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Improving Dietary Habits in Disadvantaged Women With HIV/ AIDS: The SMART/EST Women's Project

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Abstract

There is a lack of information on whether brief nutrition education can succeed in improving longer-term dietary patterns in disadvantaged populations with HIV/AIDS. In the SMART/EST II Women's Project 466 disadvantaged women with HIV/AIDS were randomized to one of four groups and received a two-phase training consisting of a coping skills/stress management and nutrition education provided either in a group or individually. At baseline the majority of participants had excessive fat and sugar consumption and suboptimal intakes of vegetables, fruits, calcium-rich foods and whole grains. Dietary patterns for all participants improved after the nutrition intervention primarily due to decreases in high fat and high sugar foods such as soda and fried foods and were still significantly better 18 months later. There were only short-term differences in improvements between the four groups. These findings support the value of even brief nutrition education for disadvantaged women living with HIV/AIDS.

Keywords

HIV; AIDS; Nutrition; Women; Cognitive-behavioral stress management

Introduction

A limited set of studies have investigated the dietary intakes of disadvantaged Americans with HIV/AIDS (Kim, Spiegelman, Rimm, & Gorbach, 2001; Kruzich, Marquis, Wilson, & Stephensen, 2004; Luder, Godfrey, Godbold, & Simpson, 1995; Woods *et al.*, 1996; Woods *et al.*, 2002) and none of the samples have included large numbers of disadvantaged women, a group at particularly high nutrition risk. Poor nutrition status is known to adversely affect the immune system (Coodley, Coodley, Nelson, & Loveless, 1993; Fields-Gardner &

Fergusson, 2004). Furthermore, nutrition status has been shown to predict survival of persons living with HIV/AIDS (Baum *et al.*, 1997).

In the last decade with the advent of highly active anti-retroviral therapy (HAART), obesity rather than weight loss has become the most frequent nutrition-related issue for people with HIV/AIDS. Kim *et al.* found that 50% of the women with HIV they studied were overweight and Kruzich *et al.* found that 51.7% of the HIV-infected youth they studied were overweight or obese (Kim *et al.*, 2001; Kruzich *et al.*, 2004).

Although many women with HIV/AIDS may be overweight, a significant number are still struggling to maintain or gain weight. (Kim *et al.*, 2001) found that 14% of their sample had HIV-related wasting. Furthermore, as the preservation of lean body mass is associated with improved survival time and health status (Kotler, 1997) sustaining or increasing lean body mass remains an important goal regardless of weight status.

In addition to weight issues, several studies have documented widespread suboptimal intakes of micronutrients in people with HIV/AIDS (Kim *et al.*, 2001; Luder *et al.*, 1995; Semba & Tang, 1999; Woods *et al.*, 2002). For example, Woods *et al.* found as many as 35% of the women in their sample had intakes less than 75% of the US Dietary Reference Intake (DRIs) for vitamins A, C, E and B₆, and iron and zinc. The 2005 US Dietary Guidelines urge Americans to obtain their vitamins and minerals primarily through a healthy diet rather than extensive micronutrient supplementation and strongly recommend consuming sufficient quantities of vegetables, whole grains, fruits and calcium-rich foods and reducing sugar and fat intake (USDA, 2005).

Recognizing the role of nutrition in sustaining the immune system in HIV infection, Congress included free or low cost nutrition counseling in the Ryan White Care Act of 1990 (HIV/AIDS of the Bureau US Department of Health and Human HIV/AIDS of the Bureau US Department of Health and Human Services, 2005).

Disadvantaged women with HIV infection may experience considerable barriers to contemplating and changing diet and lifestyle, even though nutrition counseling may be available to them. Compared to men, they have higher rates of depression and experience greater psychosocial stress (Ickovics *et al.*, 2001). Depression and stress are also associated with faster disease progression (Ickovics *et al.*, 2001).

The SMART/EST I (Stress Management and Relaxation Training/Expressive-Supportive Therapy) trial was designed to address these issues. The trial tested the effectiveness of a ten session cognitive behavioral stress management and expressive therapy training (CBSM +) in decreasing depression and anxiety, enhancing coping skills and stress-reduction strategies, improving self-efficacy and increasing social support. Results from the SMART/EST I trial showed that CBSM + was effective at improving mental health quality of life, reducing depression and decreasing anxiety (Laperriere *et al.*, 2005; Lechner *et al.*, 2003). In addition, improved HIV-related self-efficacy measures were positively related to increased CD4 levels and decreased viral loads (Ironson *et al.*, 2005).

More recently the SMART/EST II trial, was conducted to see whether participants would be better able to apply the insights and information from health education counseling if they first participated in the CBSM + training and whether such improvements would positively affect biomarkers, such as blood lipids and immune markers. This paper reports on the effects of the CBSM + training and nutrition counseling on participants' self-reported dietary patterns.

