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THE DEVELOPMENT, IMPLEMENTATION, AND EVALUATION OF A DIETARY AND PHYSICAL ACTIVITY INTERVENTION FOR OVERWEIGHT, LOW-INCOME MOTHERS

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by

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Dedication

This dissertation is dedicated to my parents, William and Virginia Clarke, for their love and support through the years.

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The purpose of this study is to evaluate a program for promoting weight loss, increasing physical activity, and enhancing nutrition attitudes in mothers of young children. An 8-week dietary and physical activity program was tested. Demographic, dietary, physical activity, and psychosocial data were collected at baseline; anthropometric data were measured at baseline and week 8. A convenience sample of 114 intervention mothers and 33 comparison mothers were recruited from public health clinics, community centers, and churches. Eligibility criteria included Hispanic, African-American, or Caucasian ethnicity; body mass index (BMI) $\geq$ 25 kg/m^2; low-income (< 200% federal poverty index); and youngest child aged 1-4 years. Baseline differences in anthropometrics and demographics between groups were tested using Chi-square and independent samples t-tests. Changes in anthropometrics, nutrients, physical activity measures, and attitudes were evaluated with paired samples t-tests. Relationships between variables were tested with Pearson and Spearman correlation coefficients. Hierarchical regression was employed to assess potential predictors of weight loss. Intervention participants lost weight, consumed fewer calories, increased pedometer steps, and demonstrated improvements in nutrition attitudes. Correlates of weight loss included less satisfaction with appearance ($r=0.24$), a greater percentage of energy from protein ($r=-0.22$), superior nutrition knowledge ($r=-0.23$), higher scores on the benefits of weight loss ($r=-0.20$), change in healthy eating attitudes ($r=-0.28$) and change in social support ($r=-0.21$). The predictive models of weight loss with baseline and change variables represented 18.7% and 17.1% of the variance, respectively. Weight management programs serving low-income mothers should stress these modifiable factors: a balanced diet that contains sufficient protein, social support, attitudes toward healthful eating, benefits of weight loss, and nutrition knowledge.

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Chapter 1: Review of Literature

The prevalence of obesity is rapidly increasing in the United States (U.S.). During 1971-74, 14% of Americans were considered obese (Flegal et al. 2002). By 2002, the prevalence of obesity increased to 30.6% (Hedley et al. 2004). Obesity is more common in minority populations, such as African-Americans and Hispanics, than Caucasians (Cossrow and Falkner 2004). For example, a study found that 39% of African-Americans, 33% of Hispanics, and 29% of Caucasians meet the criteria of obesity (Hedley et al. 2004).

Chronic diseases associated with obesity include type 2 diabetes mellitus, cardiovascular disease, hypertension, cancer, cerebrovascular disease, and osteoarthritis (Stein and Colditz 2004). The impact of this association in Texas was shown by the Texas Risk Factor Report. The survey reported that the prevalence of diabetes was 77% for adults with BMIs above 25 kg/m^2, as compared to 60% for BMIs below 25 kg/m^2 (Texas Diabetes Council). Thus, the reduction of obesity in minority populations would dramatically lower the prevalence of diabetes and other diseases in the U.S.

SUMMARY OF WEIGHT LOSS INTERVENTIONS

Most weight loss programs have targeted middle income, Caucasian women (Table 1.1). Yet, low-income women are a higher risk for obesity than those of higher socioeconomic status (Monteiro et al. 2004). This discrepancy is evident particularly during childbearing years, when excessive gestational weight gain greatly elevates the risk of postpartum weight retention among low-income women (Scholl and Chen 2002).

Table 1.1: Summary of weight loss interventions with dietary and /or behavioral approaches.

Study	Intervention	Subjects	Duration	Weight Loss
Adams et al. (1983)	small group classes (diet, food record evaluations, exercise, and behavioral techniques) Taught by Registered Dietitians.	108 women and 17 men (mean age = 44 years, mean initial weights of 195 lbs for women and 277 lbs for men)	12 weeks	- 11.1 lbs
Cogan and Rothblum (1992)	review of 50 weight loss studies (1980's)	Average participant: (White, middle class woman, 148% of ideal body weight)	13 weeks	- 12.8 lbs
Del Prete et al. (1993)	small group classes in the Pawtucket, RI community and worksites (nutrition education, exercise, and behavioral techniques)	187 women and 42 men (mean age = 49 years, mean % ideal weight = 134%)	10 weeks	- 11 lbs
Ditschuneit et al. (1999)	2 groups:	79 women and 21 men		
	energy-restricted diet	(age > 18 years,	3 months	- 2.9 lbs
	diet w/ meal replacements (Slim-fast)	BMI of 25 – 40 kg/m^2)	3 months	- 15.6 lbs
	Both groups were prescribed the same energy content of 1200-1500 kcal/day, with 20% energy as protein, 25-34% energy as fat, and 48-54% energy as carbohydrate.			

Study	**Intervention**	**Subjects**	**Duration**	**Weight loss**
Evans et al. (1999)	2 groups: energy-restricted diet diet plus aerobic exercise Prescribed diets were individualized and calculated as estimated daily requirements – 1000 kcal. All subjects were on $\geq$ 1200 kcal/day. Exercise prescription consisted of running/jogging classes to expend 1400 calories/week.	27 women (age 20 – 40 years, BMI of >27 kg/m^2, mean BMI = 31 kg/m^2)	 16 weeks 16 weeks	 - 15.9 lbs - 8.8 lbs
Fogelholm et al. (1999)	small group classes (very-low-calorie diet, behavioral techniques) Diets were individualized to provide 40% of subjects' resting energy expenditure.	85 women (29 – 46 years old, BMI of 29 – 46 kg/m^2, mean BMI = 34 kg/m^2)	12 weeks	- 29.7 lbs
Grodstein et al. (1996)	OPTIFAST program (Sandoz) of formulated shakes Prescribed calories varied from 820 calories for weeks 1-12 to 1024 calories for weeks 13-19 to 1434 calories for weeks 20-26.	192 men and women (mean age = 47 years, mean BMI = 37 kg/m^2)	26 weeks	- 48. 4 lbs
Hellerstedt and Jeffrey (1997)	2 groups: minimal contact group telephone assisted weight loss group Both groups attended 2 group classes covering diet, exercise, and behavioral techniques. Afterwards, the telephone group received weekly calls to monitor food intake and exercise.	60 women and 4 men (25 – 55 years old, 120 – 150% of ideal weight)	 24 weeks 24 weeks	 - 12.7 lbs - 7.9 lbs

Study	Intervention	Subjects	Duration	Weight loss
Hill et al. (1989)	4 groups:	32 women		- 16.7 lbs (overall)
	alternating diet + exercise	(mean ages for the groups	12 weeks	not reported
	alternating diet + no exercise	ranged from 33-40 years old,	12 weeks	not reported
	constant diet + exercise	130-160% ideal body weight,	12 weeks	not reported
	constant diet + no exercise	mean BMI = 31 kg/m^2)	12 weeks	not reported
	Both constant and alternating diets Received an average of 1200 kcal/day over the 12 week study. The constant group received 1200 kcal/each day while the alternating group varied in a pattern from 600 to 1800 kcal/day. Exercising subjects walked 5 days/week. All subjects attended a behavioral modification program.			-17.4 lbs (constant diet) -17 lbs (alternating diet) -17.6 lbs (exercise) - 13.2 lbs (no exercise)
Heshka et al. (2000)	2 groups:	423 men and women		
	self-help (diet, exercise)	(18 – 65 years old,	26 weeks	- 3.1 lbs
	Weight Watchers (food plan, activity plan, and behavioral techniques)	mean age = 44 years old, BMI of 27 – 40 kg/m^2) mean BMI = 33 kg/m^2)	26 weeks	- 10.6 lbs
Jakicic et al. (1999)	3 groups:	148 sedentary women		
	long-bout exercise	(25 – 45 years old,	18 months	- 12.8 lbs
	short-bout exercise (SB)	(mean age = 37 years,	18 months	- 8.1 lbs
	SB + home exercise equipment	(120 – 175% of ideal weight)	18 months	- 16.2 lbs

Study	Intervention	Subjects	Duration	Weight loss
Jeffrey (1993)	Invest in Your Health Weight Loss Correspondence Program offered by mail 2 groups: version with $5 fee version with $60 deposit, refunded after successful weight loss Both versions consisted of the same program of monthly newsletters and self-help weight loss manual.	822 women and 482 men (33% 55 years or older)	 6 months 6 months	 - 4.4 lbs - 8.8 lbs
Lasater et al. (1991)	community-based program in Pawtucket, RI consisting of self-help materials on diet and exercise, monetary incentives refunded after successful weight loss and a monthly weigh-in.	213 men and women	10 weeks	- 8.2 lbs
Lavery et al. (1989)	group classes (diet, exercise, behavioral techniques) Taught by Registered Dietitians.	386 women and 123 men (mean age = 44.8 years, mean % ideal weight = 129)	8 weeks	- 9.2 lbs
Miller et al. (1997)	meta-analysis of 493 weight loss studies (1972-1997) with 3 groups: diet only exercise only diet plus exercise	Average participant: (mean age = 39 years old, mean BMI = 33)	 15 weeks 15 weeks 15 weeks	 - 23.5 lbs - 6.4 lbs - 24.2 lbs

Study	Intervention	Subjects	Duration	Weight loss
Racette et al. (1995)	2 groups: reducing diet and exercise reducing diet, no exercise Diets were individually prescribed to provide 75% subjects' basal metabolic rate.	30 women (21 – 47 years old, mean age = 39 years 140 – 180% ideal body weight) mean BMI = 34 kg/m^2)	 12 weeks 12 weeks	 - 23.8 lbs - 17.8 lbs
Schlundt et al. (1992)	2 groups: breakfast treatment group no-breakfast group Both groups received 1200 kcal/day and group classes covering behavioral techniques. The breakfast group received 3 meals/day while the no-breakfast group ate 2 meals/day.	52 women (18 – 55 years old, 130 – 160% ideal body weight, mean BMI = 30 kg/m^2)	 12 weeks 12 weeks	 - 18.3 lbs - 13.4 lbs
Sikand et al. (1988)	2 groups: very-low calorie diet (VLCD) VLCD + exercise The VLCD consisted of a milk-based protein powder. Both groups received nutritional counseling and attended group classes on behavioral techniques.	30 women (mean age = 38 years, mean % of ideal weight = 184)	 4 months 4 months	 - 38.5 lbs - 48 lbs

Study	Intervention	Subjects	Duration	Weight loss
Skender et al. (1996)	3 groups:	61 women and 66 men		
	energy-restricted diet	(25 – 45 years old,	1 year	- 15 lbs
	exercise-only group	(at least 14 kg overweight)	1 year	- 6.4 lbs
	diet and exercise group		1 year	- 20 lbs
	All groups learned behavioral modification techniques. Participants followed the Help Your Heart Eating Plan, which is a low-cholesterol diet, consisting of 30% fat, 50% carbohydrate, and 20% protein.			
Summerbell et al. (1998)	3 groups:	45 men and women		
	control diet (830 kcal)	(> 17 years old,	16 weeks	- 3.8 lbs
	isoenergetic milk supplement diet	BMI > 27 kg/m^2)	16 weeks	- 20.7 lbs
	milk plus 1 designated food/day		16 weeks	- 15.4 lbs
Sweeney et al. (1993)	2 groups:	47 women		
	VLCD + exercise	(mean age = 34 years old)	6 months	- 33.2 lbs
	1300 kcal/day diet + exercise	135- 185% ideal body weight)	6 months	- 23.8 lbs
	The VLCD contained 700-800 kcal/day.			

Study	Intervention	Subjects	Duration	Weight loss
Tate et al. (2001)	2 groups: internet education internet behavior therapy Both groups attended a group weight loss session and access to internet weight loss links. Prescribed diet consisted of 1200-1500 kcal/day, with a daily fat intake of < 20%. Subjects in the behavior therapy group received weekly emails on behavioral lessons and diet record feedback, as well as access to online bulletin boards.	81 women and 10 men (18 – 60 years, mean age of 40 years, BMI of 25 –36 kg/m^2, Mean BMI = 29 kg/m^2)	 6 months 6 months	 - 3.5 lbs - 9 lbs
Torgerson et al. (1997)	2 groups: VLCD + dietary, behavioral support support alone Subjects were provided with Modifast, (Novartis nutrition) and were prescribed (456-608 kcal/day).	74 women and 39 men (37 – 58 years old, mean age = 47 years, BMI > 32 kg/m^2, Mean BMI = 40 kg/m^2)	 2 years 2 years	 - 20.2 lbs - 13.9 lbs
Wadden et al. (1992)	VLCD + behavioral classes + exercise Subjects were prescribed VLCD of 430 kcal/day (women) and 820 kcal/day (men) for 12 weeks. Diets consisted of an Optifast supplement (Sandoz Nutrition). For the remaining 14 weeks, calories were gradually increased from 1024 to 1530 kcal/day (women) and from 1229 to 1844 kcal/day (men).	407 women and 110 men (mean age = 41 years, mean BMI = 37 kg/m^2 for women, mean BMI = 39 kg/m^2 for men)	6 months	- 56 lbs

Study	Intervention	Subjects	Duration	Weight loss
Wing et al. (1997)	3 groups:	122 women and 32 men		
	diet (decreasing calories, fat intake)	Family history of diabetes	2 years	- 0.7 lb
	exercise (1500 kcal/wk activity)	(40 – 55 years,	2 years	- 4.6 lbs
	diet + exercise	mean age = 45 years,	2 years	+ 2.2 lbs
	control	mean BMI = 35 kg/m^2)	2 years	- 5.5 lbs
	Diet consisted of 800-1000 kcal/day during weeks 1-8 of the program and gradually increased to 1200-1500 kcal/day by week 16.			
Wing et al. (1996)	4 groups:	163 women		
	behavioral classes (BC)	(15-55 years,	6 months	- 17.6 lbs
	BC + meal plans + grocery lists	mean age= 41 years,	6 months	- 26.4 lbs
	BC + meal plans + food provision paid by subjects	mean BMI = 32 kg/m^2)	6 months	- 11.7 lbs
	BC + meal plans + free food provision		6 months	- 11.4 lbs

Furthermore, interventions for minorities traditionally have produced lower rates of weight loss and higher attrition than those targeting middle or upper income populations (Kanders et al. 1994). Reasons for the lack of participation by ethnically diverse, low-income women include program cost, child care responsibilities, family commitments, lack of time, inconvenient location, and work schedules (French et al. 1998).

Interventions tailored to Hispanics are shown in Table 1.2. These include a pilot weight control program for Hispanic women in low-income areas of Dallas (Domel et al. 1992a) and a family versus individual oriented intervention called Cuidando El Corazon in south Texas (Cousins et al. 1992). The pilot weight loss program by Domel was taught in Spanish by a bilingual, Hispanic dietitian. This culturally sensitive program included ethnic foods and recipes, food diaries, and behavioral modification techniques. The 11 week program resulted in a mean weight loss of 0.8 lbs/week, but the final sample size was only 20 for the experimental group; attrition was 55%. The adjusted final weight and BMI for the experimental group were significantly less than the control group. In the study by Cousins et al. (1992), subjects were divided into three groups: 1) manual-only comparison group, 2) manual plus behavioral classes (individual group), and 3) manual, classes, and family support. The manual consisted of a bilingual 'Cuidando de Corazon' cookbook with a 1200 calorie meal plan. Group 2 subjects also received the manual and attended 24 weekly classes and 6 monthly classes taught by bilingual Registered Dietitians. Group 3 subjects also received the manual and attended similar classes, but were encouraged to bring a spouse/partner to class. Weight losses were greatest for the family support group, who lost an average of 9.9 lbs after 6 months of treatment, as compared to 7.2 lbs in the individual group and 1 lb in the manual-only group.

Table 1.2: Weight loss interventions for Hispanics.

