Table 4. Demographic Characteristics of Study Participants.

	USDA (n=16)		*BCT (n=17)*		*WLC /BCT w/o maint (n=17)*		*Overall*	
	M	SD	M	SD	M	SD	M	SD
Age	40.75	7.11	39.88	7.98	40.94	6.06	40.52	6.91
Height	66.35	2.77	66.52	3.76	66.76	4.17	66.55	3.56
Weight	193.56	30.95	198.07	32.34	196.63	30.52	196.14	30.7
BMI (kg/m^2)	31.16	3.02	31.83	2.78	31.91	3.72	31.57	3.16
Waist Circumference (cm)								
Men (*n* = 18)	110.30	7.25	111.85	10.29	103.25	6.16	108.08	8.76
Women (*n* = 32)	102.69	11.90	100.67	6.70	109.02	19.08	103.97	12.03
Years of Education	14.13	.83	13.44	.96	14.40	1.05	13.98	1.02
Systolic Blood Pressure (mm Hg)	123.40	17.63	127.53	16.77	129.23	14.94	126.83	16.24
Diastolic Blood Pressure (mm Hg)	81.00	9.56	85.60	8.27	83.82	8.67	83.49	8.85
% Body Fat	37.50	9.21	36.72	4.63	35.68	8.96	36.62	7.73
Fasting Blood Sugar (mg/dl)	72.93	9.51	69.58	6.76	70.52	8.71	70.98	8.33
Total Cholesterol	218.25	45.05	222.35	43.36	229.17	44.63	223.36	43.66
Daily Calories	2253.91	641.44	2303.20	570.20	2247.49	402.45	2269.23	534.40
Servings of F&V	2.03	1.55	2.11	1.33	2.75	1.37	2.32	1.42
Vo_2max (L/min)	20.81	7.46	19.16	6.15	24.04	9.70	20.86	8.36
Daily Steps	5080.06	1996.61	5849.18	570.20	6440.05	3138.39	5790.97	2490.22
Structured Exercise per week	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manipulation Checks

To evaluate the delivery of the proposed treatment intervention program, we examined participants' responses on a questionnaire that examined their perceived knowledge and perceived confidence to maintain multiple lifestyle behaviors as a result of participation in an intervention program. The questionnaire was designed specifically to assess general health and behavior skills that were taught in all three-treatment programs in addition to specific topics and skills related to the two BCT treatment programs. A one way ANOVA yielded a significant difference between groups on perceived confidence related to various lifestyle skills, $F(2, 42) = 8.67$, $p < .001$. Post hoc analyses indicated that both the BCT with maintenance and BCT w/o maintenance groups reported significantly higher efficacy ($M = 4.61$, $SD = .34$, and $M = 4.5$, $SD = .50$) compared to the USDA group ($M = 3.89$, $SD = .66$), $p < .001$, and $p < .01$, respectively. It is important to note that while there were no statistical differences between the BCT and BCT w/o maintenance on any particular item or overall score, participants in the BCT treatment group reported higher level of efficacy specifically related to transitioning their program to their home or community and to recruit social support for assistance in their lifestyle changes ($M = 4.69$, $SD = .60$, and $M = 4.56$, $SD = .63$, respectively) compared to the BCT w/o maintenance group ($M = 4.27$, $SD = .70$, and $M = 4.40$, $SD = .51$, respectively). While we did not anticipate any statistical differences between the two groups on these items as they were discussed in both treatments, it is interesting that participants who received 'in-vivo' intervention related to exercise transitioning and family social support perceived slightly higher efficacy to perform those behaviors. Taken together, these data provide support for the fact that all three treatment groups appeared to gain knowledge and confidence in their abilities to engage in multiple lifestyle abilities as a result of their intervention program. However, participants in both BCT treatments appeared to perceive greater confidence in their ability to maintain their lifestyles changes related to specific cognitive and behavioral barriers and coping strategies.

In addition, the participant's evaluation of their interventionist independent of the intervention program was also considered. A one-way ANOVA found a significant difference between groups on the counselor evaluation, $F(2, 42) = 3.36$, $p < .05$. Post hoc analyses revealed that the USDA counselor was evaluated significantly lower (*M* = 4.51, *SD* = .54) than either the BCT and the BCT w/o maintenance groups (*M* = 4.88, *SD* = .23, and *M* = 4.61, *SD* = .45, respectively), $p < .05$. This finding is particularly notable as the individual that delivered the USDA treatment also delivered the BCT w/o maintenance treatment.

