Review Board of the University of Texas at Austin.

Demographics and Health History

Childbirth and demographic data were obtained with a 40-item questionnaire. Subjects reported information regarding gestational weight gain, number of children, ethnicity, income, education, relationship status, birth control use, employment status, and Medicaid insurance eligibility. Participants listed current and past medical conditions (colitis, depression, diabetes, hypertension, thyroid disorders) on a health history form. In addition, mothers stated the number of previous attempts at weight loss and current dieting status.

Anthropometric Variables

Self-reported height and weight were verified by direct measurements by personnel trained according to protocols of the National Health and Nutrition Examination Survey III (30). A stadiometer (Perspectives Enterprises, Portage, MI) assessed stature to the nearest 0.1 cm and an electronic weighing scale (Model HS-100-A; Fairbanks Scales, St Johnsbury, VT) measured body weight to the nearest 0.1 kg. Each measurement was taken once with the subject in light clothing, without shoes. BMI was calculated as kg/m^2. Waist circumference was assessed to the 0.1 cm level by placing a nonelastic measuring tape around the abdomen at the position of the highest lateral plane of the right iliac crest.

Dietary Intake

A registered dietitian collected 3 days of dietary data from participants at baseline and postintervention. All subjects reported 1 day with the 24-hour recall method initially and then completed 2 days of food records (1 weekend day), to yield a total of 3 days of dietary intake data at each measurement interval. For the 24-hour recall, the US Department of Agriculture five-step multiple-pass method was employed (31). Accuracy of data was aided with the use of measuring cups, measuring spoons, food models, and guidelines for completing food records. Also, a registered dietitian checked all dietary records for completeness and a second registered dietitian reviewed all records for accuracy. If necessary, additional information was obtained from participants. The Food Processor program (version 7.81, 2001, ESHA Research, Salem, OR) was used to obtain nutrient data. This data included mean daily intakes for energy, macronutrients, calcium, and Food Guide Pyramid (32) servings (bread, fruit, vegetable, meat, and dairy groups).

Physical Activity

Daily pedometer steps were used to appraise physical activity levels by a model (Model AE170, Accusplit Inc, San Jose, CA) equivalent to the Yamax Digiwalker, SW-701 (Yamax Corp, Minato-ku, Tokyo, Japan). Reliability and validity of the Yamax Digiwalker pedometer is well-established (33-35). In a study by Bassett and colleagues (33), the Yamax SW-500 pedometer showed accuracy to within 1% of the measured distance in a study of 20 subjects (13 women, seven men). Exceptional reliability has been reported for another version (SW-701) of the Digiwalker because the SW-500 model is no longer available (35). In addition, concurrent validity for the Digiwalker SW-701 was shown by the high correlation of steps with walking (r=0.84) and VO_2 max (r=0.75) (in 15 women and 10 men) (34).

At pre- and postintervention, mothers reported steps and duration from pedometers worn for 3 days (2 weekdays and 1 weekend day). Subjects were instructed to wear the pedometer for all waking hours except during swimming or bathing. Pedometer forms were checked by staff for extreme step and time values. In addition, the 3 days of steps were averaged to yield mean pedometer steps for each participant at baseline and week 8.

Psychosocial Variables

A description of the psychosocial scales used in the intervention is detailed in Table 2. At pre- and postintervention, mothers completed questionnaires assessing body image, pros and cons of weight loss, depression, nutrition attitudes, knowledge, self-efficacy, social support, and stress. Body image was measured with the 34-item Multidimensional Body Relations Questionnaire (36). This tool assessed five domains representing satisfaction with appearance (appearance evaluation), effort expended on appearance (appearance orientation), satisfaction with distinct body parts (body areas satisfaction), fixation with dieting, weight vigilance, and eating restraint (overweight preoccupation), and perception of current weight status (weight classification). The pros and cons of weight loss were appraised with the 20-item Decisional Balance Inventory (37). Pros represented the benefits of weight loss, such as wearing more attractive clothing and feeling more energetic, while the cons corresponded to negative attributes, such as paying more for meals and eating less-appetizing foods. Depression was evaluated with the 20-item Center for Epidemiological Depression Scale (38,39).