Method

Participants and procedures

The SMART/EST II trial had a 2×2 factorial design resulting in four intervention groups (Table 1). Each of the two phases of SMART/EST II were delivered in either a high or low intensity version. The study hypothesized that the degree of participation in the high intensity interventions would be related to improved health and health behaviors. For Phase 1, the high intensity intervention received ten group sessions of therapist-guided exercises in CBSM +. The low intensity intervention received ten sessions of a time-matched individual psychoeducational intervention in which participants were shown segments of a video on stress management and received the written materials of the group condition, but did not receive individualized instructions or attention. The time-matched low intensity intervention was developed as an alternative to a wait-listed control group given the vulnerability of the study population.

For Phase 2, the high intensity intervention received six sessions of behavioral exercises led by the therapist plus expert advice from a relevant professional (ie, nutritionist, exercise trainer or pharmacist) depending on the content of the session. The low intensity intervention were shown segments of a video on nutrition and exercise and received the written materials of the group condition (Yancey *et al.*, 2004).

Nutrition education component—Nutrition was the main topic of the first two Phase 2 sessions for the high intensity intervention. The sessions were organized around guided self-assessment and behavioral contracting in order to make it adaptable to the needs of each participant. This was also consistent with the cognitive-behavioral orientation of the coping-skills training during the first phase of the SMART/EST II training. It was assumed that the most common themes would be overweight/obesity, underweight, poor appetite and inadequate money for food, but that other themes would frequently surface. For that reason, the intervention focused on having each participant assess her dietary pattern and then create a behavioral contract to work on specific dietary goals. Participants were also encouraged to include physical activity goals in their behavioral contracts. Participants in the group intervention were also shown the same video on nutrition and exercise as participants in the individual condition (Yancey *et al.*, 2004) and during the exercise portions of the video, facilitators exercised along with participants.

The nutrition and physical activity intervention focused on the following four components: (a) Identification of barriers to healthy eating; (b) Facilitator-assisted self-assessment of nutritional strengths and weaknesses; (c) Behavioral contracting to address participants' highest priority nutrition or physical activity issues and (d) Monitoring behavioral progress and adapting the behavioral contract as needed. Both nutrition sessions emphasized decreasing fat and sugar intake and increasing vegetable, fresh fruit and whole grain intake. The nutrition sessions were co-facilitated by a dietitian with a specialty in HIV/AIDS nutrition and a cognitive-behavioral interventionist. The cognitive behavioral facilitator continued to monitor and reinforce diet and exercise behavior progress throughout the rest of the Phase 2 sessions.

The materials developed for this intervention included a lower-literacy nutrition self-assessment tool and behavioral contract. A set of realistic plastic foods (Nasco Nutrition, Fort Atkinson, Wi) were used to model portion sizes based on the US Food Pyramid. At the end of each of the nutrition intervention sessions, the nutritionist conducted a cooking demonstration and provided both the food and the recipes to participants. During other SMART/EST II sessions, participants were provided healthy meals and snacks.

All participants, regardless of their intervention group assignment, received their own copy of the exercise and nutrition video at the beginning of Phase 2 to take home and use.

The SMART/EST II sample consisted of 466 women who were 18 years or older and living with HIV/AIDS as defined by Centers for Disease Control and Prevention (CDC) criteria (CDC, 1999). Participants were recruited from the Greater New York area (New York City and Newark, New Jersey) and from Miami, Florida. The program was offered in English, Spanish, and Creole. Demographic characteristics of the disadvantaged women who participated in the SMART/EST II trial were similar to those of disadvantaged women in other HIV nutritional epidemiological studies (Kim *et al.*, Spiegelman, Rimm, & Gorbach, 2001; Woods *et al.*, 2002)

Exclusion criteria were limited to active psychosis, psychotic depression, or current substance dependence. Baseline demographic information was obtained through clinical interviews at screening. An additional 131 participants were screened but either did not meet the inclusion criteria (94 women) or chose not to participate (37 women). Participants were given an incentive of \$625 for completing the entire study.

Measures and data analyses

All measures were collected by trained interviewers and were collected at baseline, 3 months, 6 months, 12 months, and 24 months. The 3 month measurement point occurred soon after completing the Phase 1 CBSM + intervention and the 6 month measurement point occurred soon after completing the Phase 2 health education intervention. Therefore, the 12 and 24 month data collection points, respectively, occurred 6 months and 18 months after participants had completed the full intervention.

Dietary questionnaire—Due to the limited literacy level of many participants and the large number of other questionnaires being administered, a brief dietary assessment instrument was chosen rather than a longer semi-quantitative food frequency questionnaire. The instrument used to measure dietary changes was a modified and shortened version of the Rapid Eating and Activity Assessment for Patients (REAP) questionnaire originally developed at Brown University (Gans *et al.*, 2003). REAP focuses on food group adequacy and excess rather than the intake of specific nutrients.