Based on these findings, there are two possible explanations for the present finding. One, it could be hypothesized that the interventionist interacted differently with the two treatment groups. However, this is unlikely due to the following explanation. In an attempt to minimize the interventionist's bias between treatments, the interventionist delivered the USDA first and then was trained specifically to deliver the BCT approach treatment. While the interventionist did have knowledge and some involvement in the development of the alternative treatment approach, she was not exposed to any of the intervention sessions with the BCT group, or trained on how to deliver the treatment during the initial phase of the study. An alternative explanation is that participants in the USDA treatment program perceived their counselor less favorably than participants in the BCT w/o maintenance group due to the nature of the intervention program. That is, the USDA manualized program is educationally-based in format, allowing for only minimal interaction and collaboration on strategies and progress. As a result of this approach (typical of educationally-based programs), it is likely that these participants did not feel that their counselor was as individually invested in them.

Taken together, these data suggest that both BCT treatments were successful in promoting higher maintenance efficacy in participants compared to participants in the USDA program. In addition, based on the counselor evaluation, it is suggested that their treatment group program impacted participant's evaluations of the counselor.

Attendance

Participants in the USDA group attended 96% (*M* = 30.88, *SD* = 1.58) of their 32 sessions during the 16-week treatment phase of the program. Participants in the BCT with maintenance group attended 98% (*M* = 26.65, *SD* = .49) of their 27 sessions. Specifically related to participants in the BCT with maintenance group, they completed 100% of two environmental visits and 68% of the participants brought a family member or friend in to discuss social support and lifestyle behavior changes. The WLC did not have attendance records, as they were not contacted during the first 16-week period. However, following post-test assessment, participants in the WLC then received the BCT w/o maintenance intervention for the next 12 weeks. During this time, participants in the BCT w/o maintenance group attended 93% (M = 22.47, SD = 1.65) of the 24 sessions. Taken together, attendance to treatment was relatively high in all groups.

PRIMARY OUTCOMES: PHASE I

As discussed previously, the goal of phase I of the study was to examine two alternative interventions in comparison to a wait-list-control group on multiple health outcomes after 16 weeks. Therefore, all primary outcomes presented below relate specifically to Phase I of the treatment study. Means, standard deviations, and ANOVA tables for the primary outcome variables for Phase I are presented in Tables 5 and 6.

Table 5: Means and Standard Deviations for Phase I Primary Outcomes as a Function of Group and Time.

Outcome Variable	*USDA*		*BCT*		*WLC*	
	M	SD	M	SD	M	SD
Body Weight (Pounds)						
Baseline	193.56	30.95	198.07	32.34	196.69	30.77
Post	190.83	29.52	187.71	31.79	198.61	30.46
Intrabdominal Fat (%)						
Baseline	36.53	4.83	35.83	4.56	35.79	9.27
Post	35.49	5.88	32.93	5.49	35.60	9.50
Aerobic Fitness (L/min)						
Baseline	20.81	7.46	19.16	6.15	24.04	9.70
Post	24.62	8.29	22.29	6.94	23.56	9.61
Physical Activity (Steps)						
Baseline	4852.98	2114.96	6224.97	2348.21	6440.05	3138.39
Post	6573.92	3549.46	10414.93	3750.88	7277.65	2229.53

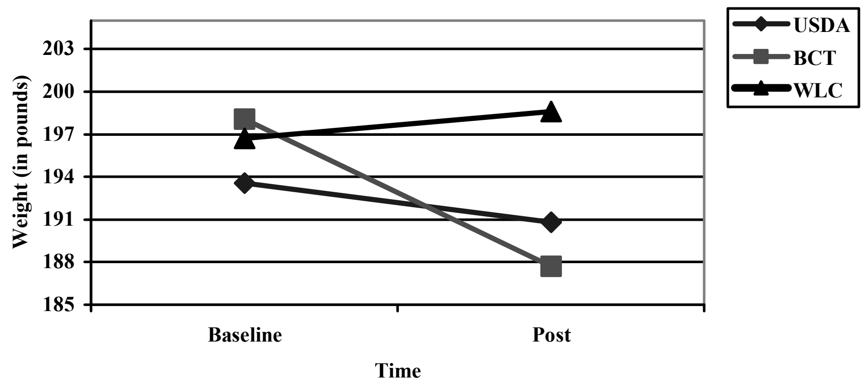
Table 6: Summary of Repeated Measures ANOVAs for Phase I Primary Outcomes as a Function of Group and Time.