Nutrition attitudes toward healthful eating, perceived barriers to eating, and emotional coping responses were measured with a 21-item scale by Nuss and colleagues (40). This scale also included sensory motivators for eating, such as taste, hunger, and cravings. Nutrition knowledge was assessed with a 25-item test covering the following content areas: weight loss, prenatal nutrition, child nutrition, the Food Guide Pyramid, macronutrients, and vitamins/minerals (27). Self-efficacy was measured for both exercise and eating. The Exercise Self-Efficacy Questionnaire evaluated the confidence to exercise in 11 different situations, such as when feeling depressed or tired (41). The Weight Efficacy Lifestyle Questionnaire consisted of 20 items with five subscales (42). These subscales represented the confidence to resist eating under the following conditions: food availability, negative emotions, positive activities, physical discomfort, and social pressure. The Social Support Scale measured the degree of assistance for mothers in six areas, such as with household tasks, childrearing, and listening during crises (39). Finally, the Stress Scale assessed the degree of hassle posed by situations, including financial problems, family conflict, and childrearing difficulties (39).

Reliability data for all psychosocial measures are shown in Table 2. With the exception of the Nutrition Knowledge Test, these scales demonstrated reliability by acceptable Cronbach's α values. The Nutrition Knowledge Test consisted of dichotomous variables so the Kuder Richardson's test was chosen to establish reliability. Because the Kuder Richardson's test is a more stringent test than Cronbach's α, a level of 0.6 for Kuder Richardson's test is considered adequate (43). For all scales, higher values represented more of the measured trait. All questionnaires were validated in women of childbearing age. Copies of the nutrition attitudes and nutrition knowledge scales are available upon request.

Statistical Analysis

Hierarchical regression analyses were conducted with the Statistical Package for the Social Sciences program (version 11.5, 2003, SPSS Inc, Chicago, IL). All available data were considered in the analyses to maximize statistical power. Preliminary data-management steps included identifying outliers and testing for normality of distribution. Because of the small sample size, no subgroup analyses were performed by racial/ethnic background.

The primary outcome measure for this study was weight loss in kilograms at week 8. Thus, negative numbers represented weight loss. Weight-loss results were stratified into responder (≤ -2.27 kg=5 lb) and nonresponder categories (> -2.27 kg). Also, baseline differences between participants according to weight-loss category (responder, nonresponder) for body size, dietary, physical activity, and psychosocial variables were investigated by independent sample t tests. Statistical significance was assigned at the level of $P<0.05$.

As the first step in model development, associations were examined between weight loss and demographic,

Table 2. Reliability of psychosocial measures used in a dietary and physical activity intervention for low-income mothers and association with weight loss

Domain	Measures/subscales	Reliability[a] Cronbach's α	Association to weight loss[b] r	No. of items	Response options
Body image	Multidimensional Body Self-Relations Questionnaire			34	1=definitely disagree to 5=definitely agree
	Appearance evaluation	.88	0.24**	7	
	Appearance orientation	.85	0.08	12	
	Body image satisfaction	.73	0.17	9	
	Overweight preoccupation	.76	−0.06	4	
	Weight classification	.89	−0.17	2	
Pros and cons of weight loss	Decisional Balance Inventory		−0.16	20	1=not important to 5=extremely important
	Pro	.91	−0.20*	10	
	Con	.84	0.00	10	
Depression	Center for Epidemiological Studies Depression Scale	.90	−0.10	20	0=rarely to 3=most or all of the time
Attitudes	Nutrition Attitudes Scale			21	
	Emotional coping responses	.80	−0.07	3	1=never to 7=always
	Healthful eating	.86	0.09	9	1=least important to 7=very important
	Perceived barriers	.78	0.02	6	1=least important to 7=very important
	Sensory motivators	.65	−0.04	3	1=least important to 7=very important
Knowledge	Nutrition Knowledge Test[a]	.60	−0.23*	25	0=incorrect or 1=correct
Self-efficacy	Exercise Self-Efficacy Questionnaire	.87	0.11	11	1=not at all confident to 5=very confident
	Weight Efficacy Lifestyle Questionnaire		0.03	20	0=not confident to 9=very confident
	Availability	.76	0.13	4	
	Negative emotions	.87	−0.02	4	
	Physical discomfort	.70	−0.09	4	
	Positive activities	.82	0.00	4	
	Social pressure	.90	0.09	4	
Social support	Social Support Scale	.87	0.00	6	1=not at all to 9=completely
Stress	Stress Scale	.73	0.06	11	1=no stress to 4=severe

[a]Kuder Richardson's KR-20 demonstrated reliability for the Nutrition Knowledge Test.
[b]Association with weight loss at week 8.
*$P<0.05$ for significant correlations.
**$P<0.01$ for significant correlations.

anthropometric, dietary, physical activity, and psychosocial factors with analysis of variance, χ^2 tests, and Spearman and Pearson correlations. Factors that showed statistically significant relationships with weight loss were then entered in the hierarchical regression analyses, as part of step 2 in model building. Baseline body weight and any demographic variables that showed substantial association with weight loss were entered first. Next, baseline psychosocial correlates with weight loss were added. This regression method was chosen to evaluate the marginal effect of psychosocial variables to the predictive model. Finally, all two-way interactions between baseline weight and substantial psychosocial correlates of weight loss were tested.