It is intended for use in clinical settings and with lower literacy patients to assess compliance with US Dietary Guidelines (Gans *et al.*, 1993; USDA, 2005) which couch their recommendations in terms of food groups rather than nutrient intake and recommend Americans consume at least five servings of vegetables, four servings of fruit, three servings of whole grain foods and three servings of fat-free or low fat calcium-rich foods per day.

The modified version of REAP was renamed the Rapid Eating Assessment for Participants, Short Version (REAP-S) and was developed at the Albert Einstein College of Medicine of Yeshiva University (Segal-Isaacson, Wylie-Rosett, & Gans, 2004). It contains 13 items (see Table 3) and three response categories: *Usually/Often*, *Sometimes* and *Rarely/Never*, which were respectively scored 3, 2 and 1. Total REAP-S scores were computed by summing the scores for all 13 items. A subscore for high sugar foods was computed by summing items 12 and 13 and a subscore for high fat foods was computed by summing the scores for items 8 through 11. The REAP-S is available at <http://www.aecom.yu.edu/nutrition/pdf/SHORT%20REAP%20modified.pdf>.

The REAP-S was piloted on 116 first-year medical students who also completed the (Block, 1998) Food Frequency Questionnaire (Block FFQ; (Segal-Isaacson *et al.*, 2004)). The Cronbach's alpha to determine reliability for the scale was .72. The Pearson correlation

coefficients between the REAP-S and the (Block, 1998) were computed for those questions that were defined similarly between the two instruments. The correlations for the categories of fruit, vegetables and dairy products were respectively .50, .51 and .50, suggesting that the convergent validity of the measure (assessed against the standard of the (Block, 1998) tool) is moderate to high (Segal-Isaacson *et al.*, 2004; Block, 1998) given that dietary questionnaires are difficult to cross compare. For example, Subar found that correlations between 24 hour dietary recalls and the three most commonly used food frequency questionnaires only ranged from .18 to .48 for energy intake (Subar *et al.*, 2001).

CD4 and CD8 cell counts—Blood samples were collected at baseline and all subsequent measurement time-points using sterile evacuated tubes containing EDTA. Whole blood was used to determine lymphocyte phenotypes, number and percentage of T cells and their subsets and monoclonal antibodies for T helper, suppressor/cytotoxic and maturation markers as described by (Asthana & Ashman, 2002).

Viral load—The viral load was estimated via reverse transcriptase polymerase chain reaction using the Roche (Nutley NJ) Amplicor HIV Monitor Ultrasensitive Assay Kit and the Biomerieux (Marcy l'Etoile, France) NucliSens HIV-1 QT assay kit as described in (Barre-Sinoussi *et al.*, 1983; Kievits *et al.*, 1991).

Lipids—The lipid panel included triglycerides, total cholesterol, HDL cholesterol, LDL cholesterol and cholesterol/HDL ratio. The blood sample for the lipid serum was collected in a SST vacutainer tube. Triglycerides, total cholesterol, HDL cholesterol were quantified using spectrophotometry. The LDL cholesterol and cholesterol/HDL ratio were calculated. Reference ranges were provided by the laboratory.

Anthropometrics—Body weight and height were measured on a balance beam scale with participants dressed in light clothing and without shoes. Body composition was measured by bioelectrical impedance analysis with the Tanita (Arlington Heights, IL) Body Composition Analyzer TBF 300A, using the formula developed by (Segal, Van Loan, Fitzgerald, Hodgdon, & Van Itallie, 1988). The circumferences of the waist and the hips were measured with a tape measure at the umbilicus and the level of maximum protrusion of the buttocks.

Data analyses

Randomization was accomplished by creating a randomization schedule of 33 intervention cohorts with a maximum size of 18 participants. As participants enrolled at each site, they were assigned to the next cohort. By the end of study recruitment, Miami had 15 cohorts and NY/NJ had 18 cohorts.

To determine whether the four different interventions resulted in different changes in total REAP-S scores over time (Tables 5 and 6), a general linear mixed-effect model was fit. A similar approach was used to evaluate REAPS high sugar and high fat subscores. This procedure was used to account for the dependence of scores from the same participant and to adjust for baseline differences between participants.

Participant retention exceeded 80% for all time-points except for the last one at 24 months. To determine whether attrition was related to intervention group assignment, two statistical procedures were used. First, a model was created using a generalized estimating equation to determine whether over all the time-points and intervention groups there were any differences between expected and observed completed REAP-S questionnaires. Second, chi-square tests were computed for each time-point separately to see whether there were any differences between intervention groups for expected versus observed completed REAP-S questionnaires.

To see whether participants with missing REAP-S data were different from those who completed all time-points, comparisons on several of the most relevant participant characteristics (ethnicity, CD4 count and age) were computed for each time-point.