Study	Low-income	Intervention	Subjects	Duration	Weight Loss
Cousins et al. (1992)	Yes	Cuidando el Corazon program 3 groups: printed materials behavioral classes classes and family support All groups received a prescribed diet of 1200 kcal/day with 30% of calories from fat, 20% of calories from protein, and 50% of calories as carbohydrate. Group 2 (behavioral classes attended 24 weekly classes and 6 monthly classes taught by bilingual Registered Dietitians. Group 3 (classes/family support) attended similar classes but were encouraged to bring a spouse/partner to class.	168 Hispanic women (18 – 45 years old, mean age = 33 years, 120 – 200% ideal body weight)	 6 months 6 months 6 months	 - 1 lb - 7.2 lbs - 9.9 lbs
Domel et al. (1992a)	Yes	Pilot weight control program for Hispanic women 2 groups: treatment group control group This culturally-sensitive program included ethnic foods and recipes, Spanish translations, food diaries, and behavioral techniques in the class.	20 Hispanic women (21 – 70 years old, mean age = 41 years, BMI of 28 – 42 kg/m^2 mean BMI = 34 kg/m^2)	 11 weeks 11 weeks	 - 8.7 lbs + .8 lb

Interventions targeting African-Americans include: 1) the Pathways weight loss program for inner-city black women with type 2 diabetes (McNabb et al. 1993); 2) the nationwide Black American Lifestyle Intervention (BALI) (Kanders et al. 1994); and 3) a pilot weight control program offered in low-income areas of Dallas (Domel et al. 1992b); and 4) a church-based weight loss program called Lose Weight and Win in Baltimore (Kuminyika and Charleston 1992) (Table 1.3). The Pathways intervention consisted of 18 weekly small group sessions and a low-literacy curriculum with the following topics: dietary fat reduction, goal-setting, reading food labels, exercise, and behavior change. This intervention produced an average weight loss of 9.8 lbs at 18 weeks (McNabb et al.1993). At a 1 year follow-up, mean BMI remained significantly lower than at baseline (33.9) ($p < 0.05$), as compared to the controls (35.6) who gained an average of 3 lbs. The attrition rate was 77% and the sample size was ten for each of the treatment and control groups.

In the BALI program, participants attended ten weekly weight loss sessions. The prescribed diet consisted of a 1200 kcal/day plan, in which two meals consisted of meal replacement shakes. The cultural sensitivity of the program was enhanced with ethnic recipes and leadership by an African-American nutritionist. Participants lost an average of 6.5 lbs in 10 weeks ($p = 0.001$) (Kanders et al.1994). Insulin levels decreased 20% from baseline ($p = 0.056$) while glucose levels decreased only nominally ($p = 0.07$). Retention was excellent, with 61 of the 67 women finishing the program. The low attrition rate of the BALI program may be explained by the higher income level of participants and the culturally sensitive curriculum.

Domel et al. (1992a) conducted a pilot weight control program for black women that produced mean weight losses of 3.1 lbs over 14 weeks. This low-literacy program

Table 1.3: Weight loss interventions for African-Americans.

Study	Low-income	Intervention	Subjects	Duration	Weight Loss
Ard et al. (2000)	No	Rice Diet - Duke U. (1000 kcal/day) The Rice Diet was modified for African-Americans by decreasing cost, providing culturally-sensitive recipes, and enhancing social support.	56 African-American men and women (mean BMI = 37 kg/m^2)	2 months	- 14.8 lbs
Domel et al. (1992b)	Yes	Weight control program for black women 2 groups: treatment group control group This low-literacy program covered the Basic Food Groups, food/exercise diaries, and behavioral techniques.	31 African-American women (19 – 73 years old, mean age = 37 years, BMI of 27 – 51 kg/m^2, mean BMI = 35 kg/m^2)	 11 weeks 11 weeks	 - 3.1 lbs - .3 lb
Kanders et al. (1994)	No	Black American Lifestyle Intervention (BALI) Program included a diet (1200 kcal/day with meal replacement shakes, exercise, and behavioral change).	61 African-American women (40 – 64 years old, mean age = 49 years, BMI of 30 – 40 kg/m^2, mean BMI = 34 kg/m^2)	10 weeks	- 6.5 lbs

Study	Low-income	Intervention	Subjects	Duration	Weight Loss
Kaul and Nidiry (1999)	Yes	behavioral classes	14 African-American women, 2 African-American men	7 weeks	- 14 lbs
Kuminyika and Charleston (1992)	Yes	Lose Weight and Win, church-based classes	184 African-American women, 3 white women (18 – 81 years old, mean age = 51 years, 110 – 200% ideal body weight)	8 weeks	- 6 lbs
Mayer-Davis et al. (2001)	Yes	Bariatrics Clinic, Howard University Group classes included nutrition education, exercise, and behavior modification with a low-literacy curriculum.	24 men and women with type 2 diabetes (96% African-American)	8 weeks	- 2.6 lbs
McNabb et al. (1993)	Yes	PATHWAYS program Small group classes covered healthful eating, exercise, and behavior change with a low-literacy curriculum.	13 African-American women, with type 2 Diabetes (41-66 years old, mean age = 57 years, > 120% ideal body weight, mean % ideal body weight = 175%)	18 weeks	- 9.8 lbs

covered the Basic Food Groups, food/exercise diaries, and behavioral techniques. Attrition averaged 27.9%, for a final count of 31 women in the treatment group and 14 in the control group. Weight loss was positively associated with food/exercise diary completion and attendance ($p < 0.05$). A Lose Weight and Win intervention (Kuminyika and Charleston 1992) was offered by the Baltimore Church High Blood Pressure Program. This intervention consisted of eight weekly sessions incorporating nutrition education, low-impact aerobics, behavioral modification, and financial incentives for the greatest weight losses. Participants had mean weight losses of 6 lbs for both those who were, and were not, taking anti-hypertensive medicine. At 6 months, 74 of the 187 subjects participated in a follow-up; 65% of these maintained their weight loss.

The incorporation of culturally sensitive curriculums may enhance the success of weight loss programs for minorities. Kaul and Nidiry (1999) and Ard et al. (2000) produced weight loss averages of 14 lbs (7 weeks) and 14.8 lbs (10 weeks) in interventions designed for African-Americans. These curriculums were modified to incorporate ethnic foods, low-cost foods, family support, food preferences, and low-literacy levels of the participants. Less success was observed for the Pounds Off Empowerment Program (POWER), an intervention targeting African-Americans with diabetes (Mayer-Davis et al. 2001). These subjects received an 8-week, culturally-sensitive intervention promoting a diet reduced in fat and calories, and an increase in physical activity. The average weight loss of 2.6 lbs for this intervention was dramatically lower than the weight losses obtained by Ard et al. and Kaul and Nidiry. The inclusion of a co-morbidity (diabetes) in the subject qualifications may partly explain the marginal results.

STRATEGIES OF WEIGHT LOSS INTERVENTIONS

Certainly, there is a need for effective obesity interventions for low-income women. The first aim of this research is to develop, implement, and evaluate a dietary and physical activity behavioral program tailored to overweight/obese, low-income women.

Hypothesis: A significant reduction in weight and % body fat will occur in subjects following a dietary and physical activity intervention program tailored to overweight/obese, low-income women.

Successful treatment approaches in weight loss interventions are summarized in Tables 1.1-1.3. These include the use of structured meal plans (Wing et al. 1996, Schlundt et al. 1992), meal replacements (Grodstein et al. 1996, Ditschuneit et al. 1999, Summerbell et al. 1998), a commercial diet plan (Heshka et al. 2000), high protein (Samaha et al. 2003) and very-low-calorie diets (Sikand et al. 1988, Wadden et al. 1992, Torgerson et al. 1997), monetary incentives (Jeffrey et al. 1993), community involvement (Lasater et al. 1991, Del Prete et al. 1993), behavior modification (Adams et al. 1983, Lavery et al. 1989, Wing et al. 1996, Hellerstedt and Jeffrey 1997, Tate et al. 2001), culturally sensitive curriculums (McNabb et al. 1993, Kaul and Nidiry 1999, Ard et al. 2000, Mayer-Davis et al. 2001), and physical activity (Miller et al. 1997, Hill et al. 1989, Perri et al. 1986, Sikand et al. 1998).

The provision of structured eating for subjects via meal plans, supplements, and grocery lists shows promise for aiding weight loss. In a 6-month study by Wing et al. (1996), subjects receiving behavioral classes, meal plans, and grocery lists lost more weight (26.4 lbs) than those attending behavioral classes alone. Grodstein et al. (1996) reported an average weight loss of 48.4 lbs for subjects participating in a 26 week Optifast supplement diet. In addition, a comparison of weight losses in the structured

Weight Watchers program with self-help revealed greater losses with Weight Watchers (10.6 lbs vs. 3.1 lbs over 26 weeks) (Heska et al. 2000). The success of the Weight Watchers program may be attributed to its incorporation of food plans, activity plans, social support, and role modeling by program graduates.

The macronutrient distribution of the diet may impact weight loss results. Several studies have found that protein promotes satiety more so than carbohydrate (Hill and Blundell 1990, Hill and Blundell 1986, Barkeling et al. 1990). Hill and Blundell (1990) reported that a high protein meal (31% of calories from protein) led to increased satiety as compared to an isocaloric, high carbohydrate meal (52% calories from carbohydrate). In their earlier study, Hill and Blundell (1986) also found that both normal weight and obese subjects decreased their intakes on a high protein meal (54% of calories as protein) by 22 and 19%, respectively as compared to a high carbohydrate meal (63% of calories as carbohydrate) with the same energy content. Barkeling et al. (1990) compared the effects of a high-protein (43% of calories from protein) with an isocaloric, high carbohydrate meal (69% of calories from carbohydrate) in 20 normal weight women. The subjects consumed 12% less ($p < 0.05$) of an *ad libitum* high protein evening meal, than a high carbohydrate meal. In contrast, high carbohydrate diets have been associated with increases in the levels of triglycerides (Mittendorfer and Sidossis 2001, Skov et al. 1999) and blood sugar (Clapp 1998) and increased odds of a heart attack for women who are overweight (Willett 2001). Thus, the higher protein diet may have beneficial health effects, as well as promote satiety and weight loss.

Another strategy to enhance weight loss is the use of very-low-calorie diets (VLCD). These diets consist of 400-800 kcal/day and promote rapid weight loss. For example, Wadden et al. (1992) reported an average weight loss of 56 lbs. over 6 months.

However, subjects treated with these diets require medical supervision and long-term treatment to minimize weight regain (Wadden et al. 1993).

The use of financial incentives also may increase motivation for weight loss. The Invest in Your Health Weight Loss Correspondence Program (Jeffrey et al. 1993) was provided in two forms to 1304 participants. One was a $60 deposit plan, in which the deposit was refunded after successful weight loss. The other form was a $5 fee-for-service version. Both forms included self-help weight loss materials and newsletters. Subjects in the $60 deposit group lost more weight (8.8 lbs) than the $5 fee-for-service form (4.4 lbs). In addition, The Pawtucket Heart Health Program (PHHP) promoted the use of monetary pledges for the attainment of weight loss goals and held a monthly city-wide weigh-in (Lasater et al. 1991). Mean weight losses of 8.2 lbs were achieved for 129 individuals in 10 weeks. Both of these innovative programs demonstrate the potential of community-based programs for reaching large numbers of obese persons.

Behavior modification is the second major component for improving adherence to a weight loss program. Techniques used in these behavioral programs include: self-monitoring with food diaries (Adams et al. 1983, Hellerstedt and Jeffrey, 1997), stimulus control to identify environmental cues associated with unhealthful eating and lack of exercising (Hellerstedt and Jeffrey 1997), social support with the group class format (Adams et al. 1983, Lavery et al. 1989) and the use of rewards for appropriate behavior changes (Tate et al. 2001). Adams conducted small group classes that covered diet, food record evaluations, and behavioral techniques for 108 women and 17 men. Average weight loss for the 12-week intervention was 11.1 lbs. Food records also were used in a telephone-assisted intervention for 60 women and four men (Hellerstedt and Jeffrey 1997). This intervention consisted of two groups: a minimal contact group and a telephone assisted weight loss group. Both groups attended two group classes covering diet, exercise, menu plans, and behavioral techniques (stimulus control, use of rewards, self-monitoring). The minimal contact group received no further contact, while the telephone group received weekly calls to monitor food intake and exercise. Surprisingly, the minimal contact group lost more weight (12.7 lbs) than the telephone assisted group (7.9 lbs) during the 24 week intervention. However, both groups did receive the same exposure to behavioral techniques at the outset of the program.

The provision of social support via group classes is another way to enhance weight loss. Lavery et al. (1989) conducted a study providing group classes for 386 women and 123 men over 8 weeks. The classes covered diet, exercise, and behavioral techniques. The average weight loss produced was 9.2 lbs. A novel approach to weight loss using the internet was undertaken by Tate et al. (2001). This 6-month intervention compared the effectiveness of internet education and internet behavior therapy for weight loss with 91 female and 10 male subjects. Both attended a group weight loss session and had access to internet weight loss links. The prescribed diet for both groups was 1200 - 1500 kcal/day, with fat < 20%. In addition, subjects in the behavior therapy group received weekly emails on behavioral lessons (including social support, rewards), diet record feedback, and access to online bulletin boards. The importance of the weekly behavioral feedback to the intervention was observed with higher weight losses for the internet behavior group (9 lbs) than the internet education group (3.5 lbs).

Finally, other studies have shown that ethnic groups differ in their attitudes toward weight loss. Compared to Caucasians, African-American women are less likely to diet, started dieting later on in life, and experience less social pressure about their weight (Striegel-Moore et al. 1996). The proposed research will evaluate the impact of the intervention on nutrition attitudes and self-efficacy by pre- and post-tests. Also, it is believed that psychosocial factors will differ between overweight and non-overweight subjects, and that these differences will diminish following the program.

PROMOTION OF PHYSICAL ACTIVITY

The second aim is to evaluate the effectiveness of an intervention for increasing physical activity levels in overweight/obese, low-income women.

Physical activity is a key component of the intervention in the proposed study. A meta-analysis of 493 weight reduction studies in adults (Miller et al. 1997), as well as numerous other interventions (Hill et al. 1989, Perri et al. 1986, Sikand et al. 1988, Skender et al. 1996), have found that combined diet and exercise interventions produced greater weight losses than dietary modification alone. For example, diet-only groups maintained 56% of initial weight loss at a 1 year follow-up, as compared to 77% for the diet plus exercise groups (Miller et al. 1997). Similar results for the benefits of diet plus exercise were seen in a 2 year follow-up study of 127 subjects (Skender et al. 1996). These studies provide support for increasing physical activity in weight loss interventions.

The most commonly prescribed exercises in weight loss interventions are walking (Sweeney et al. 1993, Jakicic et al. 1999, Racette et al. 1995, Folgelholm et al. 1999, Evans et al. 1999, Wing et al. 1997) and low-impact aerobics (Kumanyika and Charleston 1992, Wing et al. 1997). Moderate-intensity activities, such as walking, are more appropriate than vigorous activities, such as running, for overweight/obese persons due to the negative effect of excess adiposity on aerobic performance (Hu et al. 1999). In addition, walking is a low-cost (DiPietro 1995) and safe (Colbert et al. 2000) form of exercise. The amount of exercise prescribed in interventions varies as follows: 90

minutes/week (Kumanyika and Charleston 1992), 135 minutes/week (Racette et al. 1995), 150 - 200 minutes/week (Jakicic et al. 1999), 4-6 hours/week (Fogelholm et al. 1999), 1400 kcal/week (Evans et al. 1999), and 1500 kcal/week (Wing et al. 1997). Results from these studies indicate that a minimum of 150 minutes a week of moderate-intensity activity is needed to change weight loss significantly. This amount of activity is consistent with the level of physical activity recommended by the Center for Disease Control (CDC) (Pate et al. 1995). However, there is a dose response relationship present, so that overweight person can enhance weight loss further with higher levels of exercise (Jakicic et al. 1999). Indeed, several studies indicate that the amount of exercise needed for long-term weight loss may exceed the CDC recommendations (Klem et al. 1997, Schoeller et al. 1997, Jakicic et al. 1999).

PREDICTORS OF WEIGHT LOSS

The third aim is to formulate a model of successful weight management for overweight, low-income women.

Hypothesis: A model encompassing the significant predictors of weight loss for a population of low-income women can be developed to explain part of the variance in weight loss of the intervention subjects.

Currently, there are no pre-existing models of weight management for a population of low-income, ethnically diverse women. Interpersonal skills that have been associated with weight-management in the general population include the following: body image (Wardle et al. 2001), self-efficacy (Martin et al. 2004), stress management (Pawlow et al. 2003), decisional balance (analysis of the benefits of weight loss)

(Krummel et al. 2004), stages of change for exercise (Sarkin et al. 2001) weight control (Krummel et al. 2004), and environmental factors (Senekal et al. 1999).