A second regression model was performed that considered changes in dietary, physical activity, and psychosocial variables. This model also adjusted for baseline body weight and any demographic factors associated with weight loss. Change data were calculated by subtracting week 0 from week 8 values. Therefore, positive numbers represented increases in psychosocial scores. For both models, regression diagnostics were examined to identify any violation to underlying assumptions and the predictive ability was maximized by only including five or fewer independent variables (44,45). The sample size was powered at approximately 0.75 to 0.78 with α=.05 and a population r^2 of 0.10, depending on whether four or five predictors were used (46). Extreme data values were recoded to reduce their potential influence on the results.

RESULTS

Subject Characteristics

The demographic profile of program participants is shown in Table 1. The majority of subjects were under the age of 30, with a range of 18 to 44 years. Mean age and BMI for mothers was 27 years and 35, respectively. Almost two thirds (64%) of subjects were Hispanic, with the remaining representing African-American and white ethnicities. Reported annual household incomes most commonly fell in the $15,000 to $29,999/year category, with 75% below $30,000/year. The majority of participants had completed at least a high school level of education (81%), had two or more children in the household (67%), cohabitated with a spouse/partner (74%), and was eligible for Special Supplemental Nutrition Program for Women, Infants, and Children clinic services or food stamps (98%).

Responders vs Nonresponders

Prestudy measurements of body size, diet, physical activity, and psychosocial factors by weight loss responder category are shown in Table 3. Body size did not differ according to successful weight loss. Among dietary factors, responders reported consuming a lower percentage of energy from carbohydrate ($P<0.05$) and nonsignificantly higher percentages from fat and protein. However, in subjects who lost ≥5% of body weight, the percentage of energy from protein was significantly greater than for nonresponders (17.7% vs 15.1%, $P<0.01$). Physical activity, as measured by pedometer steps, did not vary substantially among groups at baseline.

Only two psychosocial scales differed between weight-loss categories; body image and decisional balance (Table 3). For body image, appearance evaluation (satisfaction with appearance) was lower in those who lost more weight ($P<0.01$). For decisional balance (ratio of pros to cons of weight loss), total scores were higher in those that were successful ($P<0.05$).

Key Correlates with Weight Loss

The mean weight loss at week 8 was −2.7 kg. Cohabitation was the only demographic factor associated with weight loss. Women who lived with a spouse/partner achieved a 3 kg reduction in body weight, as compared to 1.7 kg for those who did not.

A higher percentage of energy from protein at baseline was associated with greater weight losses (Figure). This relationship remained significant after controlling for age, BMI, cohabitation, and educational level ($P<0.05$). For other dietary variables, weight reduction was not associated with initial levels or changes in intakes of energy, percentage of energy from carbohydrate or fat, dietary fiber, calcium, or Food Guide Pyramid group servings. The lack of significance for the change in the percentage of energy of protein with weight loss is presumably due to the low variance, as most subjects (83%) increased their percentage intake.

Three baseline psychosocial factors were positively correlated with weight loss, as shown in Table 2, including the appearance evaluation subscale, decisional balance pro subscale, and the total score for the nutrition knowledge test. Thus, mothers who were more dissatisfied with their appearance, valued weight loss, and had greater nutrition knowledge scores experienced more weight loss. The relationship for the appearance evaluation and decisional balance pro subscales remained significant ($P<0.05$) after adjusting for age, BMI, cohabitation, and educational level. However, the correlation for nutrition knowledge disappeared. Of the psychosocial change scores, enhancements in healthful eating attitudes and social support were significantly associated with improved weight-loss outcomes ($r=-0.28$, $P<0.01$ and $r=-0.21$, $P<0.05$, respectively).

Table 3. Baseline diet, physical activity, and significant psychosocial factors of low-income mothers enrolled in a dietary and physical activity program[a]

Variable	Responders (n=60)	Nonresponders (n=54)
	←— *mean± SD*[b]	—→
Body size		
Body mass index[c]	34.7±6.2	35.3±7.2
Weight (kg)	91.9±18.9	92.1±21.5
Waist circumference (cm)	106.1±16.9	108.2±18.5
Diet		
Energy (kcal)	1,982±541	1,891±604
Energy from carbohydrate (%)	48.0±8.0*	51.1±7.4*
Energy from fat (%)	36.3±5.8	34.9±6.0
Energy from protein (%)	16.1±3.3	15.1±3.0
Physical activity		
Pedometer steps	6,197±2,942	5,590±3,743
Psychosocial factors		
Body image		
Appearance evaluation	2.2±0.7**	2.6±0.7**
Appearance orientation	3.4±0.7	3.5±0.6
Body image satisfaction	2.4±0.5	2.6±0.5
Overweight preoccupation	3.2±0.8	3.0±0.8
Weight classification	4.6±0.4	4.4±0.7
Decisional balance		
Total score	17.1±8.3*	13.3±8.8*
Pro	41.6±6.8	39.2±6.9
Con	24.5±7.4	25.9±8.0

[a]Responders lost (≤−2.27 kg).
[b]SD=standard deviation.
[c]Calculated as kg/m^2.
*$P<0.05$ for significant differences at baseline.
**$P<0.01$ for significant differences at baseline.