Results

Participant characteristics

The demographic characteristics of the SMART/EST II participants are shown in Table 2. Participants were primarily in their 30s and 40s with an average age of 41.9 ± 9.2 years. The study population consisted largely of women of color with approximately 42% of participants identifying themselves as African American, 37% as Latina, 12% as Haitian, 6% as other and 3% of European ancestry. Most participants were very economically disadvantaged with 88.4% reporting incomes of \$10,000 or less per year. Nearly 76% of the participants were unemployed and 57.3% were on disability. More than half the sample (51.1%) had not completed high school. Although 54.2% said they were currently single, 32.3% said they were separated, divorced or widowed and most of the women (86.9%) had children.

Participants from New York and New Jersey were somewhat older, more likely to have been born in the United States, more likely to be on disability, but also have a larger income. They were also more likely to have become infected with HIV through injected drugs than participants from Miami (refer to Table 2 for significant findings). Many of the participants in SMART/EST II were overweight or obese (Table 4).

The mean weight for participants at baseline was 166.7 ± 56.4 lbs and the mean body mass index (BMI) was 28.1 ± 6.5 kg/m². Both weight and BMI were relatively normally distributed. The mean waist circumference was 36.8 ± 5.5 " and the mean waist-to-hip ratio was 0.87 ± 0.07 suggesting that many participants had central obesity. The waist-to-hip ratio was slightly higher in the NY/NJ group compared to the Miami group.

The mean baseline CD4 count was 545 ± 351 , as shown in Table 3. More than half the sample (57.3%) had well-controlled HIV as evidenced by a viral count of less than 400 copies/mm³ (Table 3). Mean values for total cholesterol, LDL-C and HDL-C were within the normal range as defined by the current Adult Treatment Panel III guidelines (Grundy *et al.*, 2004) but mean triglyceride levels were elevated, 180 ± 106 mg/dl. The elevated triglyceride levels and waist circumferences suggest many participants may be at risk for metabolic syndrome.

Table 4 shows the distribution of participants' responses for individual items in the REAP-S dietary screener at baseline. Forty-three percent of participants reported usually drinking more than 16 ounces of sweetened beverages per day; 30.4% usually eat sweets (pastries, cookies, etc.) more than twice a day, 34.0% usually eat their foods fried and 39.8% report usually eating less than two servings of vegetables a day. More positively, 65.3% reported they rarely eat four or more times per week at restaurants, 45.5% rarely skip breakfast and 46.2% rarely use high-fat cold cuts, such as bologna or salami.

Participants in Miami and NY/NJ differed in their scores for 10 out of the 13 REAP-S individual questions. Participants in Miami reported they ate less frequently in restaurants, ate more fruit, fewer full-fat chips, and added less fat at the table. Participants in NY/NJ reported greater consumption of whole grains, vegetables, milk products, and lower consumption of high-fat cold cuts, sweets, and sweetened beverages (refer to Table 4 for significant findings).

Effect of the nutrition interventions

Trends over time for total sample—A mixed effect model showed that total REAP-S scores, as expected, did not improve after the Phase 1 CBSM + training at the three month

measurement point but did improve for the entire sample after the Phase 2 nutrition intervention (at the six month measurement point) compared to baseline scores (Table 5). Significantly improved scores were sustained through the 24 month measurement point (18 months after the nutrition intervention) without further behavioral reinforcement. A similar pattern was observed for the subscores for both the high fat items and the high sugar items.

Trends over time within intervention groups—With respect to changes within the intervention groups, Table 6 and Fig. 1 show that total REAP-S scores significantly improved between baseline and six months for Groups 2, 3 and 4. Group 3 declined between 6 and 12 months, while Groups 2 and 4 declined between 12 and 24 months. Group 1 improved between baseline and 24 months, but not between other intervals.

There were no differences in improvements between the two geographic sites nor were there significant changes in REAP-S scores for items related to vegetable, fruit, whole grains or high calcium foods.

Trends over time between the intervention groups—The general linear mixed effect model showed that Group 2 compared to Group 1 had significantly greater REAP-S scores right after the nutrition intervention at the 6 month measurement point (33.58 ± 0.54 versus 31.94 ± 0.48 , $t = 2.26$, $p < .05$) but by 24 months there were no longer any significant differences in scores between Group 1 and 2. There were no significant differences in scores between Group 2 and Group 4 or other significant differences between groups at any time-point.

Correlations between REAP-S changes and physiological parameters—There were also no consistent patterns of correlation between changes in REAP-S scores and anthropometric, lipid, immune or viral measures.