Other factors that may predict weight loss include high initial body weight, social support, and participation in physical activity (Thomas 1995). Clearly, there are a multitude of factors pertaining to the individual and intervention programs that influence weight loss. We will explore the relationship of these factors to successful weight loss and use the results to formulate a weight management program for overweight, low-income women.

CONCEPTS OF BEHAVIORAL CHANGE

The design of a weight loss intervention should be guided by health education theories. The social learning theory (Bandura 1969, 1977) and the stages of change model (Greene et al. 1994) are two distinct, yet related, theories for understanding the dynamic process of weight loss in interventions. Bandura (1969) is credited for developing the first comprehensive model of the social learning theory. This theory states that the environment is a key regulator of human behavior. Intermediate variables or "cognitive processes" act as mediating factors between the environment and behavior. Examples of these cognitive processes include self efficacy and decisional balance. Self-efficacy is the confidence an individual has that they can perform a given activity (Clark et al. 1991) while decisional balance is the comparison of the positive and negative aspects of a decision (O'Connell and Velicer 1988).

The stages of change model by Prochaska et al. (1992) compliments the social learning theory by emphasizing that intentional behavior change is created via a series of stages. This model originally focused on the behavior of smoking cessation (Prochaska et al. 1988), but was expanded to promote behavior change in the following areas: exercise

(Marcus et al. 1992), low-fat diet (Finckenor and Byrd-Bredbenner 2000), weight control (Rossi et al. 1995), alcohol and drug abuse (Sutton 2001), sexually transmitted diseases (Grimley et al. 1993), and prevention of cancer (Ruggiero 1998). The model by Prochaska includes the stages of change, processes of change, and the outcome measures of decisional balance and self-efficacy. The stages of change are as follows: pre-contemplation, contemplation, action, and maintenance. In the pre-contemplative stage, people are not yet ready to change their behavior while in the contemplative stage, change is intended within the next 6 months. At the action stage, people have made specific behavior changes within the past 6 months. The final stage of maintenance is attained when people have maintained the behavior for the past 6 months.

To progress through these stages, the processes of change are utilized (Velicer et al. 1998). These processes are as follows: consciousness raising (increasing awareness), dramatic relief (emotional arousal), environment reevaluation (social reappraisal), social liberation (environmental opportunities), self-reevaluation (self reappraisal), stimulus control (re-engineering), helping relationship (supporting), counter conditioning (substituting), reinforcement management (rewarding), and self liberation (committing). Effective usage of the processes of change then promotes behavior change. Outcome measures of the theory include the desired result (such as weight loss or smoking cessation), as well as enhanced self-efficacy and decisional balance. The intermediate variables of the social learning theory that will be assessed in this research include self-efficacy and decisional balance. Therefore, this study will evaluate the role of self-efficacy and decisional balance in successful adherence to weight loss. Overall, the impact of the proposed intervention can be determined by assessing whether subjects progressed in their motivational readiness for exercise, enhanced their efficacy, and scored higher on the decisional balance scale.

The role of the Social Cognitive Theory variables (decisional balance and self-efficacy) and the stages of change theory in the intervention is demonstrated in Figure 1.1 (Proposed Intervention Model) and Figure 1.2 (Proposed Outcomes of the Intervention). In the intervention model, decisional balance and self-efficacy act as potential predictors of weight loss. The stages of change model is included in the proposed intervention outcomes as a psychosocial measure: intent to exercise (Figure 1.2).

SUMMARY

The proposed outcomes for this intervention include anthropometrics, dietary measures, physical activity measures, and psychosocial measures. The subjects are expected to increase their intent to exercise, raise their 'pros' versus 'cons' of exercising (decisional balance), and enhance their confidence that they will be able to resist eating in tempting situations. This intervention will include those behavioral components that have been found to be effective in those individuals who have been able to maintain their weight for an extended period of time as reported by the National Weight Control Registry Study (Klem et al.1997).

The following chapters present data on the overall intervention (study 1, chapter 2), physical activity outcomes (study 2, chapter 3), and predictors of weight loss (study 3, chapter 4). For study 1, an 8-week dietary and physical activity program was tested in a sample of overweight (BMI $\geq$ 25), low-income mothers (n=114). Subjects with similar eligibility criteria (n=33) provided comparison data. In study 2, the participants (n=93) were derived from the original sample in study 1. These subjects were compared to a group of mothers (n=31) with a healthy weight (BMI < 25). Finally, study 3 provides data based on the original sample (n=114).

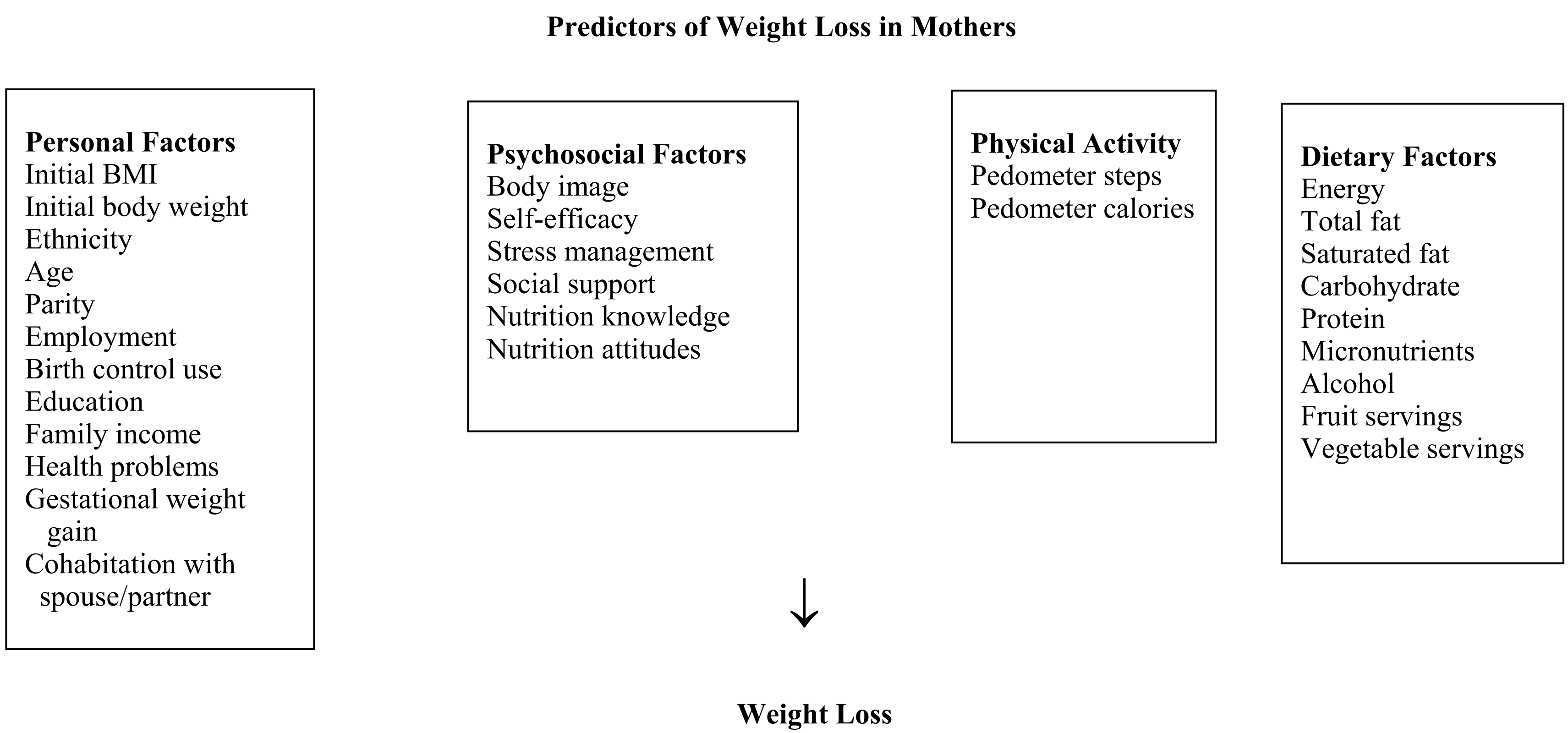

Figure 1.1: Proposed intervention model.

Anthropometrics
↓ Body Mass Index
↓ % body fat
↓ Waist circumference
↓ Weight

Dietary Measures
↑ % energy from protein
↓ Energy
↓ % energy from total fat
↓ % energy from saturated fat
↑ Fruit servings
↑ Vegetable servings

Physical Activity Measures
↑ Pedometer steps
↑ Calories expended via pedometer

Psychosocial Measures
↑ Social support
↑ Decisional balance
↑ Weight self-efficacy
↑ Exercise self-efficacy
↑ Body image
↑ Intent to exercise
↑ Nutrition knowledge
↓ Depression
↓ Stress

Figure 1.2: Proposed outcomes of the intervention.

Chapter 2: The Influence of Nutrition Attitudes on the Dietary Intakes of Low-Income Mothers in a Weight Loss Program

ABSTRACT

Objective: This study evaluated a program for enhancing nutrition attitudes and promoting weight loss in mothers of young children.

Design: An 8-week dietary and physical activity program was tested. Anthropometrics, dietary intake, and nutrition attitudes were measured at weeks 0 and 8. Overweight mothers provided comparison data.

Subjects/setting: A sample of 114 intervention mothers and 33 comparison mothers were recruited from public health clinics, community centers, and churches. Eligibility criteria included Hispanic, African-American, or Caucasian ethnicity; (BMI $\geq$ 25 kg/m^2); low-income (< 200% of the federal poverty index); and youngest child aged 1-4 years.

Statistics: Baseline differences in anthropometrics and demographics between groups were tested using the Chi-square and independent samples t-tests. Changes in anthropometrics, nutrients, and attitudes were evaluated with the paired samples t-test. Differences in attitude scores between weight loss responders ($\geq$ 5 lbs) and non-responders (< 5 lbs) were assessed with analysis of covariance, adjusting for pre-test score. Relationships between variables were tested with Pearson and Spearman correlation coefficients.

Results: Intervention participants lost weight, consumed fewer calories, and demonstrated improvements in nutrition attitudes. Weight loss responders had healthier eating attitudes and fewer perceived barriers than non-responders at week 8. Increases in dairy consumption were associated with decreased barriers to healthy eating (-0.22).

Conclusion: This dietary and physical activity curriculum is a valuable resource for public health clinics and weight management programs serving low-income women.

INTRODUCTION

The United States is facing an unprecedented epidemic of obesity. Approximately 22.9% of Americans were considered obese, as defined by a body mass index (BMI) of 30 kg/m^2 in 1988-1994 (NHANES); this increased to 30.4 % in 1999-2002 (Hedley et al. 2004). The percentage of overweight adults (BMI $\geq$ 25) in the U.S. has paralleled this trend, rising from 55.9% to 65.1%. Overall, the prevalence of obesity is higher among women (Hedley et al. 2004), minorities (Cossrow and Falkner 2004), and persons of lower socioeconomic status (Zang and Wang 2004). Among racial groups, African-American and Hispanic women incur higher rates of obesity (49.0% and 38.4%, respectively), than Caucasians (30.7 %) (Hedley et al. 2004). The concern with obesity is the increased risk for a variety of chronic diseases, including, diabetes mellitus, stroke, cancer, hypertension, sleep apnea, and cardiovascular disease (Visscher and Seidell 2001).

The majority of weight loss interventions have studied middle to upper income, white women (Cogan and Rothblum 1992), but it is low-income women who are the majority group giving birth in the U.S. (Braveman et al. 1999). In addition, minorities may face lower rates of weight loss. For example, African-American women, as compared to Caucasians, are less likely to participate in a weight loss program, have lower rates of weight loss in these programs, and are more likely to drop out (Kanders et al. 1994). Participation by low-income and minority women is problematic due to barriers such as program cost, lack of childcare, and family responsibilities (French et al. 1998).

Strategies for promoting weight loss in minorities have included low-literacy materials (Kaul and Nidiry 1999, McNabb et al. 1993), meal replacement shakes (Kanders et al. 1994), culturally sensitive curriculums (Ard et al. 2000, Domel et al.

1992b), church-based classes (Kuminyika and Charleston 1992), improvements in nutrition knowledge (Domel et al. 1992b, Agurs-Collins et al. 1997), behavior modification (Kanders et al. 1994, McNabb et al. 1993), and aerobic exercise (Mayer-Davis et al. 2001). Components of behavior modification include self-monitoring with food diaries (Domel et al. 1992b), social support (Ard et al. 2000), the use of rewards (Kuminyika and Charleston 1992), and self-efficacy training (Pinto et al. 1999).

Nutrition attitudes may play a more important role in determining food behavior than knowledge. According to a meta-analysis of the literature by Axelson et al. (1985), there is a weak correlation between nutrition knowledge and dietary behavior (r=0.10). Other factors, such as perceived barriers, emotional eating, taste preferences, cultural norms, and behavioral capability, act at the intrapersonal level to influence food choices (Story et al. 2002). However, few studies have measured the impact of weight loss interventions on nutrition attitudes in low-income populations. Fitzgibbon et al. (1995) conducted an obesity intervention with 24 African-American mothers and daughters. The 6-week curriculum covered the following topics: health consequences of obesity, fast food, fat content of foods, and nutrition labels. While participants increased their nutrition knowledge by the end of the program, their nutrition attitudes did not improve. Other interventions have evaluated the changes in attitudes in the areas of dietary fat reduction, cancer prevention, and fruit and vegetable consumption (Albright et al. 1997, Cox et al. 1996, Harnack et al. 1997, Havas et al. 1997, Howard-Pitney et al. 1997, Treiman et al.1996).

Clearly, interventions targeted towards low-income women are needed to combat the rising prevalence of obesity and diabetes in the U.S. According to the Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity (2001), the development of culturally appropriate interventions to treat obesity is a high priority area for the U.S. public health system. Thus, the overall purpose of this research is to test and evaluate a culturally-sensitive curriculum to improve the dietary quality and physical activity levels of mothers in order to reduce the prevalence of obesity in low-income populations. In addition, our study aims to evaluate the impact of the program on the nutrition attitudes of low-income mothers.

METHODS

Experimental Design

The intervention was designed to provide pre- and post-measurements for a convenience sample of overweight (BMI $\geq$ 25) mothers of young children. In intervention subjects, BMI, % body fat, waist circumference, demographics, dietary, and attitudes measures were obtained at weeks 0 and 8; anthropometrics were reassessed at week 24. Participants were divided into responders ($\geq$ 5 lbs) or non-responders (< 5 lbs) based on the amount of weight loss (Domel et al. 1992b). Another group of mothers with a similar BMI ($\geq$ 25) provided comparison data at weeks 0 and 8. All subjects gave informed consent prior to participation in the study and the Institutional Review Board at the University of Texas approved the research protocol.

Subjects

Mothers of young children were recruited from Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) clinics, community centers, and churches to participate in free weight loss classes or serve as comparison subjects. Eligibility criteria for both groups included: African-American, Caucasian, or Hispanic ethnicity; youngest child of 1- 4 years; BMI $\geq$ 25; low-income (qualification for WIC or food stamps or annual household income less than < 200% of the federal poverty index; and absence of significant breastfeeding (< 5 minutes/day). The final intervention sample size was 114 out of 260 who came to the first class, for an attrition rate of 56%. For mothers who completed the 8-week program, the class attendance rate was 87%. Dropouts did not differ from intervention subjects on baseline characteristics except that they were less likely to be living with a spouse/partner (61% vs. 81%, $p < 0.05$) and employed (60% vs. 74%, $p < 0.01$). In addition, 33 comparison mothers completed the study.

Intervention classes

Each 2-hour class incorporated recommendations for healthful eating, behavior modification, and physical activity that were based on focus group discussions (Table 2.1). The dietary recommendations were based on the U.S. Dietary Guidelines that were designed to encourage healthful eating habits and regular physical activity (US Departments of Agriculture and Health and Human Services 2000, Johnson and Kennedy 2000). The healthy eating component consisted of menu plans, culturally appropriate foods, portion control, food budget guidelines, fast food, and the fat content of foods. Prescribed energy intakes ranged from 1200-1500 kilocalories/day. Energy calculations for weight loss were obtained by subtracting 500 kilocalories from the Harris-Benedict equations using adjusted body weight (Frankenfield et al. 2003).