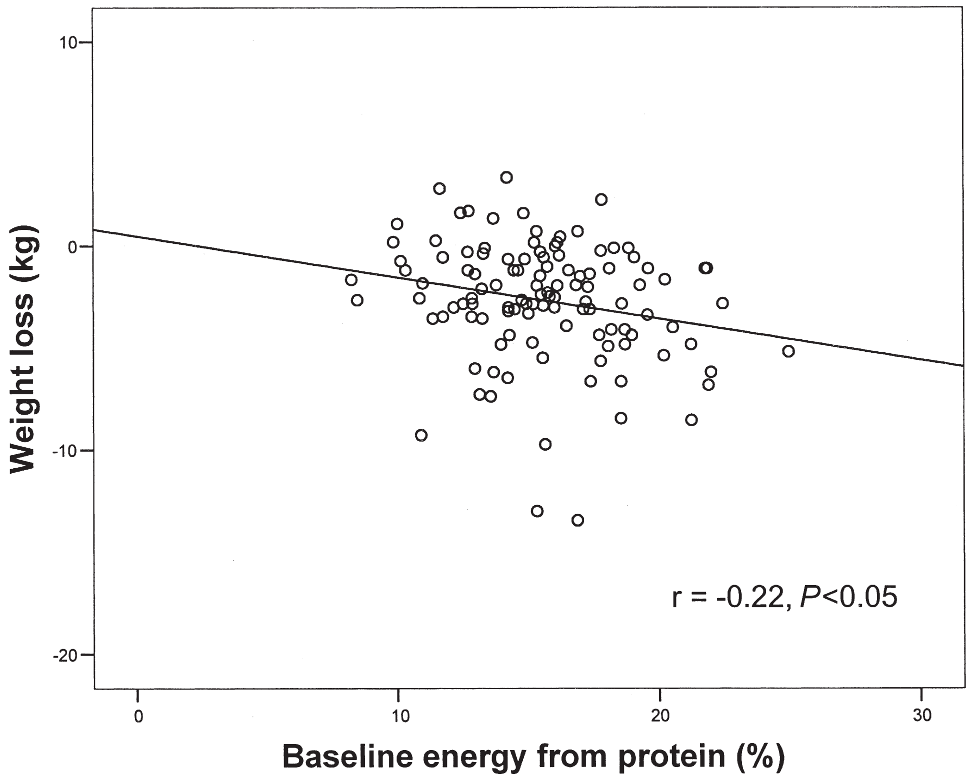

Figure. Relationship between weight loss and percent energy from protein in low-income mothers enrolled in a dietary and physical activity program.

Predictive Model

Two hierarchical regression models for the prediction of weight loss are presented in Table 4. The baseline model included only initial correlates. In step 1, the demographic variables of cohabitation and body weight represented only 6.2% of the total variance. Cohabitation demonstrated significance at $P<0.01$, but body weight did not. In step 2, the addition of the decisional balance pro subscale, nutrition knowledge, and appearance evaluation subscale significantly increased the adjusted R^2 by 5.2% ($P<0.05$) so that the final model explained 11.4% of the variance in weight loss. None of the baseline psychosocial factors were significant.

The treatment model was conducted with psychosocial change variables only, because none of the dietary or physical activity change data were significantly related to weight loss. After correcting for body weight and cohabitation (step 1), healthful eating attitude and social support change scores (step 2) represented 7.6% of the variance in weight loss ($P<0.01$) and acted as significant predictors ($P<0.05$). Inspection of the β weights related to changes in social support and healthful eating attitudes revealed negative correlations with weight loss, signifying that increases in social support and healthful eating attitudes were associated with weight loss.