Participant retention and missing data

At baseline, REAP-S questionnaires were completed by 454 of the 466 participants. For the 3 month, 6 month and 12 month measurement points, the number of questionnaires completed were similar (respectively 377, 397 and 368) yielding a retention rate of more than 80% at each time-point. The number of completed questionnaires dropped to 230 at the final data collection time-point at 24 months, 18 months after the completion of the interventions, primarily due to participants being lost to follow-up. A model fit with a general estimating equation for all time-points showed a significant difference in missing data both between the intervention groups, $X^2(3, N = 466) = 8.42$, $p < .05$, and between the time-points, $X^2(3, N = 466) = 127.73$, $p < .01$. Most of the effects in the model are explained by a greater drop-out rate for Group 1, the group that received the low intensity intervention for both Phase 1 and Phase 2 (Table 1).

An analysis of demographic characteristics between participants who did and did not complete REAP-S questionnaires showed there were no age differences. There was a difference in CD4 counts only at the 24 month time-point where the mean CD4 counts for those who did and did not complete REAP-S questionnaires were respectively 498 ± 290 compared to 601 ± 408 , $t(259, N = 261) = 2.37$, $p < .05$. However, there were significant differences by ethnicity/race for all time-points except baseline. This appeared to be due to higher completion rates by African American participants and lower completion rates by Puerto Rican and Haitian participants: at 3 months, $X^2(6, N = 466) = 20.99$, $p < .01$; at 6 months, $X^2(6, N = 466) = 13.31$, $p < .05$; at 12 months, $X^2(6, N = 466) = 14.09$, $p < .05$ and at 24 months, $X^2(6, N = 466) = 39.39$, $p < .01$.

Discussion

The purpose of the SMART/EST II randomized clinical trial was to determine the efficacy of a two-phase intervention in which 466 disadvantaged women with HIV/AIDS first participated in a series of ten cognitive-behavioral stress management and coping-skills-supportive sessions followed by six health education sessions. Participants were randomized to either a behavioral therapist-led group or individual low intensity treatment for each intervention phase. Participants in the latter treatment were provided information via videotape and reading materials. Dietary patterns improved after the nutrition intervention for the entire sample and were still significantly better at 18 months after the intervention. Groups who received the therapist-led group initially improved more than those who did not but there were no differences by 18 months post-intervention.

A central hypothesis of this study was that the high intensity therapist-led CBSM + group intervention would help participants better use subsequent health education counseling to improve health behaviors. Unfortunately, with respect to reported dietary behaviors, there was no significant advantage to the CBSM + group intervention compared to the low intensity intervention of watching a video segment on coping skills or stress reduction.

On the other hand, reported dietary patterns improved more in those who received the group nutrition intervention for at least the first six months after the intervention. Since these changes were not reinforced, it is not surprising that by 18 months after the intervention there was no longer an advantage to the group intervention. Also, since participants in all four intervention groups were provided a copy of the nutrition and exercise video (Yancey *et al.*, 2004), it is possible that over time the group intervention effect was replaced by the content of the video. Although use of the video was not monitored, this explanation is supported by Fig. 1 which shows that between 12 months and 24 months REAP-S scores “evened out” between the four groups. REAP-S scores declined among those who received the group nutrition intervention but improved among those who received the low intensity individual nutrition intervention. This may have been confounded by the disproportionately high rate of missing data from Group 1. It is possible that disaffected participants who did not make dietary changes and had lower REAP-S scores did not show up for their data collection appointments, especially later in the study. If this is true, it would have the effect of making the low intensity intervention appear more effective than it actually was. There do not appear to be any comparable randomized clinical trials in the literature to cross-compare results.

Contrary to expectation, participants in Group 2 initially did somewhat better than participants in Group 4. Intervention observers noted that participants in Group 2 appeared to be very glad to be in a group for the second phase of the intervention and may have been more receptive to the nutrition information as a result.

It is also interesting that the improvement in food group choices came primarily from decreasing fats and sugars rather than from adding vegetables, fruits, whole grains and calcium-rich foods, which were also emphasized in the nutrition sessions. Possible barriers to increasing intake of these foods may include lack of familiarity with these foods, taste, cost and availability in lower-income neighborhoods. In order to realize the goals of the 2005 Dietary Goals, future research should focus on identifying and addressing the operative barriers. It may be an easier first step in behavior change to eliminate foods from the diet rather than to add newer foods.

A limitation of the study is that the group versus individual treatments were time but not attention-matched. It is therefore not completely possible to tell whether the dietary improvements immediately and six months after the nutrition intervention were due to therapist/nutrition attention or the specific interventions. Further, because there was no true

control group, it can not be completely ruled out that changes in REAP-S scores were due to confounding environmental factors.

Another concern is that participants' improvements in REAP-S scores may have been due to social desirability factors. This seems unlikely because participants in the group nutrition intervention who received the most "good diet" cues from facilitators were also the ones to report the greatest decline in dietary quality between the 12 and 24 month time-points.