Behavioral aspects of weight management that were presented included social support, stimulus control, contingency management, and stress management (Thomas 1995). The third part of the curriculum, physical activity, consisted of 30 minute in-class exercise sessions and class discussions as detailed by Clarke, et al. (in submission). In addition, these recommendations for diet, physical activity, and behavior modification were tailored to each participant by providing feedback on diet recalls, pedometer records, and behavior modification worksheets.

Table 2.1: Curriculum of the intervention classes.

Week	Content	Learning Objective	Social Cognitive Theory Constructs
1	**Eat It! Your personal healthy eating plan and goal setting** Share weight loss success stories; learn portion sizes; plan menus with healthful food choices; discuss reasonable weight loss, diet, and exercise goals	(1) List health benefits of moderate weight loss (2) Monitor portion sizes to allow for weight loss (3) Plan daily menus using the Healthy Food Choices handout (4) Self monitor through pedometers	*Outcome expectations:* anticipatory outcome of a behavior Raise awareness of the benefits of weight loss and healthful eating
2	**Cut the calories! Take the fast food quiz challenge** Select lower-calorie restaurant items; learn fast food calorie facts; describe benefits of exercise; enlist social support for exercise; take in class 24 hour diet recalls	(1) Raise awareness of calorie content of foods (2) Learn personal caloric intake (3) List benefits/barriers of regular exercise (4) Identify a source of social support	*Outcome expectancies:* incentives and rewards for goals Provide prizes for attainment of weight loss and exercise goals
3	**Cut the fat! Read food labels for fat content** Show examples of and interpret food labels; learn the Dietary Guidelines; identify personal barriers to weight loss; incorporate strength training into an exercise plan	(1) Identify/discuss high fat foods (2) Interpret food labels for fat content (3) Apply Dietary Guidelines to own diet (4) Demonstrate strength building exercises	*Self-efficacy:* confidence to perform a particular behavior Practice reading nutrition labels in order to select healthful foods
4	**Cook It! Prepare low-fat dishes and modified recipes** Learn to modify recipes; cook a stir-fry dish; prepare quick meals; discover low-fat recipes; tips for eating out; discover heart healthy Mexican food	(1) List cooking techniques that are lower in calories (2) Identify methods of modifying recipes (3) Modify a favorite recipe to decrease calories (4) Know how to eat healthy when short on time	*Behavioral capability:* the knowledge and skills to perform a behavior Participate in cooking demonstrations to develop meal preparation skills
5	**Be a role model! Provide a healthy start for your child** Learn basics of child nutrition; plan child menus with Food Guide Pyramid; identify child portion sizes & nutrient rich-foods; discuss child physical activity needs	(1) Prepare child menus using Pyramid (2) Identify appropriate portion sizes/snacks (3) List iron/zinc-rich foods (4) Describe age-appropriate physical activities	*Role modeling:* observational learning Set a good example for children by demonstrating healthful eating and exercise habits
6	**Change It! Get rid of those bad habits** Select non-food rewards; identify bad habits; self-monitor diet and exercise; discuss environmental cues associated with unhealthful eating; manage emotional eating	(1) Identify a non-food reward for attaining goals (2) List benefits of self-monitoring (3) Identify behaviors that promote overeating (4) Propose solutions to overcoming bad eating habits	*Self-control:* regulation of problem behaviors Evaluate diet recalls and pedometer worksheets to pinpoint problem areas
7	**Don't sweat the small stuff! Learn to manage stress** Identify stressors that trigger eating, learn to reduce stress; control binge eating; identify social support for weight loss	(1) Identify sources of stress that trigger eating (2) Describe ways to reduce stress (3) List nutrients that may alleviate stress (4) Explain how to stop a food binge before it starts	*Emotional coping responses:* provision of strategies for addressing emotional stimuli Use stress management techniques to control emotional eating
8	**Eat to live! Maintain weight loss with proven strategies** Plan for special events; improve body image; identify strategies for lifelong weight management; learn motivational tips based on stage of weight loss	(1) State ways to help improve body image (2) Plan a diet around special events (3) Select current stage of weight loss (4) Describe techniques to help maintain weight loss	*Social support:* encouragement and help from others Impart advice and motivation through small group classes and staff phone calls

The curriculum was based on the Social Cognitive Theory by Bandera (1986). This theory proposes that dynamic and reciprocal interactions between cognitions, behaviors, and the environment determine the actions of individuals. Specifically, the intervention promoted a healthier environment (increased availability of healthful foods and support for regular physical activity) by affecting mothers' cognitions and behaviors. Mothers' cognitions were altered by setting weight loss goals and increasing knowledge of the caloric content of foods, nutrition label guidelines, meal planning, and recipe modification. Behavioral changes included increased self-efficacy for healthful eating and exercise, enhanced social support by other mothers, increased self-control to manage problem eating and exercise behaviors, and role modeling for observational learning. Different constructs of the theory were addressed in each class. For example, the opening class strived to raise awareness of the benefits of weight loss and healthful eating (outcome expectations), the cooking demonstration class aimed to enhance the knowledge and skills for meal preparation (behavioral capability), and the stress management class focused on the strategies to control binge eating (emotional coping responses).

Measures

Anthropometric variables

Weight was measured with an electronic weighing scale (Model HS-100-A, Fairbanks Scales, St. Johnsbury, VT) and height was determined with a stadiometer (Perspective Enterprises, Portage, MI). Percent body fat was assessed via bioimpedance with a body composition analyzer (Model TBF-300A, Tanita Corporation, Arlington

Heights, IL). Waist circumference was obtained by positioning a measuring tape around the abdomen at the highest lateral border of the right iliac crest, as recommended by NHANES III (National Heart, Lung, and Blood Institute 1998).

Dietary Assessment

Mothers reported a 24-hour diet recall and 2 days of food records at weeks 0 and 8 and a 24-hour recall weekly during each class. The weekly 24-hour recalls were conducted for self-monitoring to provide feedback on dietary intakes. Subjects were provided with oral and written instructions by registered dietitians who used measuring spoons and cups for portion size estimation. Nutrient data were analyzed via Food Processor 7.81 (2001, ESHA Research, Salem, OR).

Nutrient values were adjusted with the Software for Intake Distribution Estimation (Side, version 1.0, 2002, Ames, IA) prior to comparison with recommended intakes. This software corrected for the variability in daily consumption and produced adjusted estimates of usual intake distributions. Mean dietary intakes were compared to the following: Dietary Reference Intake (DRI) (Institute of Medicine 2002) standards of Estimated Average Requirements (EARs) (protein, carbohydrate), Acceptable Macronutrient Distribution Ranges (AMDRs) (percentage of energy from protein, carbohydrate, and fat), and Adequate Intakes (AI) (dietary fiber); National Cholesterol Education Program (NCEP) (National Heart, Lung, and Blood Institute 2002) guidelines (cholesterol and the percentage of energy from fat, saturated fat, monounsaturated fat, and polyunsaturated fat), and Food Guide Pyramid (US Department of Agriculture 1992) servings.

Psychosocial and demographic variables

The Nutrition Attitudes Scale consisted of 21 items with four subscales: sensory motivators, emotional eating, perceived barriers, and healthy eating (Hanss-Nuss et al. 2002). The sensory subscale encompassed taste, hunger, and cravings as motivators for eating. Emotional eating was assessed for states of depression, stress/anxiety, and anger. Perceived barriers included dislike of low-fat foods, family preferences, confusion regarding nutrition guidelines, too much effort, employment, and lack of interest in changing habits. The healthy eating subscale incorporated items pertaining to the enjoyment and importance of nutritious foods. Items were evaluated according to a Likert scale ranging from 1=least important to 7=very important (sensory motivators, perceived barriers, healthy eating) or 1=never to 7=always (emotional eating responses). Each subscale score consisted of the average sum of items in the subscale. Higher scores represented more of the measured trait. Factor analysis was used to demonstrate validity of the subscales. Reliability of the subscales varied from fair for sensory motivators (alpha=0.65) to very good for promoters of eating healthy (alpha=0.86). In addition, demographic data was elicited with a 40-item questionnaire that also covered cultural and childbirth information.

Statistical Analyses

The Statistical Package for Social Sciences (version 11.5, 2003, SPSS Inc, Chicago, IL) software was used to analyze all data. Entered data was checked for accuracy, scanned for missing values, analyzed for the presence of outliers, and assessed for normality of distribution. Statistical significance was shown by a p value less than 0.05 (2 tailed).

Baseline differences on anthropometrics and demographics between groups (intervention and comparison, intervention and program dropouts) were tested using the Chi-square or Fisher exact test and independent samples t-tests. Changes in anthropometrics, nutrients, and attitudes for intervention subjects were evaluated with the paired samples t-test and Wilcoxon signed ranks test. Differences in attitude scores between weight loss responders and non-responders at week 8 were assessed with analysis of covariance, adjusting for pre-test score. Relationships between weight loss and continuous and categorical variables were tested with Pearson and Spearman correlation coefficients, respectively.

RESULTS

The demographic profile of subjects at baseline is shown in Table 2.2. The mean ages of the intervention and comparison mothers were 27.3 and 30.8 years, respectively. The average BMI differed little for the intervention and overweight comparison groups (35.0 and 34.4) and did not vary by ethnicity. Among intervention participants, 64% were Hispanic, 19% were African-American, and 17% were Caucasian, as compared to 49%, 39%, and 12% for comparison mothers, respectively. The majority of subjects were employed, graduated from high school, and had 1-2 children living at home. About three-quarters of the intervention subjects were living with a partner as opposed to about half of the comparison group. Most participants (98%) and comparison mothers (85%) qualified for WIC services and reported an annual household income under $29,999 (75% and 62%, respectively).

Figure 2.1 diagrams the changes in motivators for eating and nutritional attitudes for participants. At baseline, the sensory motivators were rated as greater influences on eating healthy than attitudes regarding health, emotions, and barriers. However, healthy attitudes ranked higher than sensory motivators by the end of the program. Subjects reported more favorable attitudes toward healthy eating and reduced emotional eating and perceived barriers as well. In addition, differences in attitudes were observed by responder categories (Table 2.3). Those who lost at least 5 lbs reported a greater emphasis on eating healthy and fewer perceived barriers than non-responders.

The subscale of healthy eating attitudes represented items that were not easily comparable; however, all items improved as a result of the intervention. With the subscale of emotional eating, participants associated depression and stress/anxiety more

Table 2.2: Demographic profile of subjects.

	Intervention group (n=114)		Comparison group (n=33)	
Characteristic	**n**	**%**	**n**	**%**
Age (y)				
18-24	38	33.3	10	30.3
25-29	43	37.8	3	9.1
30-39	26	22.8	15	45.4
≥40	7	6.1	5	15.2
BMI (kg/m^2)				
25.0-29.9	24	21.1	11	33.3
30.0-34.9	42	36.8	7	21.2
35.0-39.9	26	22.8	10	30.3
≥ 40	22	19.3	5	15.2
Educational level				
High school not completed	22	19.3	8	24.2
High school graduate	34	29.8	11	33.3
Partial college	42	36.8	9	27.3
College/graduate degree	16	14.0	5	15.2
Employed (%)				
Yes	92	80.7	28	84.8
No	22	19.3	5	15.2

Children in household (n)				
1-2	79	69.3	17	51.5
3-4	31	27.2	14	42.4
$\geq$ 5	4	3.5	2	6.1
Living with spouse/partner*				
Yes	84	73.7	18	54.5
No	30	26.3	15	45.5

*$P < 0.05$.

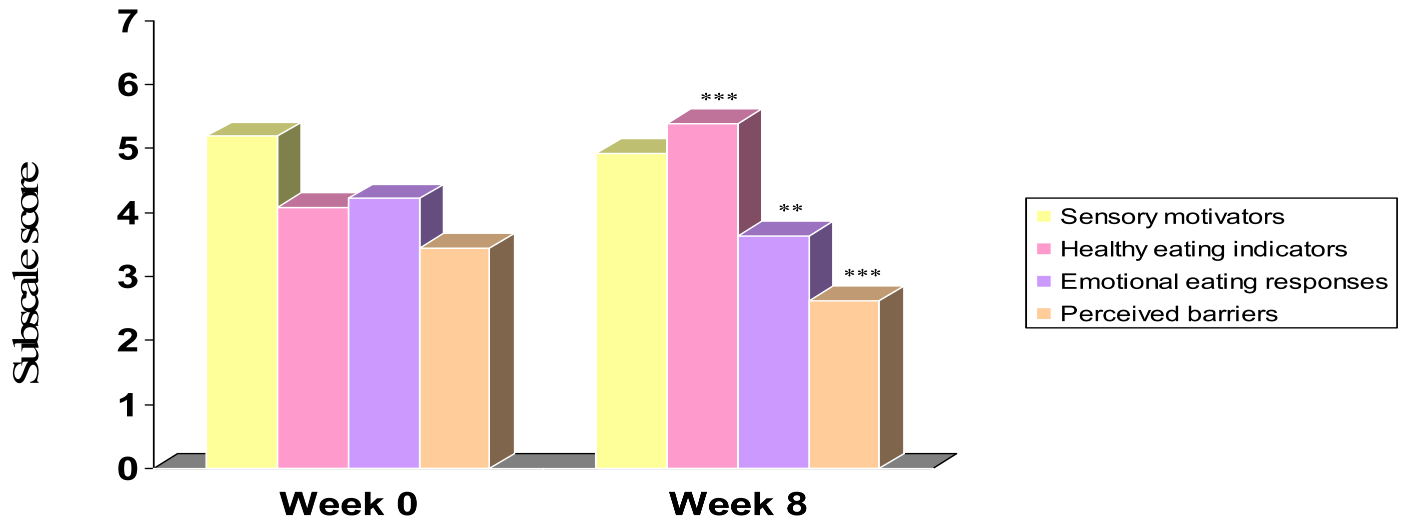

Figure 2.1: Motivations for eating and nutritional attitudes of intervention mothers at weeks 0 and 8.

***P < 0.01.*

****P < 0.001.*

Table 2.3: Attitude subscale scores at baseline and post-intervention based on response to weight loss (mean ± SD)[a].

	Week 0		Week 8	
Attitude Subscale[b]	**Responders (n=60)**	**Non-responders (n=54)**	**Responders (n=60)**	**Non-responders (n=54)**
Positive attitudes				
Healthy eating indicators[c]	4.1 ± 1.2	4.1 ± 1.0	5.6 ± 0.9**	5.2 ± 0.9**
Negative/neutral attitudes				
Perceived barriers[c]	3.4 ± 1.3	3.5 ± 1.0	2.4 ± 1.1*	2.9 ± 1.2*
Emotional eating responses[d]	4.3 ± 1.8	4.2 ± 2.0	3.6 ± 1.9	3.6 ± 1.8
Sensory motivators[c]	5.2 ± 1.5	5.2 ± 1.4	5.0 ± 1.4	4.9 ± 1.3

[a]SD=standard deviation.

[b]Hanss-Nuss et al. 2002.

[c]response options 1=not important to 7=very important.

[d]response options 1=never to 7=always.

$*P < 0.05$, $**P < 0.01$ (analysis of covariance, adjusted for week 0 score).

often with overeating (78% and 70%, respectively) than anger (59%). By post-intervention, women were less likely to eat more when depressed (63%) or angry (56%); however, overeating associated with stress exhibited little change (68%). For the third subscale, subjects initially ranked the dislike of low-fat foods (68%), confusion regarding nutrition (68%), and family preferences (58%) highest among barriers (Figure 2.2). These all decreased upon program completion.

The anthropometric changes for the intervention and comparison subjects are displayed in Table 2.4. Initially, the mean body weight, percent body fat, and waist circumference of intervention mothers was 202 lbs, 43%, and 42 in, respectively. As a result of the 8-week program, women decreased weight (x=-5.9 lbs, median=-5.4 lbs), body fat (-1.2 %) and waist circumference (-1.4 in). Ninety-eight participants lost weight (86%); one maintained the same weight (1%); 15 gained weight (13%). In contrast, the overweight comparison mothers gained a slight, but not significant, amount of weight during the same time period (x=0.3 lbs). At follow up (week 24), the declines in weight, percent body fat, and waist circumference remained significant.