Outcome Variable	*df*	*F*	*P*	Power	Effect Size
Body Weight (Pounds)					
Time	1,46	19.52	.00	.99	.30
Group	2,46	.20	.82	.01	.07
Group x Time	2,46	11.09	.00	.98	.32
Intrabdominal Fat (%)					
Time	1,46	17.57	.00	.98	.28
Group	2,46	24.89	.76	.09	.01
Group x Time	2,46	6.02	.00	.86	.21
Aerobic Fitness (L/min)					
Time	1,46	18.51	.00	.99	.29
Group	2,46	.60	.55	.14	.03
Group x Time	2,46	6.83	.00	.90	.23
Physical Activity (Steps)					
Time	1,36	28.49	.00	.99	.44
Group	2,36	2.91	.07	.53	.14
Group x Time	2,36	5.57	.01	.82	.24

Body Weight

A repeated measures ANOVA showed a significant interaction between treatment group and time for weight (in pounds), $F(2, 46) = 11.09$, $p < .001$. Between-groups testing indicated that there were no significant differences at post-test. As shown in Figure 2, within-groups post hoc analyses indicated that the BCT showed a significant weight loss (5.2%) from baseline to post-test ($M = -10.35$, $SD = 7.79$). However, there were no differences from baseline to post-test for the two two groups (USDA (1.3%), $M = -2.73$, $SD = 6.64$, and WLC (+.15%), $M = -.26$, SD=5.34), $t(16) = 5.48$, $p < .001$.

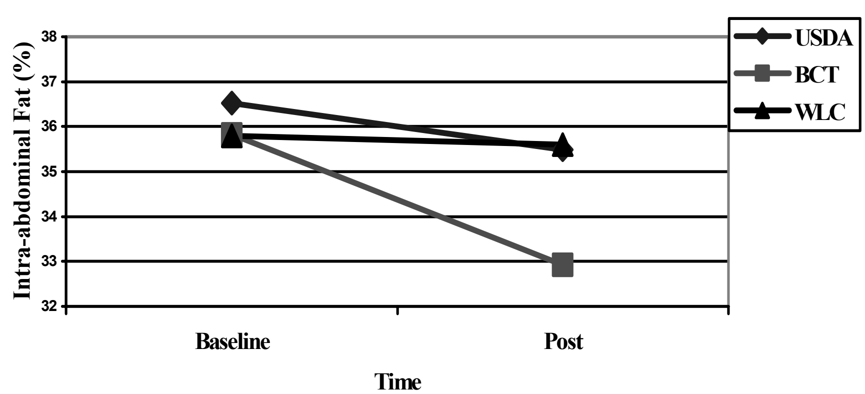
Figure 2. Body weight as a of function group assignment from baseline to post-test in Phase I.



Intra-abdominal Fat

A repeated measures ANOVA showed a significant interaction between treatment group and time for percent intra-abdominal fat, $F(2, 46) = 6.02$, $p < .01$. Between-group testing indicated that there were no differences at post-test. As shown in Figure 3, within-groups post hoc analyses indicated that both the BCT and USDA groups lost a significant percentage of intra-abdominal fat from baseline to post-test ($M = -2.90$, $SD = 3.00$ and $M = -1.14$, $SD = 1.70$, respectively) while the WLC group did not ($M = -.19$, $SD = 1.91$); $t(16) = 3.97$, $p < .001$, and $t(15) = 2.44$, $p < .05$. Notably, participants in the BCT group lost over twice as much intra-abdominal fat as the USDA group.

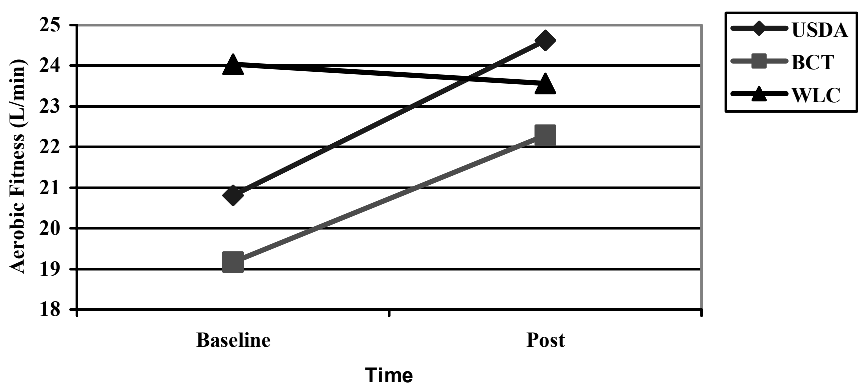
Figure 3. Intra-abdominal fat as a function of group assignment from baseline to post-test in Phase I.



Aerobic Fitness

A repeated measures ANOVA showed a significant interaction between treatment group and time for aerobic fitness, $F(2, 46) = 6.83$, $p < .01$. Between-group testing indicated that there were no differences at post-test. As shown in Figure 4, within-groups post hoc analyses indicated that both the BCT and USDA groups showed comparable improvement in their fitness (19%) from baseline to post-test ($M = +3.32$, $SD = 2.24$, and $M = +3.81$, $SD = 1.69$, respectively) while the WLC group did not ((1.5%) $M = -.48$, $SD = 5.63$), $t(16) = 6.12$, $p < .001$, and $t(15) = 8.99$, $p < .001$.