This is the first clinical trial in which the REAP-S was used at repeated time points to measure changes in dietary patterns. Although the REAP-S has only three response categories for each question (Table 2) changes in dietary patterns were detected. The REAP-S is currently being revised to include five response categories to further increase its ability to discriminate between response patterns. This version of REAP-S is currently being piloted in a trial on diabetes medication adherence (Walker, 2005).

A SMART/EST III trial is currently being planned whose purpose is to create and implement a fully translated clinical model. For this trial it may be useful to use elements of both the individual and group nutrition education model in order to increase its cost-effectiveness and practicality. Two lessons learned from the current trial include the importance of directly surveying participants about what intervention elements were of most use to them and the importance of reinforcing health messages over time. The last may be the most critical as it will help learners truly integrate information into their lives and make the leap from knowledge to behavior.

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Fig. 1.
REAP-S Scores Over 24 Months

Table 1

Combinations of intervention assignments For SMART/EST II

Group	Phase 1	Phase 2	Delineated in Text
	General CBSM	Applied CBSM +	
1	Low Intensity Individual Psychoeducation	Low Intensity Individual Psychoeducation	(Ind/Ind)
2	Low Intensity Individual Psychoeducation	High Intensity Facilitated Group	(Ind/Grp)
3	High Intensity Facilitated Group	Low Intensity Individual Psychoeducation	(Grp/Ind)
4	High Intensity Facilitated Group	High Intensity Facilitated Group	(Ind/Ind)

Table 2

Demographic characteristics of participants

Variable	Total sample	Geographic sites		Statistical test		Intervention groups			Statistical test		
	All n = 466	Miami n = 203	NY/NJ n = 263	df	t test or Chi Square ²	Group 1 n = 132	Group 2 n = 99	Group 3 n = 98	Group 4 n = 137	df	F or Chi Square ²
Age In Yrs (Mean ± Sd)	41.91 ± 9.15	39.65 ± 9.76	43.66 ± 8.25	455	-4.76**	41.50 ± 8.05	39.42 ± 9.74	42.50 ± 8.91	43.67 ± 9.53	3	4.35**
Race/Ethnicity (%)				6	80.62					18	13.36
African-American	41.85	49.26	36.12			36.36	48.48	44.90	40.15		
Puerto Rican	26.82	7.88	41.44			35.61	18.18	24.49	26.28		
Haitian	12.88	19.70	7.60			12.12	13.13	13.27	13.14		
Central And South American	7.73	10.34	5.70			6.06	10.10	6.12	8.76		
European Ancestry	3.00	4.93	1.52			3.79	2.02	2.04	3.65		
Cuban	2.15	3.94	0.76			1.52	2.02	2.04	2.92		
Other	5.58	3.94	6.84			4.55	6.06	7.14	5.11		
Born In USA (%)	64.81	57.64	70.34	1	8.11**	65.91	70.71	63.27	60.58	3	2.75
Work Status (%)				2	0.67					6	4.67
Not Working	75.60	74.63	76.36			72.31	79.38	72.45	78.36		
Part-Time Or Volunteering	20.92	22.39	19.77			22.31	17.53	25.51	18.66		
Work Full Time	3.49	2.99	3.88			5.38	3.09	2.04	2.99		
On Disability (%)	57.33	44.78	66.92	1	22.84**	52.67	54.55	53.06	66.91	3	7.31
Income (%)				3	17.47					9	12.22
Less Than \$5,000	54.19	64.53	46.18			45.45	57.58	56.12	58.82		
\$5,001 To \$10,000	34.19	28.08	38.93			40.15	31.31	34.69	30.15		
More Than \$10,000	9.89	6.90	12.21			10.61	11.11	9.18	8.82		
Declined To Answer	1.72	0.49	2.67			3.79	0.00	0.00	2.21		
Education Completed				3	6.66					9	12.08
<High School	51.10	51.00	51.17			48.46	52.58	50.00	53.38		
High School	30.92	31.50	30.47			34.62	23.71	31.25	32.33		
1-2 Yrs College	12.72	15.00	10.94			10.77	20.62	10.42	10.53		
>2 Yrs College	5.26	2.50	7.42			6.15	3.09	8.33	3.76		
Marital Status				2	4.37					6	10.96
Single	54.19	51.49	56.27			56.82	51.02	61.22	48.91		
Married	13.55	17.33	10.65			14.39	11.22	17.35	11.68		
Divorced/Separated or Widowed	32.26	31.2	33.1			28.79	37.76	21.43	39.42		
Have Children	86.85	84.24	88.89	3	2.17**	87.02	86.87	86.60	86.86	3	0.01
Route of HIV Infection				3	16.54					9	13.88
Sex	71.03	70.44	71.48			72.73	78.79	67.35	66.42		
Drug Use	7.3	2.46	11.03			9.09	5.05	7.14	7.30		
Transfusion	3.0	3.45	2.66			0.76	2.02	2.04	6.57		
Don't know or Other	18.7	23.65	14.83			17.42	14.14	23.47	19.71		

* $p < .05$;

** $p < .01$

¹ The t-test was used to compare the distribution of participants' ages between the sites and ANOVA was used to compare the distribution of participants' ages between the intervention groups.