The recommended intakes and changes in dietary intakes for intervention subjects are shown in Table 2.5. Women reduced their consumption of energy, protein, carbohydrate, and total fat. In terms of percentages, calories from protein increased and those from fat declined. Levels of nutrients associated with heart disease risk, such as saturated fat and cholesterol, were lower at the end of the program. However, these levels still remained above guidelines set by the National Cholesterol Education Program (NCEP) (National Heart, Lung, and Blood Institute 2002). Women reported fewer than the recommended number of servings for bread, fruits, vegetables, and milk at weeks 0

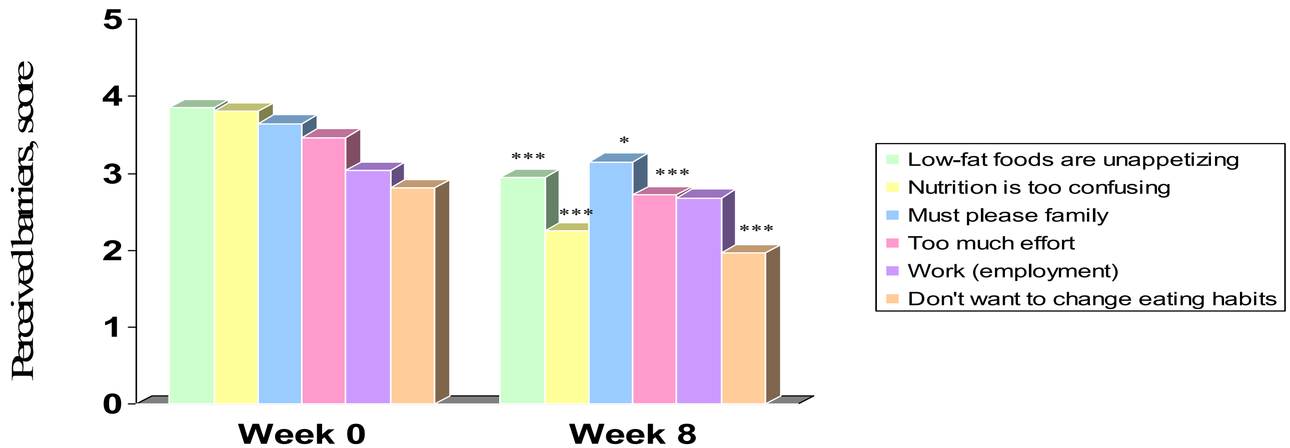

Figure 2.2: Barriers to healthy eating for intervention mothers at week 0 and week 8.

**P < 0.05.*

****P < 0.001.*

Table 2.4: Anthropometric measurements of intervention and comparison subjects (mean ± SD)[a,b]

	Intervention group (n=114)		Comparison group (n=33)	
Variable	**Week 0**	**Week 8**	**Week 0**	**Week 8**
Weight (lbs)	202.3 ± 44.2	196.4 ± 44.4***	198.9 ± 42.8	199.2 ± 43.5
Body fat (%)	43.0 ± 5.8	41.9 ± 6.2***	43.2 ± 5.3	42.9 ± 6.4
Waist circumference (in)	42.2 ± 6.9	40.8 ± 6.9***	42.1 ± 5.6	42.1 ± 5.4

[a]SD=standard deviation.

[b]Paired t-test analyses conducted separately for intervention and comparison groups.

****P < 0.001.*

Table 2.5: Recommended and reported dietary intakes for intervention subjects (mean ± SD)[a].

Dietary factor	**Recommended intakes[b,c,d,e,f]**	**Intervention group (n=114)**	
		Week 0	**Week 8**
Energy (kcal)	2285-2531	1967 ± 475	1238 ± 324***
Protein (g/d)	**61**	78.4 ± 25.3	61.7 ± 20.4***
Energy from protein (%)	(10-35)	16.0 ± 3.6	20.1 ± 4.8***
Carbohydrate (g/d)	**100**	241 ± 69.1	150 ± 46.1***
Energy from carbohydrate (%)	(45-65)	49.1 ± 8.0	48.6 ± 8.9
Fiber (g/d)	25*[g]	14.7 ± 5.9	12.5 ± 5.8**
Total fat (g/d)	ND[h]	77.9 ± 26.5	44.1 ± 17.0 ***
Energy from fat (%)	(20-35)	35.2 ± 6.3	31.7 ± 6.2 ***
Saturated fat (%)	<7%	11.5 ± 2.4	10.6 ± 2.6**
Monounsaturated fat (%)	<20%	10.6 ± 3.4	10.3 ± 3.2
Polyunsaturated fat (%)	<10%	5.0 ± 2.0	4.2 ± 1.5**
Cholesterol (mg/d)	<200	324 ± 166	223 ± 117***
Food Guide Pyramid			
(servings/d)			
Bread	6-11	5.8 ± 2.0	3.8 ± 1.8***
Fruit	2-4	1.5 ± 1.4	1.2 ± 1.4

Vegetable	3-5	2.7 ± 1.5	2.8 ± 1.5
Milk	2-3	1.3 ± 0.8	0.8 ± 0.5***
Meat	2-3	2.6 ± 1.2	2.3 ± 1.2
Fat	Use sparingly	20.4 ± 10.9	9.1 ± 7.5***

[a]SD=standard deviation.

[b]Estimated Average Requirements (EARs) in **bold type**; Adequate Intakes (AIs) in ordinary type followed by an asterisk (*); Acceptable Macronutrient Distribution Range (AMDR) is the range of recommended intakes for an energy source.

[c]Energy requirements for weight maintenance based on Total Energy Expenditure (TEE) calculation using mean age, height, weight, and physical activity level (sedentary, low active) of subjects at baseline.

[d]EAR for protein based on mean weight of participants at baseline.

[e]Saturated fat, monounsaturated fat, polyunsaturated fat, and cholesterol recommendations based on the National Cholesterol Education Program Guidelines (NCEP) (National Heart, Lung, and Blood Institute 2002).

[f]Food Guide Pyramid servings (US Department of Agriculture 1992).

[g]RDA/AI for 19-30 y and 31-50 y females.

[h]ND=not determined.

**$P < 0.01$.

***$P < 0.001$.

and 8. In addition, there were significant decreases in bread, milk, and fat servings upon program completion.

Several improvements in dietary intakes were related to changes in perceived barriers to healthy eating. A greater consumption of dairy foods was negatively related to perceived barriers ($r=-0.22$, $p < 0.05$). In addition, mothers who increased their dairy servings reported less confusion regarding nutrition ($r=-0.28$, $p < 0.01$) and fewer complaints of the effort required to eat healthy ($r=-0.26$, $p < 0.01$). Also, subjects who decreased their cholesterol intake by post-intervention reported less difficulty in changing their dietary habits ($r=0.24$, $p < 0.01$).

Overall, the weight loss intervention was rated highly. Over 90% of participants reported learning a great deal from the program. In particular, women stated that the in-class exercise (88.3%), weekly weigh-ins (85.3%), and wearing a pedometer (84.7%) were very useful components. Suggestions for future classes included establishing maintenance classes, offering more cooking classes, and providing the program in Spanish.

DISCUSSION

Limited studies have assessed the impact of a weight loss intervention on nutrition attitudes in low-income populations. This study is unique for its comparison of sensory and behavioral attitudes of nutrient intake by low-income women. At baseline, mothers reported a greater influence of sensory motivators, such as taste and hunger, on eating choices rather than specific attitudes. It is well established that taste is a major reason for food selection (Freeland-Graves and Nitzke 2002). However, our sensory subscale did not change as a result of the intervention. This lack of change was not unexpected since sensory factors are largely influenced by biological mechanisms (Yamamoto et al. 1998). Upon program completion, healthy eating concerns superseded sensory attributes as the most important motivator for eating.

The reduction in emotional eating and perceived barriers at the end of the intervention corroborate other enhancements in attitudes by mothers enrolled in studies targeting cancer prevention (Cox et al. 1996, Harnack et al. 1997), dietary fat reduction (Albright et al. 1997, Howard-Pitney et al. 1997), and fruit and vegetable consumption (Havas et al. 1997, Treiman et al. 1996). In contrast, Fitzgibbon et al. (1995) did not find significant changes in nutrition attitudes in an obesity prevention study for African-Americans. The authors attributed this result to the small sample size of 24 participants and short treatment duration of 6 weeks.

Our intervention produced significant reductions in weight, % body fat, and waist circumference. The mean weight loss at 8 weeks was comparable to other studies involving minorities, such as Kanders et al. (1994) (6.5 lbs) and Kumanyika and Charleston (1992) (6 lbs). Weight loss was higher in this study than that for Domel et al. (1992b) (3.1 lbs), Mayer-Davis et al. (2001) (2.6 lbs), Sullivan and Carter (1985)

(0.4 lbs), and lower than Ard et al. (2000) (14.8 lbs), Kaul and Nidiry (1999) (14 lbs), and McNabb et al. (1993) (9.8 lbs). The fact that mothers maintained significant decreases in weight, % body fat, and waist circumference at 6 months shows that this program has potential for promoting lasting health benefits in this population.

Energy fell below recommended requirements for maintenance (Institute of Medicine 2002) and average daily intakes (2028 kcals) of 20-39 year-old women in the U.S (NHANES 1999-2000, Wright et al. 2003) at baseline. This finding may be due, in part, to a tendency for overweight subjects to underreport energy consumption by 300-500 calories/day (Litchman et al. 1992). Yet, the percentage of calories from protein (16%) and carbohydrate (49.1%) were within the recommended Acceptable Macronutrient Distribution Ranges (AMDR) (10-35% and 45-65%, respectively) (Institute of Medicine 2002). For these nutrients, none of the women reported intakes above the AMDR.

Participants exceeded the AMDR (Institute of Medicine 2002) for total fat and the National Cholesterol Education Program (NCEP) guidelines (National Heart, Lung, and Blood Institute 2002) for saturated fat and cholesterol. The percentage of fat in the diet (35.2%) was slightly above the upper range of the recommended AMDR (20-35%) and mean intakes (32.3%) for U.S. women (Wright et al. 2003). Over half of the women (50.9%) in our sample had fat intakes above the AMDR. Also, the percentage of calories from saturated fat was higher than the average intake for a reference population (11.5% vs 10.9%) (Wright et al. 2003). In contrast, there was a modest consumption of the potentially beneficial monounsaturated and polyunsaturated fats. Intakes were approximately half of the maximum levels suggested by the NCEP. For Food Guide Pyramid servings, mothers ate less than the recommended number of breads, fruits, vegetables, and milk servings at all times. Similiar inadequacies in fruits, vegetables, and dairy have been reported in other studies conducted with low-income women (Haines et al. 1992, Krebs-Smith et al. 1992, Kaiser et al. 2003, George et al., in submission).

Upon program completion, calories decreased by 37% and fat intakes by 43%. Consequently, there was a greater percentage of energy from protein, and lower percentages from carbohydrate and fat, in the diet. These declines were paralled by reduced servings of bread, milk, and fat. The decrease in milk consumption was unfortunate, since the nutrients in dairy products are essential for the bone health of young women (Looker 2003). These findings reiterate the necessity of emphasizing calcium-rich foods during weight loss interventions (Ramsdale and Bassey 1994, Rourke et al. 2003).

The improvements in perceived barriers toward healthy eating are believed to have contributed to the positive dietary changes observed in this study. The associations between attitudes and dietary behavior do not prove a cause and effect relationship, but support the preposition by Bandera (Bandera 1986) that cognitive changes interact with behavior.

The attrition rate for this program is within the range of 23-80% in other studies recruiting minorities (Domel et al. 1992b, Kumanyika and Charleston 1992, Stevens et al. 1993, McNabb et al. 1993, Kaul and Nidiry 1999, Mayer-Davis et al. 2001). Factors influencing attrition in this program included illness of a child, lack of childcare, lack of transportation, job conflicts, financial constraints, family responsibilities, insufficient time, lack of family support, personal stress, and respondent burden of the questionnaires. These barriers to participation have been documented in previous research with low-income women (French et al. 1998). Although we attempted to minimize these issues by providing free and make-up classes, varying class times and locations, and childcare, obstacles remained.

CONCLUSIONS

Obesity is reaching epidemic proportions in the United States. Low-income and minority women are especially at risk for obesity.

A curriculum was developed to enhance attitudes toward healthy eating and promote weight loss. Mothers improved their attitudes toward healthy eating and reduced their perceived barriers to healthy eating and emotional coping responses. Significant declines in weight, % body fat, and waist circumference were observed. Mothers consumed less than the recommend number of dairy servings at pre- and post-intervention.

This finding is of concern because of the importance of calcium rich foods in maintaining bone health. The consumption of low-fat dairy and other sources of calcium must be emphasized in programs for this population.

Chapter 3: Promotion of Physical Activity in Low-Income Mothers Using Pedometers

ABSTRACT

Objective: This study tested the effectiveness of an intervention for increasing physical activity levels in overweight/obese mothers of young children.

Design: An 8-week physical activity and dietary intervention was conducted. Participants' motivational readiness to exercise, exercise self-efficacy, pedometer steps, and pedometer calories were evaluated at week 0 and 8. Healthy weight mothers provided comparison data at baseline.

Subjects/setting: A convenience sample of 93 intervention women (BMI $\geq$ 25) and 31 healthy weight women (BMI < 25) were recruited from Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) clinics, community centers, and churches. Eligibility criteria included Hispanic, African-American, or Caucasian ethnicity and low-income (< 200% of the federal poverty index).

Statistics: Baseline differences between groups were assessed with the independent samples t-test and Chi-square test. Changes in physical activity measures were evaluated with the paired samples t-test and the Wilcoxon signed-ranks test. Associations between physical activity measures and other variables were tested with Pearson and Spearman correlations.

Results: This program enhanced motivational readiness to exercise ($p < 0.001$), exercise self-efficacy ($p < 0.05$), pedometer steps ($p < 0.001$), and pedometer calories ($p < 0.001$). Significant correlations were observed between exercise self-efficacy and exercise readiness ($r=0.28$), pedometer steps ($r=0.30$), and pedometer calories ($r=0.28$).

Conclusions: This intervention successfully increased the physical activity levels of low-income mothers. Public health clinics, such as WIC, may wish to incorporate elements of this intervention into its programs to improve the physical fitness of its clients.

INTRODUCTION

The prevalence of physical inactivity is escalating in the United States (U.S.), especially among minority women. In 2001, the Behavioral Risk Factor Surveillance System (BRFSS) revealed that 54.6% of adults in the U. S. perform less than 30 minutes of moderate physical activity each day (CDC 2003). Levels of physical activity vary by gender, age, ethnicity, and socioeconomic status (Bauman 2002). Women, Hispanics, African-Americans, older adults, and persons of lower socioeconomic status are population subgroups that are more likely to be inactive. Among women, those with young children are less likely to engage in regular physical activity than women without children (Brown et al. 2000, Verhoef et al. 1992). Regarding ethnicity, 55.2% of African-American women and 57.4% of Hispanic women are sedentary (American Heart Association 2003). These high rates of inactivity among minorities increase their risk for chronic diseases, such as heart disease, obesity, diabetes, colon cancer, and osteoarthritis (CDC 1997).

An effective strategy for promoting physical activity in interventions is the use of pedometers as a self-monitoring tool. A pilot study, The First Step Program, tested an 8-week physical activity intervention for persons with type 2 diabetes (Tudor-Locke et al. 2002). Walking time for nine participants (six women, three men) increased by 34.3 minutes/day upon program completion and remained elevated at 2 months post-intervention. In another study, Lindberg (2000) used pedometers to increase the physical activity levels of 22 subjects in Minnesota. This mail-based approach provided motivational cards, activity logs, and personal action planners to participants. Pedometer steps increased by 60.9% over the course of the 8-week study. Lindberg extended the program to worksites, allowing 2,677 employees to participate. Of these, 421 subjects returned activity logs, showing a significant increase in steps. In addition, Speck and Looney (2001) assessed the role of daily activity records and pedometer use for promoting physical activity among 49 working women. Results showed that women who maintained daily physical activity records attained significantly higher pedometer steps than controls.