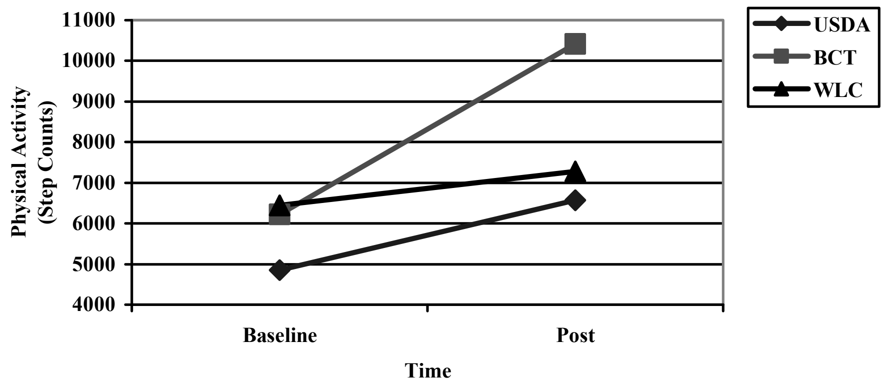
Figure 4. Aerobic fitness as a function of group assignment from baseline to post-test in Phase I.



Physical Activity

A repeated measures ANOVA showed a significant interaction between treatment group and time for physical activity, $F(2, 36) = 5.57$, $p < .01$. Post hoc analyses showed that the BCT group was significantly more active than either the USDA or WLC groups at post-test $F(36) = 4.93$, $p < .05$. As shown in Figure 5, within-groups post-hoc analyses indicated that both the BCT and USDA groups showed a significant improvement their daily physical activity from baseline to post-test ($M = 4189.96$, $SD = 2635.01$, and $M = 1720.94$, $SD = 2039.60$, respectively) while the WLC group did not ($M = 837.60$, $SD = 2919.91$), $t(16) = 6.12$, $p < .001$, and $t(15) = 8.99$, $p < .001$. Notably, the BCT group increased their step count over twice a much as the USDA group.

Figure 5. Physical activity as a function of group assignment from baseline to post-test in Phase I.



Taken together, the primary outcomes from Phase I of the study have several notable findings. The overall findings suggest that both the USDA and BCT groups were better compared to the WLC group at producing change on all of the primary health outcomes from baseline to post-test. More specifically, participants in both the USDA and BCT groups made significant improvements in aerobic fitness as a result of participation in their intervention program while participants in the WLC group slightly decreased fitness. Similarly, participants in the USDA and BCT groups decreased body weight and intra-abdominal fat while participants in the WLC group slightly increased weight and intra-abdominal fat. However, participants in the BCT group exhibited over three times as much weight loss and over twice as much intra-abdominal fat loss compared to participants in the USDA group. Further, while participants in both the USDA and BCT significantly increased their level of physical activity from baseline to post-test, participants in the BCT increased their physical activity by approximately 40 minutes while participants in the USDA increased their activity by less than 20 minutes. Overall, this pattern of findings would suggest that, with the exception of aerobic fitness, the BCT treatment was more beneficial in producing positive health changes in body weight, intra-abdominal weight and physical activity than the BCT, but both interventions were more beneficial compared to no intervention.

PRIMARY OUTCOMES: PHASE II

As discussed previously, the goal of phase II analyses was to examine the impact of the USDA, BCT with maintenance and BCT w/o maintenance intervention programs on multiple health outcomes at post-test and at 3 month follow-up. Therefore, all primary outcomes presented below relate specifically to Phase II of the treatment study. Means, standard deviations, and ANOVA tables for the primary outcome variables for Phase II are presented in Tables 7 and 8.

Table 7: Means and Standard Deviations for Phase II Primary Outcomes as a Function of Group and Time.

Outcome Variable	*USDA*		*BCT*		*BCT w/o maint*	
	M	SD	M	SD	M	SD
Body Weight (Pounds)						
Baseline	190.64	29.66	194.94	30.62	196.68	30.91
Post	187.65	27.58	184.24	29.31	188.90	30.54
Follow-up	186.91	27.53	183.65	27.39	189.37	30.24
Intrabdominal Fat (%)						
Baseline	36.83	4.85	35.65	4.76	35.39	9.81
Post	35.78	6.08	32.58	5.72	34.11	11.31
Follow-up	36.25	5.78	32.93	6.11	33.57	11.63
Aerobic Fitness (L/min)						
Baseline	19.88	6.70	17.82	6.03	25.01	9.31
Post	23.68	7.65	21.19	7.07	28.12	11.88
Follow-up	21.23	7.49	21.13	6.36	26.46	11.01
Physical Activity (Steps)						
Baseline	4851.52	2218.18	6218.89	2621.31	7508.32	2279.64
Post	6511.11	3715.70	10634.55	4125.07	10506.23	2640.81
Follow-up	7774.18	3675.27	10641.03	3064.75	10024.08	2326.69