² The chi-square test was used to make statistical comparisons between the sites and between the intervention groups for all other variables in Table 2.

Table 3

Clinical and laboratory characteristics at baseline¹

Variable	Total sample <i>n</i> = 377 mean ± SD	Geographic sites		Stat. test T (df = 375)	Intervention groups		Stat. test F (df = 376)
		Miami <i>n</i> = 191 mean ± SD	NY/NJ <i>n</i> = 186 mean ± SD		Group 1 <i>n</i> = 97 mean ± SD	Group 2 <i>n</i> = 83 mean ± SD	
Weight (lbs)	166.7 ± 56.4	165.4 ± 40.5	167.9 ± 69.1	-0.43	159.4 ± 42.0	170.7 ± 39.3	0.78
BMI (kg/m ²)	28.1 ± 6.5	28.1 ± 6.5	28.0 ± 6.5	0.29	27.7 ± 7.2	28.2 ± 5.7	0.54
Fat%	36.1 ± 8.6	36.8 ± 8.3	35.4 ± 8.9	1.56	34.8 ± 10.0	36.9 ± 7.3	2.24
Waist	36.8 ± 5.5	37.0 ± 5.3	33.6 ± 5.7	0.53	27.3 ± 15.4	30.1 ± 15.0	0.83
Waist- To-Hip Ratio	0.87 ± 0.07	0.86 ± 0.07	0.88 ± 0.07	-2.78*	0.86 ± 0.07	0.86 ± 0.07	0.3
Basal Metabolic Rate (kcal)	1478 ± 192	1489 ± 197	1466 ± 186	1.16	1457 ± 195	1486 ± 188	1.97
CD4 Count (cells/mcl)	545 ± 351	506 ± 362	577 ± 338	1.63	505 ± 370	508 ± 357	1.38
% < 500	47.1%	50.0%	44.3%	0.91 ³	56.5%	49.2%	3.9 ^{3,0}
% ≥ 500	52.9%	50.0%	55.7%		43.5%	50.8%	
CD4%	25.8 ± 12.7	27.1 ± 14.4	24.5 ± 10.4	1.72	23.2 ± 12.3	24.6 ± 12.5	2.02
CD8%	51.8 ± 37.0	49.8 ± 14.4	53.9 ± 51.2	-0.95	62.5 ± 74.0	51.1 ± 14.3	2.48
CD4/CD8 Ratio	0.6 ± 0.4	0.6 ± 0.4	0.6 ± 0.4	0.05	0.5 ± 0.4	0.5 ± 0.4	1.61
Viral Load (copies/mm ³)	17,668 ± 68,903	25,684 ± 93,074	9,980 ± 30,072	1.94	17,668 ± 36,372	14,093 ± 119,330	0.74
% ≤ 400	57.3%	53.2%	57.8%	0.63 ³	55.60%	46.30%	3.60 ³
% > 400	42.7%	46.8%	42.2%		44.40%	53.70%	
Total Cholesterol	191 ± 45	190 ± 43	191 ± 47	-0.33	195 ± 43	186 ± 46	0.59
HDL-C	50 ± 18	49 ± 15	50 ± 20	-0.45	47 ± 14	49 ± 17	1.29
LDL-C	109 ± 85	108 ± 36	110 ± 114	-0.23	112 ± 34	102 ± 37	0.50
Triglycerides	180 ± 106	166 ± 100	193 ± 107	-0.99	188 ± 103	169 ± 103	1.06

*
p < .05;

**
p < .01

¹ Baseline data for anthropometric, immune function, HIV viral load and blood lipid measurements were available for 377 participants