Fogelholm et al. (1999) evaluated the effects of weekly exercise expenditure on pedometer step levels among obese women. Subjects (n=85) were randomized to either a control group (no walking program) or one of 2 walking groups (moderate, rigorous) for a 40-week weight maintenance phase that followed a 12-week weight reduction period. Walkers in the rigorous walking group (2000 kcal expenditure weekly) showed a greater increase in pedometer steps than participants in the control group; however there was a non-significant difference in pedometer steps between the moderate walking group (1000 kcal) and the controls. To our knowledge, there have been no published interventions that have used pedometers to promote physical activity in low-income mothers.

The conceptual framework underlying this intervention is based on the self-efficacy theory. Bandera defined self-efficacy as the confidence that an individual has to perform a particular activity, such as exercise (Bandera 1997). This concept is a powerful predictor of the ability of an individual to implement and maintain a physical activity program (Pinto et al. 1999). Significant improvements in exercise self-efficacy have been observed in obese women enrolled in a weight management program (Pinto et al. 1999). Participants (n=32) reported an increase in mean exercise duration of 229% and an increase in exercise self-efficacy of 14% at the end of the 12-week intervention.

In addition, Miller et al. (2002) conducted an intervention based on exercise self-efficacy with mothers of preschool children. An aim of this study was to determine whether self-efficacy training would predict the mothers' attainment of physical activity guidelines ($\geq$ 150 min/wk at moderate intensity). Mothers were randomized to either a control group (group 1) or one of two experimental conditions. Participants in group 2 received printed materials on surmounting physical activity barriers while mothers in group 3 also attended strategy sessions designed to increase capacity building, social advocacy, and partner support. Upon program completion, mothers in group 3 were more likely to meet physical activity guidelines than those in groups 1 and 2, after adjusting for baseline age and physical activity. Also, the change in self-efficacy predicted meeting guidelines, after controlling for baseline physical activity.

Other studies show a link between levels of exercise self-efficacy and motivational readiness to change exercise behavior (Marcus et al. 1992, Marcus et al. 1994). Motivational readiness for exercise is a concept that relates behavior change to a process of movement through stages. Readiness for exercise increases through the stages of precontemplation, contemplation, preparation, action, and maintenance. Therefore, we hypothesize that mothers will increase their motivational readiness to exercise and exercise self-efficacy following an exercise and dietary intervention. In addition, this study aimed to assess the effectiveness of pedometers for increasing the physical activity levels and reducing body weight of low-income mothers.

METHODS

Experimental Design

The program measured pre/post differences in an 8-week physical activity and dietary program offered to low-income, overweight (BMI $\geq$ 25 kg/m^2, n=124) mothers of 1-4 year old children. Participants in the intervention group completed demographic, motivational readiness for exercise, and exercise self-efficacy questionnaires at weeks 0 and 8. Mothers recorded pedometer steps for 3 days at weeks 0 and 8. A subset of the women (n=24) reported the frequency and amount of usual physical activities. Weight, height, body fat, and waist circumference were measured at weeks 0, 8, and week 24 for an assessment of weight maintenance. Also, demographics, motivational readiness for exercise, and exercise self-efficacy at baseline were compared for differences with healthy weight women (BMI < 25, n=38).

Subjects

Low-income mothers (n=124) were recruited to participate in the intervention by fliers posted at Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) clinics, public health clinics, community centers, and churches. Eligibility qualifications included: age of 18-45 years; African-American, Caucasian, or Hispanic ethnicity; youngest child of 1- 4 years; ability to speak and read English; BMI $\geq$ 25, low-income (below 200% of federal poverty level or qualification for WIC or food stamps); absence of pregnancy; and access to a telephone or digital pager. Mothers were divided into responder categories as suggested by Domel et al. (1992b), with responders classified as $\geq$ 5 lbs weight loss and non-responders, < 5 lbs weight loss. Of the 124 participants, 7 did not complete pedometer records and 24 reported a disproportionate number (≥3) of "not applicable" responses for the exercise self-efficacy questionnaire. This left a final sample of 93 women.

In addition, mothers were recruited for the healthy weight group. Qualifications for these women were similar to those of intervention participants except for a different category of BMI. Regarding the healthy weight group, 7 mothers submitted invalid self-efficacy questionnaires to yield a total of 31 healthy weight mothers. The Institutional Review Board of the University of Texas at Austin authorized the study protocol and informed consent was obtained from each subject.

Intervention classes

The eight weekly classes included recommendations for physical activity, healthful eating, and behavior modification. The physical activity component of the intervention consisted of class discussions and 30 minutes of exercise at each class. The participants shared ideas for increasing physical activity, such as reducing barriers, establishing exercise goals, recording pedometer data, and identifying sources of social support. The instructor led physical activities that mothers could continue on a daily basis, such as walking, toning exercises, climbing stairs, low impact aerobics, resistance training with 5 lb weights, and video exercise tapes (kickboxing). Mothers were instructed to exercise at least 5 days a week for 45 minutes/session at a moderate intensity, equivalent to a brisk walk. Physical activity for the mothers was assessed by weekly recording of steps and calories via pedometers.

The dietary component of the curriculum consisted of menu planning with ethnic foods, cooking demonstrations, recipe modifications, portion control, food budgeting, and fast food. Behavioral topics that were presented included social support, self-monitoring, role modeling by successful dieters, and stress management. The dietary and behavioral results of this intervention were described in companion articles by (Clarke et al., in submission and Klohe et al., in submission).

Measures

Anthropometric variables

Height was measured with a stadiometer (Perspective Enterprises, Portage, MI). Weight was obtained with an electronic weighing scale (Model HS-100-A, Fairbanks Scales, St. Johnsbury, VT). Percent body fat was determined with a body composition analyzer (Model TBF-300A, Tanita Corporation, Arlington Heights, IL). Waist circumference was measured by according to the NHANES III protocol (National Heart, Lung, and Blood Institute 1998). This protocol recommends locating the iliac crest and then positioning the measuring tape around the abdomen at the level of the uppermost lateral border of the right iliac crest.

Physical activity variables

Daily steps and estimates of caloric expenditure were recorded electronically to assess physical activity levels (Model AE170, Accusplit, San Jose, CA). This model is the same pedometer (Yamax Digiwalker SW-701), but with a different merchandising label. A comparison of five pedometers for accuracy by Bassett (1996) found that the Yamax Digiwalker SW-500 performed the best by measuring the number of steps of participants (13 women, 7 men) to within 1% of the actual distance. Similar results have been found for the Yamax Digiwalker SW-701 (Schneider et al. 2004). In addition, the

Yamax Digiwalker SW-701 demonstrated concurrent validity with steps during walking (r=0.84) and VO_2 max (r=0.75) (Hendelman et al. 2000) in a sample of 15 women and 10 men.

At week 0 and week 8, mothers recorded steps and calories for two weekdays and a weekend day on pedometer worksheets. The women were instructed to wear the electronic device for the entire day except for time spent showering or swimming. Program staff investigated outlier values of pedometer steps by comparing steps to pedometer calories, distance (not reported), and narrative accounts of the amount of physical activity performed. An extra day of pedometer recordings was substituted for any questionable readings. In addition, high physical activity was defined at $\geq$ 10,000 steps/day; moderate activity as 4,000-10,000 steps/day; and low-activity as < 4,000 steps/day (Lindberg 2000) (2000 steps=approximately 1 mile, Bassett et al. 1996).

The exercise self-efficacy questionnaire (ESE) evaluated the confidence to exercise in different situations with a 5-point scale (1=not at all confident to 5=very confident). This 11-item measure showed an internal consistency of 0.87, item: corrected scale coefficients of 0.40 to 0.66 and validity in research with Hispanic men (n=70) and women (n=118) aged 19-65 with 3-21 years of education (Laffrey and Lee, in press). The stages of change for exercise measure assessed the frequency and intent to exercise regularly (Marcus et al. 1992) with five response options (1=no, and I do not intend to in the next 6 months (precontemplation) to 5=yes, I have been for more than 6 months (maintenance). The instrument demonstrated reliability, with an internal consistency of 0.76 (n=388) and concurrent validity in a sample of predominately women (85%) with an average educational attainment of 13.8 years and age of 40.5 years. In addition, test-retest reliability for 20 employees, yielded a Kappa index of 0.78 over 2 weeks.

Statistical Analyses

Data were analyzed with the Statistical Package for Social Sciences (version 11.5, 2003, SPSS Inc, Chicago, IL) program. All t-tests were two-tailed with a significance level of $p < 0.05$. Baseline differences in continuous variables between intervention and healthy weight mothers were assessed with the independent samples t-test. Categorical variables were analyzed with the Chi-square test. Paired samples t-tests were used to assess overall changes in pedometer measures, anthropometrics, and mean exercise self-efficacy scores for the intervention subjects. The Wilcoxon signed-rank test was performed to evaluate pre/post differences for the stage of change and individual items of the exercise self-efficacy questionnaires. Pearson and Spearman correlations were performed to assess the relationships between the physical activity measures and other variables.

RESULTS

The demographic profile of the intervention and comparison groups at baseline is shown in Table 3.1. Mean BMI was significantly lower for the comparison mothers (21) than participants (35). Age averaged 27 years for both groups, and did not differ by ethnicity. The majority of the women were employed, and cohabitating with a spouse/partner. Education was similar for the two groups, with high school graduates comprising 86% of intervention and 81% of comparison subjects. A large proportion of mothers who completed the program were born in the U.S. (87%). Others stated their place of birth as Mexico (10%) or other countries (3%). The most frequently reported annual household income level was $15,000 to $29,999 (75% < $29,999, 25% ≥ $30,000).

Analysis of the exercise readiness questionnaire revealed that only 26.9% of intervention subjects were in the action/maintenance stages at baseline, compared to 64.5% of healthy weight mothers (Table 3.1). In addition, significant differences in exercise self-efficacy were observed between the healthy weight and intervention groups (Table 3.2). In particular, the healthy weight women were more confident they would exercise when feeling depressed (3.2 vs. 2.6, $p < 0.05$) and during bad weather (3.3 vs. 2.8, $p < 0.05$).

However, upon program completion 79.6% of intervention participants were in the action/maintenance stages of exercise readiness. Only 7.5% of subjects showed backward staging movement, while 29% remained at the same stage and 63.4% reported greater readiness for exercise upon program completion. Also, total exercise self-efficacy score increased significantly following the program. Higher levels of exercise

Table 3.1: Characteristics of intervention and healthy weight subjects at baseline.

	Intervention group (n=93)		Healthy weight group (n=31)	
Variable	**n**	**%**	**n**	**%**
BMI (kg/m^2) [a]				
< 25	0	0.0	31	100.0
25-29.99	24	25.8	0	0.0
30-34.99	28	30.1	0	0.0
35-39.99	25	26.9	0	0.0
>40	16	17.2	0	0.0
Age (y)				
18-25	41	44.1	15	48.4
26-39	49	52.7	14	45.2
40-45	3	3.2	2	6.4
Ethnicity				
African-American	18	19.4	5	16.1
Caucasian	19	20.4	13	41.9
Hispanic	56	60.2	13	41.9
Employed				
Yes	74	79.6	26	83.9
No	19	20.4	5	16.1
Living with spouse/partner				
Yes	68	73.1	18	58.1
No	25	26.9	13	41.9
Educational level				
High school not completed	13	14.0	6	19.4
High school graduate	31	33.3	9	29.0
Partial college	35	37.6	9	29.0
College/graduate degree	14	15.1	7	22.6
Exercise readiness**				
Precontemplation	1	1.1	1	3.2
Contemplation	14	15.1	4	12.9
Preparation	53	57.0	6	19.4
Action	17	18.3	11	35.5
Maintenance	8	8.6	9	29.0

[a]Did not conduct statistical tests since by definition group membership is based on selection criteria.

**$P < 0.01$ for between group differences at week 0.

Table 3.2: Anthropometric and physical activity variables for intervention and healthy weight groups (mean ± SD)[a].

	Intervention group (n=93)		Healthy weight group (n=31)
Variable	**Week 0**	**Week 8**	**Week 0**
Exercise self-efficacy	2.7 ± 0.8	2.9 ± 0.8*	3.1 ± 0.7[t]
Pedometer			
Steps/day	5969 ± 3123	9757 ± 3843***	ND[b]
Calories/day	281.8 ± 155.3	506.2 ± 229.3***	ND
Weight (lbs)	204 ± 47.3	197.5 ± 46.5***	123.0 ± 13.7
Body fat (%)	43.0 ± 6.2	41.6 ± 6.6***	23.0 ± 5.9
Waist circumference (in)	42.3 ± 7.0	40.9 ± 7.0***	29.7 ± 2.2

[a]SD=standard deviation.

[b]ND=not determined.

$*P < 0.05$, $***P < 0.001$ for pre/post differences between week 0 and week 8.

[t]$P < 0.05$ for between group (intervention, healthy weight) differences at week 0.

self-efficacy at week 8 were reported by mothers in the action/maintenance stage than the contemplation and preparation stages (3.0 vs. 2.6, $p < 0.05$). Specifically, participants increased their confidence to exercise during bad weather (2.8 to 3.0, $p < 0.05$), while on vacation (2.7 to 3.0, $p < 0.05$), and when feeling depressed (2.6 to 3.0, $p < 0.01$). Improvements in exercise self-efficacy total scores were correlated with decreases in body weight ($r=-0.22$, $p < 0.05$) and % body fat ($r=-0.27$, $p < 0.01$).

Pedometer steps increased significantly by the end of the program (Table 3.2). Only 4.3% of subjects averaged fewer than 4000 steps/day (low), while 49.5% recorded between 4000 and 10,000 steps/day (moderate) and 46.2% met the 10,000 steps/day criteria for high activity (Lindberg 2000). This corresponds to initial levels of 30.1% (low), 58.1% (moderate), and 11.8% (high). Calories, as calculated by this pedometer, increased by 224 per day ($p < 0.001$). Mean pedometer steps at week 8 were associated negatively with % body fat ($r=-0.24$, $p < 0.05$) and positively with submission of self-monitoring pedometer worksheets ($r=0.38$, $p < 0.01$). Overall, there were significant associations between exercise self-efficacy and pedometer steps ($r=0.30$, $p < 0.01$, Figure 3.1), calories burned ($r=0.28$, $p < 0.05$), and exercise readiness ($r =0.28$, $p < 0.01$) at week 8.

Intervention participants significantly decreased their body weight (-6.6 lbs), % body fat (-1.4%), and waist circumference (-1.4 in) during the program. Slightly more than half (54.8%) of the women were classified as responders vs. 45.2% non-responders. Of the non-responders, 11 gained weight (x=3.0 lbs). Weight loss was higher for those who cohabitated with a spouse/partner (-7.6 vs. -3.8 lbs, $p < 0.05$). In terms of % body weight, 24.7% lost at least 5% of their body weight, while 75.3% did not.

Figure 3.1: Relationship between pedometer steps and exercise self-efficacy.

For Caucasians, there was a significant difference over time in pedometer steps for subjects who lost greater than 5% of body weight, as compared with those who did not, after controlling for baseline anthropometrics (BMI, % body fat, waist circumference), number of children, relationship status, age, education, and income ($p < 0.05$). Overall, subjects who lost greater than 5% of body weight increased their pedometer steps (6084 to 10464) to a greater extent than those who lost less than 5% (5866 to 9516); however, this difference was non-significant. At week 24, there was additional weight loss (-0.3 lbs) that totaled -6.9 lbs for the entire intervention period.

The majority of participants evaluated the program positively, with particular appreciation for the instructors (87.1%*),* weekly weigh-ins (87.0%), group exercise sessions (86.0%), and wearing a pedometer to electronically measure activity (86.0%). The physical activity components of the intervention were ranked "very useful" more often than the dietary segments, such as the food records (62.0%) and menus (47.8%).

DISCUSSION

This intervention successfully increased the physical activity levels of mothers to an average of 9757 steps/day or 4.9 miles/day. This rise in pedometer steps from baseline to post-intervention (63.5%) was similar to that reported by Lindberg with a 60.9% increase in pedometer steps (4753 to 7649 steps) over 8 weeks. The use of the pedometers in the program was rated highly in the evaluation because they provided motivation and accountability. These results corroborate the positive findings reported in other studies that have utilized pedometers to promote physical activity in obese women (Fogelholm et al. 1999), sedentary women (Sidman et al. 2004), working women (Speck and Looney 2001), and men and women with type 2 diabetes (Tudor-Locke et al. 2002).