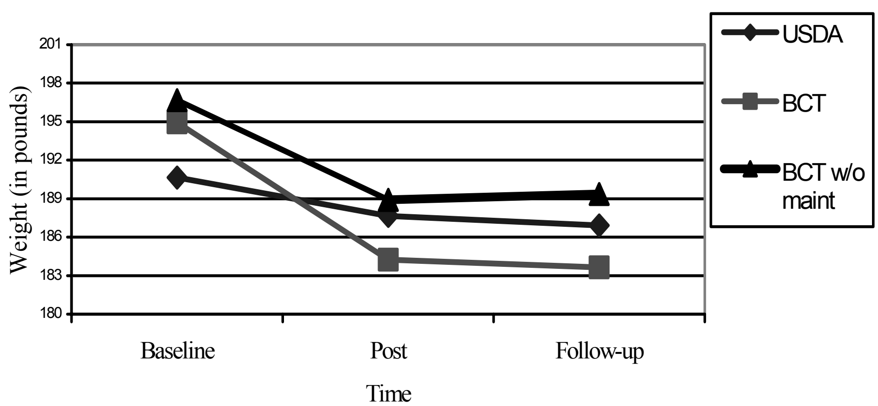
Table 8: Summary of Repeated Measures ANOVAs for Phase II Primary Outcomes as a Function of Group and Time.

Outcome Variable	*df*	*F*	*P*	Power	Effect Size
Body Weight (Pounds)					
Time	2,44	27.77	.00	1.0	.56
Group	2,45	.09	.91	.06	.00
Group x Time	4,90	2.60	.04	.71	.10
Intrabdominal Fat (%)					
Time	2,41	10.71	.00	.98	.34
Group	2,42	.46	.64	.12	.02
Group x Time	4,84	2.09	.09	.59	.09
Aerobic Fitness (L/min)					
Time	2,38	29.47	.00	1.0	.61
Group	2,39	2.35	.11	.44	.11
Group x Time	4,78	.91	.46	.27	.04
Physical Activity (Steps)					
Time	2,29	45.89	.00	1.0	.76
Group	2,30	311.67	.02	.71	.22
Group x Time	4,60	2.54	.05	.68	.14

Weight

A repeated measures ANOVA showed a significant interaction between treatment group and time for weight, $F(4, 90) = 2.60$, $p < .05$. Between-groups testing indicated that there were no significant differences at either post-test or follow-up. As shown in Figure 6, within-groups post hoc analyses indicated that both the BCT and BCT w/o maintenance groups showed significant weight loss from baseline to post-test ((5.2%) $M = -10.69$, $SD = 7.92$, and (3.8%) $M = -7.78$, $SD = 4.82$, respectively) while the USDA group did not ($M = -2.99$, $SD = 6.79$), $t(15) = 5.41$, $p < .001$, and $t(16) = 6.64$, $p < .001$. From baseline to follow-up, both the BCT and BCT w/o maintenance groups maintained their weight loss ($M = -11.28$, $SD = 13.61$, and $M = -7.30$, $SD = 6.45$, respectively), $t(15) = 3.31$, $p < .005$ and $t(16) = 4.67$, $p < .001$. The USDA group lost a small amount of weight during the follow-up period that resulted in reaching a statistically significant level of weight loss from baseline to follow-up (M = -3.7, SD = 6.05), $t(14) = 2.39$, $p < .05$. With these findings, it is important to note while both BCT groups maintained their overall weight loss at follow-up, the BCT group continued to lose weight while the BCT w/o maintenance group slightly increased body weight.

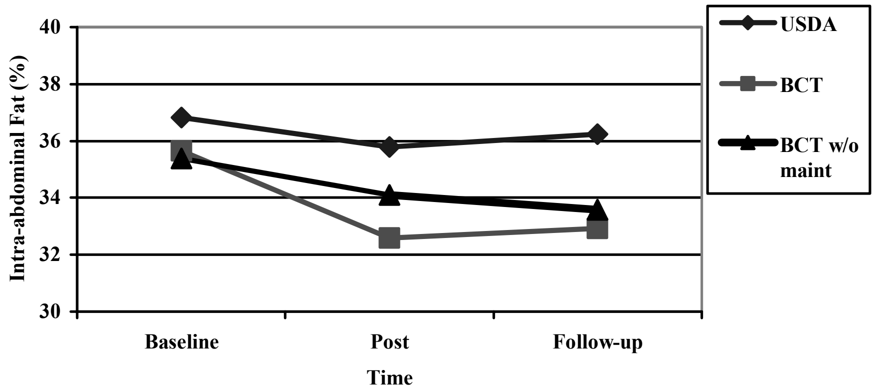
Figure 6. Body weight as a function of group assignment from baseline, post-test, and follow-up in Phase II.