² As measured by BIA

³ Chi Square Statistic

Table 4

REAP-S baseline response patterns by geographic location

Item	Response	All ¹ n = 454 %	Miami n = 197 %	NY/NJ n = 257 %	Chi-Square (2 df)
In an average week, how often do you:					
1. Skip breakfast?	Usually/Often	25.2	25.5	25.0	1.63
	Sometimes	29.3	26.1	32.1	
	Rarely/Never	45.5	48.4	42.9	
2. Eat 4 or more meals from a restaurant?	Usually/Often	11.1	10.1	12.0	8.46*
	Sometimes	23.6	17.0	29.3	
	Rarely/Never	65.3	73.0	58.7	
3. Eat less than 2 servings of whole grains or high fiber starches a day?	Usually/Often	41.1	52.7	31.9	17.37**
	Sometimes	32.8	24.2	39.6	
	Rarely/Never	26.1	23.0	28.5	
4. Eat less than 2 servings of fruit a day?	Usually/Often	36.1	39.2	33.7	9.76**
	Sometimes	27.3	19.3	33.7	
	Rarely/Never	36.6	41.6	32.7	
5. Eat less than 2 servings of vegetables a day?	Usually/Often	39.8	50.6	31.1	19.53**
	Sometimes	25.8	16.3	33.5	
	Rarely/Never	34.4	33.1	35.4	
6. Eat/drink less than 2 servings of milk products a day?	Usually/Often	37.5	47.6	29.3	17.64**
	Sometimes	25.1	16.3	32.2	
	Rarely/Never	37.5	36.1	38.5	
7. Eat more than 8 ounces of meat, chicken or fish per day?	Usually/Often	42.2	42.8	41.7	4.10
	Sometimes	22.5	18.1	26.1	
	Rarely/Never	35.3	39.2	32.2	
8. Use regular processed meats (high fat cold cuts)?	Usually/Often	25.7	32.9	20.5	8.73*
	Sometimes	28.2	24.3	31.0	
	Rarely/Never	46.2	42.8	48.6	
9. Eat fried foods?	Usually/Often	34.0	32.5	35.8	0.69
	Sometimes	34.2	36.0	32.1	
	Rarely/Never	31.8	31.5	32.1	
10. Eat regular (high fat) potato or other chips?	Usually/Often	29.5	22.4	38.8	17.93**
	Sometimes	28.1	31.0	24.4	
	Rarely/Never	42.4	46.6	46.6	
11. Add butter, margarine or oil to foods at the table?	Usually/Often	40.5	44.4	35.6	20.07**
	Sometimes	30.2	35.6	23.3	
	Rarely/Never	29.3	20.0	41.1	
12. Eat sweets more than 2 times per day?	Usually/Often	30.4	31.7	28.8	18.57**
	Sometimes	24.7	32.2	15.3	
	Rarely/Never	44.8	36.1	55.8	
13. Drink 16 ounces or more of regular soda, punch or Kool-Aid per day?	Usually/Often	43.0	39.2	47.8	9.60**
	Sometimes	17.6	23.1	10.7	
	Rarely/Never	39.4	37.7	41.5	

*
p < .05;

**
p < .01

¹ Number of participants who completed REAP-S at baseline

Table 5
Changes in all participants' REAP-S scores over 24 months using mixed effects modeling^I

Timepoint	Total REAP-S Score	REAP-S sugar subscore			REAP-S fat subscore		
		Adjusted mean scores ± SE	t	df = 1356	Adjusted mean scores ± SE	t	df = 1346
Baseline	454	31.39 ± 0.24	n/a	n/a	7.99 ± 0.12	n/a	n/a
3 Months	377	31.60 ± 0.29	0.73	0.36	8.22 ± 0.13	1.77	1.77
6 Months	397	32.81 ± 0.42	4.97**	5.37**	8.58 ± 0.13	4.59**	4.59**
12 Months	368	32.68 ± 0.29	4.42**	3.24**	8.57 ± 0.13	4.42**	4.42**
24 Months	230	32.52 ± 0.13	3.31	2.37*	8.41 ± 0.16	2.74*	2.74*

* $p < .05$;

** $p < .01$

^I Changes compared to baseline scores

Table 6
Changes in REAP-S scores over 24 months by intervention groups using mixed effects modeling $n = 454$ at baseline, $df = 548$

	Adjusted mean scores $\pm$ SE for baseline	Adjusted mean scores $\pm$ SE for 3 months ¹	Adjusted mean scores $\pm$ SE for 6 months	t for change between baseline- 6 months	Adjusted mean scores $\pm$ SE for 12 months	t for change between 6-12 months	Adjusted mean scores $\pm$ SE for 24 months	t for change between 12- 24 months
Group 1	31.29 $\pm$ 0.46	32.39 $\pm$ 0.51	32.14 $\pm$ 0.47	1.61	32.07 $\pm$ 0.49	0.12	33.24 $\pm$ 0.62	1.63 *
Group 2	31.55 $\pm$ 0.54	31.66 $\pm$ 0.50	33.46 $\pm$ 0.51	4.08 **	33.62 $\pm$ 0.51	0.27	31.76 $\pm$ 0.64	2.54 *
Group 3	31.14 $\pm$ 0.54	33.06 $\pm$ 0.56	33.13 $\pm$ 0.49	3.55 **	31.62 $\pm$ 0.51	2.44 *	32.94 $\pm$ 0.62	1.83
Group 4	31.51 $\pm$ 0.48	31.12 $\pm$ 0.50	32.71 $\pm$ 0.42	3.15 **	33.15 $\pm$ 0.44	0.84	31.88 $\pm$ 0.53	2.06 *

*
 $p < .05$;

**
 $p < .01$

¹ t values were not computed for Baseline to 3 months because since only the first intervention had been completed, there were, effectively, only two intervention groups tested at this timepoint