The theory of self-efficacy provided the foundation for this program. Subjects were involved in confidence building activities, such as the use of goal setting, exercise diaries, social support, and stress management. At baseline, overweight/obese women had lower efficacy scores than healthy weight subjects; however, these differences were attenuated by the end of the program. These findings support other documented increases in exercise self-efficacy for older Mexican-American women (Laffrey and Asawachaisuwikrom 2001), younger Mexican-American men and women (Laffrey and Lee, in press), Caucasian women undergoing weight loss (Pinto et al. 1999), and cardiac rehabilitation patients (Bock et al. 1997). The significant associations between exercise self-efficacy, and pedometer steps, pedometer calories, and exercise readiness at week 8 confirm the usefulness of this scale for women of low socioeconomic status.

The weight losses observed in this program are within the range of those published by programs targeting minorities (0.4 lbs to 14.8 lbs over 8 weeks): Ard et al. 2000 (14.8 lbs), Cousins et al. 1992 (1 lb, 7.2 lbs, 9.9 lbs for 3 groups), Domel et al.

1992b (3.1 lbs), Kanders et al. 1994 (6.5 lbs), Kaul and Nidiry 1999 (14 lbs), Kumanyika and Charleston 1992 (6 lbs), Mayer-Davis et al. 2001 (2.6 lbs), McNabb et al. 1993 (9.8 lbs), Sullivan and Carter 1985 (0.4 lbs). The modest results for many of these interventions attest to the difficulty of attaining weight loss in minority populations (Kanders et al. 1994).

Limitations of this study include its short duration and the measure of physical activity in the intervention. It is realized that the 6-month length of this program does not provide for an assessment of permanent weight loss. However, a longer contact period was not feasible since our subjects had frequent phone disconnections and unanticipated moves. Nonetheless, the fact that the 6 month weight loss was greater than the post-intervention value suggests that this program may have had a significant impact in their lives.

The measurement of physical activity with a pedometer is limited by its inability to detect speed, display patterns of activity, and assess upper body activities, such as swimming and cycling (Freedson and Miller 2000). Unlike accelerometers, pedometers cannot evaluate the intensity and pattern of physical activity. However, the high cost of accurate accelerometers ($500), as compared to pedometers ($15-30), was prohibitive for this demonstration program for low-income mothers in WIC clinics. Furthermore, a sub-sample of participants revealed that only a small percentage engaged in upper-body activities, such as swimming (16.7%) or bicycling (8.3%) > 1 hour per week. The self-reporting measure of pedometer readings by the subjects may not be ideal, but it is a useful tool of self-monitoring in this population.

CONCLUSIONS

In this study we created and tested a curriculum to promote weight loss via increased physical activity levels, improved dietary quality, and enhanced exercise self-efficacy. Program components contributing to its success included the use of pedometers; mastery experiences such as cooking demonstrations, group support, structured menus incorporating ethnic foods; and in-class exercise sessions. In particular, pedometers were found to be inexpensive and motivating devices that encouraged physical activity. Dietetics professionals and nurses should consider incorporating pedometers into wellness programs for their clients.

Chapter 4: Predictors of Weight Loss in Low-Income Mothers of Young Children

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. Sociodemographic, dietary, physical activity, and psychosocial data were collected at baseline; anthropometric data were measured at baseline and week 8.

Subjects/setting: A convenience sample of 114 Hispanic, African-American, and Caucasian mothers of 1-4 year old children participated in the intervention. Subjects' annual income was < 200% of the federal poverty index.

Statistics: Analysis of variance, chi-square tests, Spearman, and Pearson correlations were used to test bivariate associations between baseline data and weight loss at week 8. Hierarchical regression was employed to assess the marginal significance of dietary and psychosocial factors over socioeconomic influences.

Results: Correlates of weight loss included less satisfaction with appearance ($r=0.24$), a greater percentage of energy from protein ($r=-0.22$), superior nutrition knowledge ($r=-0.23$), higher scores on the benefits of weight loss ($r=-0.20$), healthy eating attitude change ($r=-0.28$) and social support change ($r=-0.21$). The only sociodemographic factor associated with weight loss was cohabitation with a spouse or partner ($p < 0.05$). The predictive models of baseline and change variables represented 18.7% and 17.1% of the variance, respectively.

Conclusions: Weight management programs serving low-income mothers should stress a balanced diet higher in protein, social support, attitudes toward healthful eating, benefits of weight loss, and nutrition knowledge.

INTRODUCTION

Annual expenditures on weight loss products exceed $30 billion in the United States (U.S.) (Kruger et al. 2004). Despite these costs, the prevalence of overweight and obesity continues to escalate. Approximately 47.4% of Americans were overweight and 15.1% obese during 1976-1980 (CDC 2003), as compared to 65.1% and 30.4 % during 1999-2002 (Hedley et al. 2004). In particular, women, minorities, and persons of low socioeconomic status are disproportionably affected by obesity (33.2% women vs. 27.6% of men) (Hedley et al. 2004). The prevalence rates among men do not differ by ethnicity; in women, more African-Americans and Hispanics are obese (49.0% and 38.4%) than Caucasians (30.7%) (Hedley et al. 2004).

Environmental contributors to weight loss include diet (Saris 2003), physical activity (Jakicic et al. 2002), and psychosocial factors (Senekal et al. 1999). Restriction of caloric intake and expenditure of calories via physical activity are the primary mechanisms for the promotion of energy deficits (Campbell and Chen 1999). Dietary components associated with weight loss include protein (St Jeor et al. 2001), fat (Poppitt et al. 2002, Shick et al. 1998, Carmichael et al. 1998), complex carbohydrates (Wien et al. 2003), dietary fiber (Howarth et al. 2001), and certain types of foods, such as dairy products (Zemel 2004).

The relationship between dietary consumption patterns and energy intakes was investigated in 10,014 U.S. adults participating in the Continuing Survey of Food Intake by Individuals (CSFII) 1994-1996 (Kennedy et al. 2001). Subjects were divided into non-vegetarian and vegetarian groups. Non-vegetarians were further categorized into low (< 30% of energy), medium (30-55% of energy), or high dietary carbohydrates (> 55%). Both the vegetarian and high carbohydrate groups had the lowest energy intakes and body mass index (BMI). In addition, the study conducted a review of published literature on the effects of low-carbohydrate diets on weight loss. Overall, the authors indicated that caloric intake appears to be a more important determinant of short-term weight loss than specific dietary patterns.

In contrast, physical activity represents the expenditure side of caloric balance. The Center for Disease Control (CDC) and the American College of Sports Medicine (ACSM) have established a goal of 30 minutes of moderate activity on most days (preferably all) days of the week (Pate et al.1995). However, the Institute of Medicine (IOM) has released a more stringent recommendation of 1 hour/day (IOM 2002) based on evidence that this amount may be needed to maintain a healthy weight. A study by Jakicic et al. (2002) observed trends in weight loss with increasing duration of exercise over 12 months. Subjects who reported less than 150 min/wk lost 4.7% of their body weight, as compared to 9.5% for 150 min/wk and 13.6% for 200 min/wk. Consequently, Lee (2003) recommended the CDC guideline of 30 minutes/day as a general rule, but stated that greater weight losses could be obtained by adhering to IOM 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 (Walker 1998).
Strategies to enhance adherence to treatment for weight loss focus on self-efficacy (Pinto et al. 1999) and stress levels (Foreyt and Poston 1998). Finally, other potential correlates and predictors include age (Anderson et al. 2002), body image (Teixeira et al. 2004), body weight (Martin et al. 2004), decisional balance (Pinto et al. 1999), depression (Sherwood et al. 1999), nutrition attitudes (Striegel-Moore et al. 1996), nutrition knowledge (Domel et al. 1992a, Klohe et al., in submission), and socioeconomic status (Thomas 1995).

Models for weight management for low-income mothers are limited. A recent intervention by Martin et al. (2004) 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=56). In the tailored program, a high baseline self-efficacy was associated with weight gain and its improvement was related to greater weight loss. Hierarchical regression modeling revealed that initial self-efficacy and positive self-efficacy change were significant 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

Experimental Design

Mothers (n=114) of 1-4 year old children participated in an 8-week dietary and physical activity program. This interventional study assessed pre- and post measurements of body weight, diet, physical activity, and psychosocial factors. Sociodemographics, health and dieting history, dietary, physical activity, and psychosocial data were evaluated at baseline.

Subjects

Mothers were recruited from community centers, public health clinics, churches, and Special Supplemental Women Infant and Children (WIC) clinics in Central Texas. Subject qualifications included: age 18-45 years; BMI $\geq$ 25; African-American, Caucasian, or Hispanic ethnicity; ability to speak and read English; and income less than < 200% federal poverty index. Pregnant, lactating (breastfeeding $\geq$ 5 minutes/day), and seriously ill subjects were excluded. Further details regarding subject characteristics and the intervention are available (Clarke et al. in submission). 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.

Measures

Sociodemographics and Health history

Childbirth and sociodemographic data were obtained with a 40-item questionnaire. Subjects reported information regarding gestational weight gain (GWG), 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.

Anthropometrics

Body weight (kg) was measured via an electronic weighing scale (Model HS-100-A, Fairbanks Scales, St. Johnsbury, VT) and a stadiometer (Perspectives Enterprises, Portage, MI) assessed stature (cm). Measurements were taken in light clothing, without shoes. Body mass index was calculated as weight in kg divided by height in meters squared (kg/m^2). Waist circumference was assessed by placing a measuring tape around the abdomen at the position of the highest lateral plane of the right iliac crest, according to NHANES III protocol (National Heart, Lung, and Blood Institute 1998).

Dietary Intake

A registered dietitian collected three days of dietary data from participants at baseline. Subjects reported one day with the 24 hour recall method and completed two days of food records, to yield a total of three days of dietary intake data. Accuracy of data were aided with the use of measuring cups, measuring spoons, food models, and guidelines for completing food records. The Food Processor program (version 7.81, 2001, ESHA Research, Salem, OR) was used to analyze dietary data. This data included mean daily intakes for energy, macronutrients, calcium, and Food Guide Pyramid (US Department of Agriculture 1992) servings (bread, fruit, vegetable, meat, and dairy groups).

Physical Activity

Daily pedometer steps were used to appraise physical activity levels by a model (Accusplit AE170, San Jose, CA) equivalent to the Yamax Digiwalker, SW-701. The reliability and validity of the Yamax Digiwalker pedometer is well-established (Bassett et al. 1996, Hendelman et al. 2000, Schneider et al. 2003). In a study by Bassett et al. (1996), the Yamax SW-500 pedometer showed accuracy to within 1% of the measured distance in a study of 20 subjects (13 women, 7 men). Exceptional reliability has been reported for another version (SW-701) of the Digiwalker since the SW-500 model is no longer available (Schneider et al. 2003). 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) (Hendelman et al. 2000).

At baseline, mothers reported steps for three days (two weekdays and a weekend day) on pedometer forms. 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 values. In addition, the three days of steps were averaged to yield mean pedometer steps for each participant.

Psychosocial

A description of the psychosocial scales used in the intervention is detailed in Table 4.1. At pre- and post-intervention, 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 (MBSRQ) (Brown et al. 1990). 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 (Rossi et al. 1995). 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 (CES-D) (Radloff 1977, Walker 1997).

Nutrition attitudes toward healthy eating, perceived barriers to eating, and emotional coping responses were measured with a 21-item scale by Hanss-Nuss et al. (2002). 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, macronutrients, and

Table 4.1: Reliability of psychosocial measures and association with weight loss.

Domain	Measures/subscales	Reliability[a] Cronbach's α	Association to weight loss[b] r
Body image	Multidimensional Body Self-Relations Questionnaire		
	Appearance evaluation[c]	0.88	0.24**
	Appearance orientation[d]	0.85	0.08
	Body image satisfaction[e]	0.73	0.17
	Overweight preoccupation[f]	0.76	-0.06
	Weight classification[g]	0.89	-0.17
Pros and cons for weight loss	Decisional Balance Inventory[h]		-0.16
	Pro[i]	0.91	-0.20*
	Con[j]	0.84	0.00
Depression	Center for Epidemiological Studies Depression Scale[k]	0.90	-0.10
Attitudes	Nutrition Attitudes Scale		
	Emotional coping responses[l]	0.80	-0.07
	Healthy eating[m]	0.86	0.09
	Perceived barriers[n]	0.78	0.02
	Sensory motivators[o]	0.65	-0.04
Knowledge	Nutrition Knowledge Test[p]	0.60[a]	-0.23*
Self-efficacy	Exercise Self-Efficacy Questionnaire[q]	0.87	0.11
	Weight Efficacy Lifestyle Questionnaire[r]		0.03

	Availability	0.76	0.13
	Negative emotions	0.87	-0.02
	Physical discomfort	0.70	-0.09
	Positive activities	0.82	0.00
	Social pressure	0.90	0.09
Social support	Social Support Scale[s]	0.87	0.00
Stress	Stress Scale[t]	0.73	0.06

[a]Kuder Richardson's KR-20 demonstrated reliability for the nutrition knowledge test.

[b]Association with weight loss at week 8.

[c]Based on mean of 7 items, response options 1=definitely disagree to 5=definitely agree.

[d]Based on mean of 12 items, response options 1=definitely disagree to 5=definitely agree.

[e]Based on mean of 9 items, response options 1=definitely disagree to 5=definitely agree.

[f]Based on mean of 4 items, response options 1=definitely disagree to 5=definitely agree.

[g]Based on mean of 2 items, response options 1=definitely disagree to 5=definitely agree.

[h]Calculated as pro subscale – con subscale.

[i]Based on sum of 10 items, response options 1=not important to 5=extremely important.

[j]Based on sum of 10 items, response options 1=not important to 5=extremely important.

[k]Based on sum of 20 items, response options 0=rarely to 3=most or all the time.

[l]Based on mean of 3 items, response options 1=never to 7=always.

[m]Based on mean of 9 items, response options 1=least important to 7=very important.

[n]Based on mean of 6 items, response options 1=least important to 7=very important.

[o]Based on mean of 3 items, response options 1=least important to 7=very important.

[p]Based on sum of 25 items, scored 0=incorrect or 1=correct.

[q]Based on mean of 11 items, response options 1=not at all confident to 5=very confident.

[r]Each subscale was based on sum of 4 items, from 0=not confident to 9=very confident.

[s]Based on sum of 6 items, response options 1=not at all to 9=completely.

[t]Based on sum of 11 items, response options 1=no stress to 4=severe stress/hassle.

*$P < 0.05$.

**$P < 0.01$.

vitamins/minerals (Klohe et al. in submission). Self-efficacy was measured for both exercise and eating. The Exercise Self-Efficacy Questionnaire (ESE) evaluated the confidence to exercise in 11 different situations, such as when feeling depressed or tired (Laffrey and Lee, in press). The Weight Efficacy Lifestyle Questionnaire (WEL) consisted of 20 items with five subscales (Clark et al. 1991). 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 (Walker 1997). Finally, the Stress Scale assessed the degree of hassle posed by situations, including financial problems, family conflict, and childrearing difficulties (Walker 1997).

The reliability data for all psychosocial measures are shown in Table 4.1. 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 (KR-20) test was chosen to establish reliability. Since the KR-20 is a more stringent test than Cronbach's α, a level of 0.6 for KR-20 is considered adequate (McDonald 1999). For all scales, higher values represented more of the measured trait. All questionnaires were validated in women of childbearing age.

Statistical Analyses

Hierarchical regression analyses were conducted with the Statistical Package for Social Sciences (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.

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 ($\leq$ -2.27 kg=5 lbs) and non-responder categories (> -2.27 kg). Also, baseline differences between participants according to weight loss category (responder, non-responder) for body size, dietary, physical activity, and psychosocial variables were investigated by the independent t-test. Statistical significance was assigned at the level of $p < 0.05$.

As the first step in model development, bivariate associations were examined between weight loss and sociodemographic, anthropometric, dietary, physical activity, and psychosocial factors with analysis of variance, chi-square tests, Spearman correlations, or 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. Within the model, baseline body weight and any sociodemographic variables that showed significant association with weight loss were entered first. Next, baseline dietary and psychosocial correlates with weight loss were added. This regression method was chosen to evaluate the marginal effect of dietary and psychosocial variables to the predictive model. Lastly, all two-way interactions between baseline weight and significant dietary and psychosocial correlates of weight loss were tested.