Intra-abdominal Fat

A repeated measures ANOVA showed a significant main effect for time on intra-abdominal fat, $F(2, 46) = 6.02$, $p < .001$. As shown in Figure 7, within-groups post hoc analyses indicated that the BCT and USDA groups lost a significant percentage of intra-abdominal fat from baseline to post-test (M = -3.07, SD = 3.17, and M = -1.05, SD = 1.76, respectively) while the BCT w/o maintenance group did not (M = -1.27, SD = 2.61), $t(14) = 3.75$, $p < .01$ and $t(14) = 2.32$, $p < .05$. At 3-month follow-up, participants in the BCT group had maintained their intra-abdominal fat loss (M = -2.72, SD = 4.09), $t(14) = 2.57$ $p < .05$. Participants in the BCT w/o maintenance group continued to lose intra-abdominal resulting in a significant difference from baseline (M = -1.82, SD = 2.66), $t(14) = 2.65$ $p < .05$. Taken together, the BCT and BCT w/o maintenance groups were able to show significant intra-abdominal fat loss from baseline to follow-up while participants in the USDA treatment group were unable to maintain their fat loss following treatment.

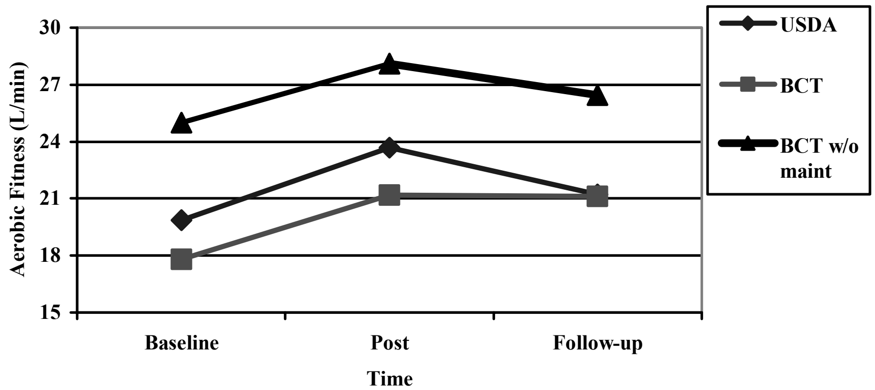
Figure 7. Intra-abdominal fat as a function of group assignment from baseline, post-test, and follow-up in Phase II.



Aerobic Fitness

A repeated measures ANOVA showed a significant main effect for time on cardiovascular fitness, $F(2, 38) = 29.47$, $p < .01$. As shown in Figure 8, within groups post hoc analyses indicated that all three groups (BCT, USDA, and BCT w/o maintenance) significantly improved their fitness from baseline to-post-test ($M = +3.36$, $SD = 2.36$, $M = +3.80$, $SD = 1.765$, and $M = +3.11$, $SD = 4.18$, respectively), $t(12) = 5.14$, $p < .001$, $t(14) = 8.40$, $p < .001$, and $t(13) = 2.79$, $p < .05$. Participants in the USDA and BCT w/o maintenance groups decreased their cardiorespiratory fitness from post-test to follow-up ($M = -2.45$, $SD = 4.89$, $M = -1.67$, $SD = 3.21$, respectively). Conversely, from post to follow-up, the BCT group maintained their cardiorespiratory fitness. As a result, from baseline to follow-up, only the BCT exhibited significant increases in their cardiorespiratory fitness ($M = +3.30$, $SD = 2.73$), while the other two did not (USDA, $M = +1.35$, $SD = 4.18$, and BCT w/o maintenance, $M = +1.44$, $SD = 2.84$), $t(12) = 4.37$, $p < .001$.

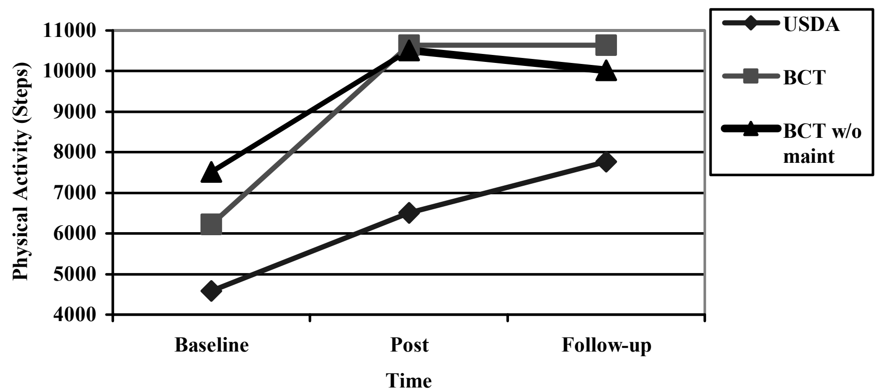
Figure 8. Aerobic fitness as a function of group assignment from baseline, post-test, and follow-up in Phase II.