DISCUSSION

In our predictive models of weight loss for low-income mothers of young children, the most important modifiable factors were positive changes in social support and nutrition attitudes. The significance of positive social support is not surprising, as others have observed its importance for weight-loss success in obesity interventions targeting African-American women (47), Hispanic women (48), and mothers (49). Young and colleagues (47) conducted four focus groups with African-American women (N=34) to elicit intervention strategies. Social support was articulated as an essential motivator for engaging in physical activity and weight-loss efforts. In Hispanic women, Cousins and colleagues (48) conducted a weight-loss intervention with three groups: (a) behavioral classes; (b) behavioral classes with added family support; and (c) comparison group. Women in the family support group demonstrated superior weight losses (9.9 lb), as compared to those in the behavioral (7.2 lb) and comparison groups (1 lb). A third study by Peterson and colleagues (49) integrated social support into its intervention targeting low-income, postpartum women, including supportive behaviors and network size as mediators for intervention outcomes (dietary, physical activity, weight loss).

Fitzgibbon and colleagues (50) measured nutrition attitudes and dietary intake in an obesity-prevention program for 24 African-American mothers and their preadolescent daughters. No improvements in attitudes were found for mothers or daughters as a result of the intervention, but the impact of attitudes on weight loss was not presented for mothers. In a larger sample of 183 low-literacy, low-income adults (86% women, 58% His-

Table 4. Hierarchical regression models for prediction of weight loss in a population of low-income mothers after 8 weeks of intervention

Variable	Adjusted R^2 change	β	P value
Baseline model			
Step 1	0.062*		
Cohabitation[a]		−.27	0.004**
Initial weight (kg)		−.08	0.418
Step 2	0.052*		
Initial decisional balance pro score		−.16	0.128
Initial nutrition knowledge score		−.14	0.163
Initial appearance evaluation score		.10	0.356
Model adjusted R^2	0.114		
Treatment model			
Step 1	0.062*		
Cohabitation[a]		−.27	0.004**
Initial weight (kg)		−.08	0.418
Step 2	0.076**		
Change in social support		−.22	0.017*
Change in healthful eating attitudes		−.20	0.035*
Model adjusted R^2	0.138		

[a]1=cohabitation with a spouse/partner and 0=no cohabitation.
*$P<0.05$ for significant prediction of weight loss.
**$P<0.01$ for significant prediction of weight loss.

panic), the Stanford Nutrition Action Program (51) assessed nutrition attitudes as part of their dietary fat intervention. Intervention subjects showed greater enhancements in nutrition attitudes than controls (n=168) in general nutrition classes, but no changes in BMI were observed.

Higher weight loss was more prevalent among women who lived with a spouse/partner. This finding may reflect the influence of social support (52) and increased resources (53) on behavior change. However, a study (54) of the predictors of 1-year weight loss among 2,586 overweight women showed that the category of "never married" was associated with greater success ($P<0.05$). These results may be explained in part by Sobal and colleagues (53) in a longitudinal study over 10 years who observed that marital changes had more of an impact on weight loss, than just status. Women who were married at baseline and follow-up, gained less weight than single women who married during the study. Other demographic factors related to weight loss include age (14), BMI (54), educational level (55), ethnicity (56), income (55), and medical illness. However, these items were not significant in the current study.

The three variables that were significantly related to weight loss, but did not retain significance in the model, were decisional balance, nutrition knowledge, and appearance evaluation. For decisional balance, scores on the pro subscale were associated with weight reduction, yet cons only marginally influenced the outcome measure. This meant that mothers who felt the benefits of weight loss outweighed the barriers were more likely to be successful. Therefore, positive messages may have had a greater impact on our low-income population than negative ones for behavioral change (57). Nutrition knowledge was higher in those who were successful in losing weight. Other weight loss interventions for Hispanics and African-American women revealed that the treatment groups who lost weight (8.7 lb and 3 lb, respectively) scored significantly higher than the controls who gained weight on nutrition knowledge posttests (26,58). Also, the positive association between weight loss and appearance evaluation suggests that a more critical view toward one's body image may impact motivation and success in weight loss.

Low-income mothers may have difficulty initiating substantial dietary changes if access to healthful foods is limited.

We did not observe any significant correlations between changes in dietary components and weight loss to enter into the regression model. The initial dietary protein intake, but not the change, was related to weight loss. Other dietary factors reported to be related to weight loss are complex carbohydrates (9), dairy products (11), dietary fiber (10), and low-fat diets (13,14). However, we did not observe these associations in this study. The lack of predictability of dietary changes in our model may be due, in part, to our primary focus on individual behavioral measures. Yet, sustainable weight-loss results from environmental influences as well. Low-income mothers, for example, may have difficulty initiating substantial dietary changes if access to healthful foods is limited. Previous research indicates that environmental factors, such as the higher cost and lower availability of healthful foods, may act as deterrents to improved nutritional intakes, especially in low-income cohorts (59).