A second regression was performed that considered changes in psychosocial variables. This model also adjusted for baseline body weight and any sociodemographic factors associated with weight loss. Change data was 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. Data were windsorized to minimize the influence of valid outlying variables.

RESULTS

Subject characteristics

The demographic profile of program participants is shown in Table 4.2. The majority of subjects were under the age of 30, with a range of 18-44 years. The mean age and BMI for mothers was 27 and 35, respectively. Almost two-thirds (64%) of subjects were Hispanic, with the remaining representing African-American and Caucasian 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 were eligible for WIC services or food stamps (98%).

Sociodemographic, dietary, physical activity, and psychosocial correlates

Cohabitation was the only sociodemographic factor associated with weight loss (x=-2.7 kg). 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 pre-intervention was associated with greater weight losses (Figure 4.1). 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 change for the percentage of energy of

Table 4.2: Demographic profile of intervention participants at baseline (n=114).

Variable	n	%
Age (y)		
18-29	81	71.1
30-39	26	22.8
40-44	7	6.1
BMI (kg/m^2)		
25-29.9	24	21.1
30-39.9	68	59.6
40-56.5	22	19.3
Race		
African-American	22	19.3
Caucasian	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
Children in Household (n)		
1	38	33.3
2-3	64	56.2
4-8	12	10.5
Cohabitation		
Yes	84	73.7
No	30	26.3

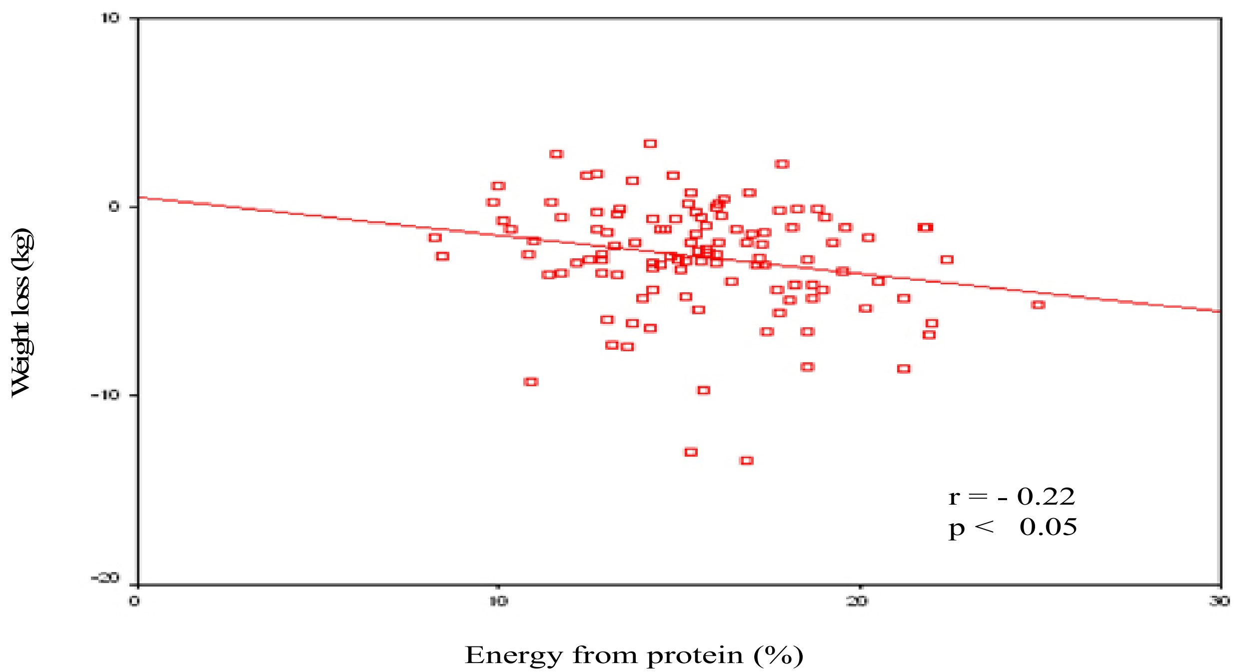

Figure 4.1: Relationship between weight loss and % energy from protein.

protein is presumably due to the low variance, as most subjects (83%) increased their percentage intake.

Three baseline psychosocial factors were correlated with weight loss, as shown in Table 4.1, including the MBSRQ appearance evaluation subscale, decisional balance pro subscale, and the total score for the nutrition knowledge test. 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 healthy eating attitudes and social support were associated with improved weight loss outcomes ($r=-0.28$, $p < 0.01$ and $r=-0.21$, $p < 0.05$, respectively).

Responders vs. Non-responders

Pre-study measurements of body size, diet, physical activity, and psychosocial factors by weight loss responder category are shown in Table 4.3. Body size did not differ according to successful weight loss. Among dietary factors, responders reported consuming a lower percentage of calories from carbohydrate ($p < 0.05$) and non-significantly higher percentages from fat and protein. However, in subjects who lost $\geq$ 5% of body weight, the percentage of calories from protein was significantly greater than for non-responders (17.7% vs.15.1%, $p < 0.001$). Physical activity, as measured by pedometer steps, did not vary significantly among groups at baseline.

Only two psychosocial scales differed between the weight loss categories; body image and decisional balance. For body image, appearance evaluation (satisfaction with appearance) was less in those who lost more weight ($p < 0.01$). For decisional balance, total scores were higher in those that were successful ($p < 0.05$).

Table 4.3: Baseline diet, physical activity, and significant psychosocial factors investigated as predictors for weight loss (mean ± SD)[a,b].

Variable	Responders (n=60)	Non-responders (n=54)
Body size		
Body mass index (kg/m^2)	34.7 ± 6.2	35.3 ± 7.2
Weight (kg)	91.9 ± 18.9	92.1 ± 21.5
Waist circumference (cm)	106 ± 16.9	108 ± 18.5
Diet		
Energy (kcal)	1982 ± 541	1891 ± 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	6197 ± 2942	5590 ± 3743
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]SD=standard deviation.

[b]Responders lost ($\leq$ -2.27 kg).

*$P < 0.05$.

**$P < 0.01$.

Predictive model

Two hierarchical regression models for the prediction of weight loss are presented in Table 4.4. The baseline model included only initial correlates. In step 1, the sociodemographic variables of body weight and cohabitation represented only 7.9% of the total variance. In step 2, the addition of the percentage of calories from protein, nutrition knowledge, decisional balance pro subscale, and appearance evaluation subscale significantly increased the R^2 by 10.8% ($p < 0.05$) so that the final model explained 18.7% of the variance in weight loss. For sociodemographic predictors, cohabitation demonstrated significance at $p < 0.01$, but body weight did not. Among dietary and psychosocial factors, only the percentage of energy from protein was significant ($p < 0.05$).

The treatment model was conducted with psychosocial change variables only, since none of the dietary change data were significantly related to weight loss. After correcting for body weight and cohabitation (step 1), healthy eating attitude and social support change scores (step 2) represented 9.1% of the variance in weight loss ($p < 0.01$) and acted as significant predictors ($p < 0.05$).

Table 4.4: Hierarchical regression models of weight loss after 8 weeks of intervention.

Variable	$R^2\Delta$	*B*	P value
Baseline Model			
Step 1	0.079*		
Cohabitation[a]		-0.27	0.004**
Initial weight (kg)		-0.08	0.418
Step 2	0.108*		
Initial energy from protein (%)		-0.18	0.049*
Initial decisional balance pro score		-0.14	0.173
Initial nutrition knowledge score		- 0.13	0.176
Initial appearance evaluation score		0.09	0.418
Model R^2	0.187**		
Treatment Model			
Step 1	0.079*		
Cohabitation[a]		-0.27	0.004**
Initial weight (kg)		-0.08	0.418
Step 2	0.091**		
Change in social support		-0.22	0.017*
Change in healthy eating attitude		-0.20	0.035*
Model R^2	0.171**		

[a]1=cohabitation with a spouse/partner and 0=no cohabitation.

**P< 0.05.*

***P< 0.01.*

DISCUSSION

In our predictive models of weight loss for low-income mothers of young children, the most significant modifiable factors were dietary protein and positive changes in social support and nutrition attitudes. The only dietary factor that contributed to the variance in weight loss was the percentage of energy from protein at baseline. This finding corroborates the importance of a diet higher in protein for weight management (Foster et al. 2003, Samaha et al. 2003, Skov et al. 1999). Presumably this effect is due to a higher degree of satiation with dietary protein, as compared to carbohydrates or fat (Latner and Schwartz 1999, Poppitt et al. 2002, Skov et al. 1999). Other dietary factors reported to be related to weight loss are complex carbohydrates (Wien et al. 2003), dairy products (Zemel 2004), dietary fiber (Howarth et al. 2001), low-fat diets (Carmichael et al. 1998, Shick et al. 1998), and alcohol (Jorgenson et al. 1995). However, we did not observe these associations in this study.

The significant prediction of positive social support is not surprising, as others have observed its importance for obesity interventions targeting African-American women (Young et al. 2001), Hispanic women (Cousins et al. 1992), and mothers (Peterson et al. 2002). Young et al. (2001) conducted four focus groups with African-American women (n=34 total) 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 et al. (1992) conducted a weight loss intervention with three groups: 1) behavioral classes; 2) behavioral classes with added family support; and 3) comparison group. Women in the family support group demonstrated superior weight losses (9.9 lbs), as compared to those in the behavioral (7.2 lbs) and comparison groups (1 lb). A third study by Peterson et al. (2002) integrated social support into its intervention targeting low-income, post-partum women, including supportive behaviors and network size as mediators for intervention outcomes (dietary, physical activity, weight loss).

Fitzgibbon et al. (1995) 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% Hispanic), the Stanford Nutrition Action Program (SNAP) (Howard-Pitney et al.1997) assessed nutrition attitudes as part of their dietary fat intervention. Subjects showed greater enhancements in nutrition attitudes than other participants (n=168) in general nutrition classes, but no changes in BMI.

Higher weight loss was more prevalent among women who lived with a spouse/partner. This finding may reflect the influence of social support (McLean et al. 2003) and increased resources (Sobal et al. 2003) on behavior change. However, a study (Meltzer and Everhart 1996) of the predictors of 1-year weight loss among 2586 overweight women showed that the category of 'never married' was associated with greater success ($p < 0.05$). These results may be explained by Sobal et al. (2003) 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 (Carmichael et al. 1998), income (Hjartaker et al. 2001), ethnicity (Kanders et al. 1994), educational level (Hjartaker et al. 2001), BMI (Meltzer and Everhart 1996) and medical illness. However, these items were not significant in our model.

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 benefits subscale were associated with weight reduction; yet, barriers only marginally influenced the outcome measure. Therefore, positive messages may have had a greater impact on our low-income population than negative ones for behavioral change (Freeland-Graves and Nitzke 2002). Nutrition knowledge was elevated in those who were successful in losing weight. Other weight loss interventions for Hispanics and black women revealed that the treatment groups scored significantly higher than the controls on nutrition knowledge post-tests (Domel et al. 1992a, Domel et al. 1992b). 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.

Physical activity, as measured by pedometers, was not associated with 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 Brill et al. (2002). 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 et al. (2004) 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 Caucasians and Hispanics.

The design of our study did not permit the measurement of resting metabolic rate 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 occur in a model incorporating a longer length of time. However, a lengthy follow-up was not feasible in this sample due to their high mobility, lack of transportation, financial instability, and significant personal problems.

CONCLUSIONS

The prevalence of obesity in the U.S. is at unprecedented levels. In particular, African-American, Hispanic, and low-income women are prone to obesity.

Predictors of weight loss included higher dietary protein and 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 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 U.S.

Chapter 5: Conclusions and Recommendations

The purpose of this study was to develop a dietary and physical activity curriculum for overweight, low-income mothers. This program is unique for its dual emphasis of promoting weight loss in mothers while targeting the prevention of obesity in their young children. To date, the majority of weight loss interventions have studied middle to upper class women. However, surveys indicate that low-income and minority women incur greater rates of obesity than those of higher socioeconomic status.

In study 1, the aim was to evaluate the effectiveness of a program for promoting weight loss and improving the nutritional attitudes of low-income mothers. A tri-ethnic (African-American, Caucasian, Hispanic) sample (n=114) attended 8 weekly classes that incorporated diet, physical activity, and behavioral strategies for weight loss. Anthropometrics, dietary intake, and nutrition attitudes were measured at weeks 0 and 8. Treatment subjects were grouped into responder ($\geq$ 5 lbs) and non-responder (< 5 lbs) categories; a convenience sample of overweight mothers (n=33) supplied comparison data. Results indicated that intervention mothers lost weight and reduced their energy intake. Responders differed from non-responders by reporting fewer barriers and more healthy eating attitudes. Finally, an association between perceived barriers and dairy servings was observed. Participants who increased their dairy consumption had fewer perceived barriers to healthful eating. These findings reiterate the importance of improving nutrition attitudes in a weight loss plan. Thus a focus on the reduction of perceived barriers may be a sound strategy for increasing dairy consumption among low-income mothers.

In study 2, the objective was to assess the impact of the intervention for raising physical activity levels of overweight mothers of young children. Mothers (n=93) with a

BMI $\geq$ 25 attended an 8-week physical activity and dietary program. Pre- and post-measurements of pedometer steps, pedometer calories, exercise self-efficacy, and exercise readiness were obtained. A group of healthy weight subjects (n=31) completed baseline assessments. By week 8, intervention mothers increased their physical activity, as evaluated by pedometer steps and calories. Improvements also were observed for exercise self-efficacy and exercise readiness. Associations were found between exercise self-efficacy, exercise readiness, and pedometer steps. These results demonstrate that the use of pedometers may be a plausible method for increasing physical activity in this population. In addition, the significant relationships between exercise self-efficacy, readiness, and pedometer steps suggest a further confirmation of the proposed link between theory and behavioral change in this population.

For study 3, the goal was to identify predictors of weight loss in overweight, low-income mothers. Participants attended an 8-week dietary and physical activity intervention. Sociodemographic data were assessed at baseline; anthropometrics, dietary intake, physical activity levels, and psychosocial scores were measured at baseline and post-intervention. Changes in anthropometrics, diet, physical activity, and psychosocial data were calculated by subtracting week 0 values from week 8. Hierarchical regression modeling revealed four predictors of weight loss: cohabitation, baseline percentage of energy from protein and changes in social support and nutrition attitudes. These results indicate that modifiable dietary and psychosocial factors may contribute to the variance observed in weight loss results for low-income mothers.

The findings of this study are limited by its short length, sample size, assessment measures, and lack of a control group that was measured at all data points. The 6-month duration of this research does not allow for an assessment of weight loss maintenance. Longer interventions are recommended to provide more definitive conclusions regarding the effectiveness of this curriculum for low-income mothers. In addition, the assessment of energy intakes is characterized by inherent inaccuracies. For 3-day diet records, these include reporting bias and lack of knowledge regarding food products. The overrepresentation of Hispanics in our study sample precluded the stratification of results by race. This problem was due in part to the demographics of the research site in Texas. Finally, the lack of a control group for all study outcomes limits the generalizability of our results. A comparison group was used, but funds did not permit us to have the ideal design. Thus, not all changes in dietary and psychosocial data can be directly attributed to the program. However, these findings provide insights into a population that is studied infrequently in obesity interventions.

Future directions for research targeting overweight, low-income mothers include the manipulation of dietary components (i.e. calcium), marketing of pedometers, and the development of regression models for weight maintenance. Studies indicate that calcium and dairy-rich foods may enhance weight loss (Zemel 2004). Other investigations show promise for diets high in protein (Foster et al. 2003) and low in glycemic load (Pawlak et al. 2002). Further research is needed to test these dietary factors for their role in weight loss in this population. For physical activity, an interesting approach is social marketing campaigns to promote the use of pedometers in walking interventions. By utilizing the techniques of commercial advertisers, such as the development of a market plan, message, and packaging considerations, public health clinics may improve on past efforts. Another important issue for research is the development of strategies for long-term weight management. The National Weight Control Registry, for example, provides insight into successful weight loss for the U.S. population. However, few models or tracking systems have been developed to assess potential predictors for ethnically diverse, low-income mothers.

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Vita

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