Physical Activity

A repeated measures ANOVA showed a significant interaction between treatment group and time for physical activity, $F(4, 60) = 2.54$, $p < .05$. Between-group testing indicated that there were significant differences at baseline (as discussed previously) and post-test $F(36) = 4.93$, $p < .05$. Post hoc analyses showed that the BCT group was significantly more active than either the USDA or BCT w/o maintenance groups at post-test. As shown in Figure 9, within-groups post hoc analyses indicated that all three groups showed a significant improvement in their daily physical activity from baseline to post-test (BCT, $M = 4417.66$, $SD = 2866.43$, BCT w/o maint, $M = 2997.91$, $SD = 1398.78$, and USDA, $M = 1659.59$, $SD = 2127.50$), $t(9) = 4.62$, $p < .01$, $t(12) = 7.73$, $p < .001$, and $t(10) = 2.59$, $p < .05$. At 3-month follow-up, all three groups maintained their increased level of physical activity (BCT, $M = 4424.66$, $SD = 1960.21$, BCT w/o maintenance, $M = 2515.75$, $SD = 1400.61$, and USDA, $M = 2922.66$, $SD = 3241.57$), $t(9) = 4.62$, p < .01, $t(12) = 7.73$, $p < .001$, and $t(10) = 2.59$, $p < .05$. Notably, while both BCT groups reached their goal of increasing their step count by 3000 per day (approximately 30 minutes of physical activity per day or 10,000 steps per day) during treatment and maintained their goal at follow-up, the BCT group maintained 100% of their daily physical activity while the BCT w/o maintenance group began to show some slight decline in daily activity. Interestingly, participants in the USDA group continued to make steady increases in their physical activity from post-test to follow-up so that they were now almost walking 3000 steps more than baseline. However, their overall level of activity was significantly less than either the BCT or BCT w/o maintenance groups.

Figure 9. Physical Activity as a function of group assignment from baseline, post-test, and follow-up in Phase II.



Taken together, the primary outcomes from Phase II of the study are significant. The overall findings suggest that the BCT, BCT w/o maintenance, and USDA groups were all effective in producing change on multiple health outcomes. However, there were notable differences between groups on relative changes at post-test and their ability to maintain their changes at follow-up. As expected, participants in all treatment groups made similar improvements in cardiovascular fitness from baseline to post-test. However, by 3-month follow-up, only participants in the BCT group were able to maintain their fitness gains while the other two groups exhibited notable declines in fitness across time. In addition, participants in the BCT and BCT w/o maintenance groups were able to lose more weight during treatment compared to the USDA group. By 3-month follow-up, the USDA had continued to lose a minimal amount of weight so that participants in all three groups had shown significant weight loss. Notably, only participants in the BCT group continued to exhibit weight loss from post-test to follow-up while participants in the BCT w/o maintenance began to show an increase in body weight. Conversely, from baseline to post-test, only the BCT and USDA groups exhibited significant decreases in intra-abdominal fat. However, from post-test to follow-up, the BCT w/o maintenance continued to decrease intra-abdominal fat that reached statistical significance while participants in the USDA increased intra-abdominal fat so their changes were no longer significant. Therefore, only the two BCT groups lost a significant amount of intra-abdominal fat from baseline to follow-up. Lastly, while participants in all three treatment groups significantly increased their level of physical activity from baseline to post-test, participants in the two BCT groups increased their activity by almost twice as much as the USDA during treatment. Interestingly, similar to the trend of body weight, at 3-month follow-up, participants in the BCT maintained their increased physical activity 100% while participants in the BCT w/o maintenance showed a slight decline in their overall level of activity from post-test.

Overall, this pattern of results would suggest that both BCT treatments appeared to be more beneficial in producing significant health changes in body weight, intra-abdominal weight and physical activity from baseline to follow-up in comparison to the USDA group. Moreover, with the exception of intra-abdominal fat, participants in the BCT group maintained their cardiorespiratory fitness gains, and to a less extent, exhibited better maintenance of body weight and physical activity in comparison to the BCT w/o maintenance group.