Physical activity, as measured by pedometers, was not related to weight loss, presumably because 82% of subjects increased their activity. Similar findings were observed in a diet and physical activity intervention for ethnically diverse, overweight women by Bond Brill and colleagues (60). Participants were randomized as: 30 minutes walking for 5 days/week; 60 minutes walking, 5 days/week; or no walking (control). All women followed the same low-fat, ad libitum diet but no treatment demonstrated superior results. Thus, physical activity did not appear to have a powerful influence on weight loss in these subjects.

A similar study in 48 overweight/obese, low-income, African-American women by Martin and colleagues (23) observed only self-efficacy to be linked to weight loss. Baseline self-efficacy predicted weight *gain*, whereas the change in self-efficacy predicted weight loss. This disparity was explained by the hypothesis that initial overconfidence may be associated with an inability to deal with the difficulties of their endeavors. In contrast, self-efficacy was not significant in our study. One possible explanation is that the sample population above was only African Americans, as opposed to our ethnically diverse women. In our subjects, the self-efficacy of African-American women was higher than both whites and Hispanics.

The design of our study did not permit the measurement of other factors that may contribute to successful weight loss. For example, resting metabolic rate was not evaluated as the aim was to focus on behavioral factors that could be modified in a community-based program. Another limitation is that our models may not represent weight maintenance and different predictors might become evident based on longer-term weight loss. However, a lengthy follow-up was not feasible in this sample because of their high mobility, lack of transportation, financial instability, and considerable personal problems. Third, there are limitations regarding the self-reported data for diet and physical activity. The potential for reduced accuracy with self-reported information may have influenced the detection of differences between responders and nonresponders in this study. Finally, the stratification of results by ethnicity was limited in regression analyses because of the small sample size. Therefore, results from this study may not be applicable to a particular ethnic group.

CONCLUSIONS

Predictors of weight loss included enhancements in nutrition attitudes and social support. Greater success was observed in those who articulated the benefits of weight loss, had higher nutrition knowledge, and had lower satisfaction with appearance at baseline.

Further research is needed to develop long-term models of weight management for low-income mothers. Specifically, there is a need for culturally sensitive resources to guide the weight-loss efforts of ethnically diverse women in the United States.

This research was supported by a grant from the Texas Higher Education Coordinating Board (UTA#00-377).

References

1. Kruger J, Galuska DA, Serdula MK, Jones DA. Attempting to lose weight: Specific practices among US adults. *Am J Prev Med.* 2004;26: 402-406.
2. Centers for Disease Control and Prevention. Prevalence of physical activity, including lifestyle activities among adults-United States, 2000-2001. *MMWR Morb Mortal Wkly Rep*. 2003;52:764-769.
3. Hedley AA, Ogden CL, Johnson CL, Carroll MD, Curtin LR, Flegal KM. Prevalence of overweight and obesity among US children, adolescents, and adults, 1999-2002. *JAMA*. 2004;291:2847-2850.
4. Haslam DW, James WP. Obesity. *Lancet.* 2005;366:1197-1209.
5. Jakicic JM, Otto AD. Physical activity considerations for the treatment and prevention of obesity. *Am J Clin Nutr*. 2005;82(suppl 1): S226-S229.
6. Senekal M, Albertse EC, Momberg DJ, Groenewald CJ, Visser EM. A multidimensional weight-management program for women. *J Am Diet Assoc.* 1999;99:1257-1264.
7. Campbell TC, Chen J. Energy balance: Interpretation of data from rural China. *Toxicol Sci*. 1999;52(suppl 2):S87-S94.
8. Layman DK, Evans E, Baum JI, Seyler J, Erickson DJ, Boileau RA. Dietary protein and exercise have additive effects on body composition during weight loss in adult women. *J Nutr.* 2005;135:1903-1910.
9. Wien MA, Sabate JM, Ikle DN, Cole SE, Kandeel FR. Almonds vs complex carbohydrates in a weight reduction program. *Int J Obes Relat Metab Disord*. 2003;27:1365-1372.
10. Howarth NC, Saltzman E, Roberts SB. Dietary fiber and weight regulation. *Nutr Rev.* 2001;59:129-139.
11. Zemel MB. Role of calcium and dairy products in energy partitioning and weight management. *Am J Clin Nutr*. 2004;79(suppl 5):S907-S912.
12. Poppitt SD, Keogh GF, Prentice AM, Williams DE, Sonnemans HM, Valk EE, Robinson E, Wareham NJ. Long-term effects of ad libitum low-fat, high-carbohydrate diets on body weight and serum lipids in overweight subjects with metabolic syndrome. *Am J Clin Nutr.* 2002; 75:11-20.
13. Shick SM, Wing RR, Klem ML, McGuire MT, Hill JO, Seagle H. Persons successful at long-term weight loss and maintenance continue to consume a low-energy, low-fat diet. *J Am Diet Assoc.* 1998; 98:408-413.
14. Carmichael HE, Swinburn BA, Wilson MR. Lower fat intake as a predictor of initial and sustained weight loss in obese subjects consuming an otherwise ad libitum diet. *J Am Diet Assoc.* 1998:98:35-39.
15. Institute of Medicine. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids, September 5, 2002. Available at: http://www.iom.edu. Accessed December 5, 2005.
16. Lee IM. Physical activity in women: How much is good enough? *JAMA*. 2003;290:1377-1379.
17. Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C, Buchner D, Ettinger W, Heath GW, King AC. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA*. 1995;273:402-407.
18. Walker LO. Weight-related distress in the early months after childbirth. *West J Nurs Res.* 1998;20:30-44.
19. Pinto BM, Clark MM, Cruess DG, Szymanski L, Pera V. Changes in self-efficacy and decisional balance for exercise among obese women in a weight management program. *Obes Res*. 1999;7:288-292.
20. Foreyt JP, Poston WS. The role of the behavioral counselor in obesity treatment. *J Am Diet Assoc*. 1998;98(suppl 2):S27-S30.
21. Anderson LA, Eyler AA, Galuska DA, Brown DR, Brownson RC. Relationship of satisfaction with body size and trying to lose weight in a national survey of overweight and obese women aged 40 and older, United States. *Prev Med.* 2002;35:390-396.
22. Teixeira PJ, Going SB, Houtkooper LB, Cussler EC, Metcalfe LL, Blew RM, Sardinha LB, Lohman TG. Pretreatment predictors of attrition and successful weight management in women. *Int J Obes Relat Metab Disord.* 2004;28:1124-1133.
23. Martin PD, Dutton GR, Brantley PJ. Self-efficacy as a predictor of weight change in African-American women. *Obes Res.* 2004;12:646-651.
24. Sherwood NE, Jeffery RW, Wing RR. Binge status as a predictor of weight loss treatment outcome. *Int J Obes Relat Metab Disord*. 1999; 23:485-493.
25. Striegel-Moore RH, Wilfley DE, Caldwell MB, Needham ML, Brownell KD. Weight-related attitudes and behaviors of women who diet to lose weight: A comparison of black dieters and white dieters. *Obes Res*. 1996;4:109-116.
26. Domel SB, Alford BB, Cattlett, HN, Rodriquez ML, Gench BE. A pilot weight control program for Hispanic women. *J Am Diet Assoc.* 1992; 92:1270-1271.
27. Klohe-Lehman DM, Freeland-Graves J, Anderson ER, McDowell T, Clarke KK, Hanss-Nuss H, Cai G, Puri D, Milani TJ. Nutrition knowledge is associated with greater weight loss in obese and overweight low-income mothers. *J Am Diet Assoc.* 2006;106:65-75.
28. Thomas PR. *Weighing the Options: Criteria for Evaluating Weight-Management Programs*. Washington, DC: National Academies Press; 1995.
29. Klohe-Lehman DM, Freeland-Graves JH, Clarke KK, Cai G, Voruganti SV, Milani TJ, Hanss-Nuss H, Proffitt JM, Bohman T. Low-income overweight and obese mothers as agents of change to improve food choices, fat habits, and physical activity in their 1-3 year old children. *J Am Coll Nutr.* 2007. In press.
30. National Heart, Lung, and Blood Institute. Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults: The Evidence Report, NIH Publication No. 98-4083, September 1998.
31. Conway JM, Ingwersen LA, Vinyard BT, Moshfegh AJ. Effectiveness of the US Department of Agriculture 5-step multiple-pass method in assessing food intake in obese and nonobese women. *Am J Clin Nutr*. 2003;77:1171-1178.
32. *Food Guide Pyramid: A Guide to Daily Food Choices*. Washington, DC: US Department of Agriculture, Human Nutrition Information Service; 1992. Home and Garden Bulletin No. 252.
33. Bassett DR, Ainsworth BE, Leggett SR, Mathien CA, Main JA, Hunter DC, Duncan GE. Accuracy of five electronic pedometers for

measuring distance walked. *Med Sci Sports Exerc*. 1996;28:1071-1077.

34. Hendelman D, Miller K, Baggett C, Debold E, Freedson P. Validity of accelerometry for the assessment of moderate intensity physical activity in the field. *Med Sci Sports Exerc*. 2000;32(suppl 9):S442-S449.
35. Schneider PL, Crouter SE, Lukajic O, Bassett DR. Accuracy and reliability of 10 pedometers for measuring steps over a 400-m walk. *Med Sci Sports Exerc.* 2003;35:1779-1784.
36. Brown TA, Cash TF, Mikulka PJ. Attitudinal body-image assessment: Factor analysis of the Body-Self Relations Questionnaire. *J Pers Assess*. 1990;55:135-144.
37. O'Connell D, Velicer WF. A decisional balance measure and the stages of change model for weight loss. *Int J Addict*. 1988;23:729-750.
38. Radloff LS. The CES-D: A self-report depression scale for research in the general population. *Appl Psychol Meas.* 1977;1:385-401.
39. Walker LO. Weight and weight-related distress after childbirth: Relationships to stress, social support and depressive symptoms. *J Holist Nursing.* 1997;15:389-405.
40. Nuss H, Clarke K, Klohe-Lehman D, Freeland-Graves J. Influence of nutrition attitudes and motivators for eating on postpartum weight status in low-income new mothers. *J Am Diet Assoc.* 2006;106:1774-1782.
41. Clarke KK, Freeland-Graves J, Klohe-Lehman DM, Milani TJ, Nuss HJ, Laffrey S. Promotion of physical activity in low-income mothers using pedometers. *J Am Diet Assoc*. 2007;107:962-967.
42. Clark MM, Abrams DB, Niaura RS, Eaton CA, Rossi JS. Self-efficacy in weight management. *J Consult Clin Psychol*. 1991;59:739-744.
43. McDonald RP. *Test Theory: A Unified Treatment.* Mahwah, NJ: Lawrence Erlbaum Associates; 1999.
44. Munro BH. *Statistical Methods for Health Care Research.* Philadelphia, PA: Lippincott; 1997.
45. Nunnally JC, Bernstein IH. *Psychometric Theory.* New York, NY: McGraw-Hill; 1994.
46. Cohen J. *Statistical Power Analysis for the Behavioral Sciences.* Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.
47. Young DR, Gittelsohn J, Charleston J, Felix-Aaron K, Appel LJ. Motivations for exercise and weight loss among African-American women: Focus group results and their contribution towards program development. *Ethn Health.* 2001;6:227-245.
48. Cousins JH, Rubovits DS, Dunn JK, Reeves RS, Ramirez AG, Foreyt JP. Family versus individually oriented intervention for weight loss in Mexican American women. *Public Health Rep.* 1992;107:549-555.
49. Peterson KE, Sorensen G, Pearson M, Hebert JR, Gottlieb BR, McCormick MC. Design of an intervention addressing multiple levels of influence on dietary and activity patterns of low-income, postpartum women. *Health Educ Res.* 2002;17:531-540.
50. Fitzgibbon ML, Stolley MR, Kirschenbaum DS. An obesity prevention pilot program for African-American mothers and daughters. *J Nutr Educ.* 1995;27:93-99.
51. Howard-Pitney B, Winkleby MA, Albright CL, Bruce B, Fortmann SP. The Stanford Nutrition Action Program: A dietary fat intervention for low-literacy adults. *Am J Public Health.* 1997;87:1971-1976.
52. McLean N, Griffin S, Toney K, Hardeman W. Family involvement in weight control, weight maintenance and weight-loss interventions: A systematic review of randomised trials. *Int J Obes Relat Metab Disord.* 2003;27:987-1005.
53. Sobal J, Rauschenbach B, Frongillo EA. Marital status changes and body weight changes: A US longitudinal analysis. *Soc Sci Med*. 2003; 56:1543-1555.
54. Meltzer AA, Everhart JE. Correlations with self-reported weight loss in overweight U.S. adults. *Obes Res*. 1996;4:479-486.
55. Hjartaker A, Laake P, Lund E. Body mass index and weight change attempts among adult women. The Norwegian Women and Cancer Study. *Eur J Public Health*. 2001;11:141-146.
56. Kanders BS, Ullmann-Joy P, Foreyt JP, Heymsfield SB, Heber D, Elashoff RM, Ashley JM, Reeves RS, Blackburn GL. The black American lifestyle intervention (BALI): The design of a weight loss program for working-class African-American women. *J Am Diet Assoc.* 1994; 94:310-312.
57. Freeland-Graves J, Nitzke S. Position of the American Dietetic Association: Total diet approach to communicating food and nutrition information. *J Am Diet Assoc.* 2002;102:100-108.
58. Domel SB, Alford BB, Cattlett, HN, Gench BE. Weight control for black women. *J Am Diet Assoc.* 1992;92:346-348.
59. Jetter KM, Cassady DL. The availability and cost of healthier food alternatives. *Am J Prev Med.* 2006;30:38-44.
60. Bond Brill J, Perry AC, Parker L, Robinson A, Burnett K. Dose-response effect of walking exercise on weight loss. How much is enough? *Int J Obes Relat Metab Disord*. 2002;26:1484-1493.