SECONDARY OUTCOMES: PHASE I

As discussed previously, the goal of phase I of the study was to examine two alternative interventions in comparison to a wait-list-control group on multiple health outcomes after 16 weeks. Therefore, all secondary outcomes presented below relate specifically to Phase I of the treatment study. Means, standard deviations, and ANOVA tables for the exploratory outcome variables are presented in Tables 9 and 10.

Table 9: Means and Standard Deviations for Phase I Secondary Outcomes as a Function of Group and Time

Outcome	*USDA*		*BCT*		*WLC*	
Variable	M	SD	M	SD	M	SD
Anthropometrics						
BMI						
Baseline	31.16	3.02	31.83	2.79	31.71	3.73
Post	30.68	3.06	29.99	2.77	31.57	3.92
Waist						
Baseline	105.07	11.03	103.94	12.19	106.65	15.09
Post	104.59	9.93	96.66	11.33	106.30	14.92
Hip						
Baseline	112.89	9.33	115.01	5.99	116.63	8.81
Post	112.46	7.85	110.08	5.55	116.33	10.43
% Body Fat						
Baseline	37.50	9.22	36.72	4.63	35.41	9.19
Post	34.35	6.35	34.03	5.07	34.94	9.42
Blood Lipids						
Triglycerides						
Baseline	126.43	54.74	121.41	73.61	162.31	66.85
Post	120.35	63.60	92.47	46.96	136.06	81.34
Total Cholesterol						
Baseline	218.25	45.05	222.35	43.36	229.31	46.10
Post	207.83	33.42	205.94	39.81	235.56	42.62
HDL						
Baseline	50.18	19.51	53.76	12.88	45.56	9.65
Post	50.25	16.06	51.35	10.42	48.56	11.52
LDL						
Baseline	129.91	53.34	144.23	37.10	144.50	47.87
Post	124.62	41.09	136.00	37.79	159.81	35.67

Blood Pressure						
Systolic						
Baseline	128.63	11.90	128.06	13.98	128.47	17.17
Post	120.50	15.24	118.59	12.70	121.53	11.03
Diastolic						
Baseline	89.88	6.95	87.88	11.25	85.76	9.16
Post	85.00	11.82	82.12	7.19	84.35	11.32
Strength						
Baseline	59.88	23.00	59.38	15.58	52.91	19.88
Post	117.12	33.54	105.34	30.22	53.86	19.93

Table 10: Summary of Repeated Measures ANOVAs for Phase I Secondary Outcomes as a Function of Group and Time

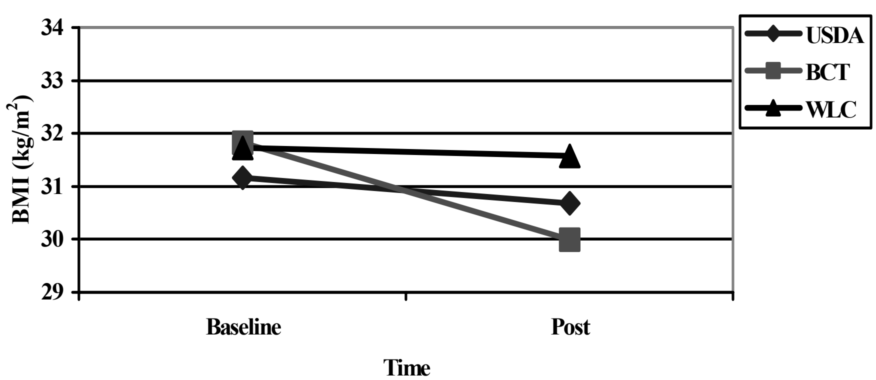
Outcome Variable	*df*	*F*	*p*	Power	Effect Size
Body Composition					
BMI					
Time	1,50	25.23	.00	.99	.34
Group	2,50	.29	.75	.09	.01
Group x Time	2,50	10.26	.00	.98	.30
Waist					
Time	1,46	21.93	.00	.99	.32
Group	2,46	1.08	.35	.28	.04
Group x Time	2,46	15.59	.00	.99	.40
Hip					
Time	1,44	8.94	.00	.83	.17
Group	2,44	1.17	.32	.24	.05
Group x Time	2,44	5.73	.00	.84	.21
% Body Fat					
Time	1,46	10.24	.00	.88	.18
Group	2,46	4.87	.95	.05	.00

Group x Time	2,46	1.57	.21	.32	.06
Blood Lipids					
Triglycerides					
Time	1,44	7.46	.00	.76	.14
Group	2,44	2.03	.14	.40	.08
Group x Time	2,44	.89	.42	.19	.04
Total Cholesterol					
Time	1,46	3.09	.08	.41	.06
Group	2,46	1.22	.30	.25	.05
Group x Time	2,46	3.02	.05	.56	.11
HDL					
Time	1,46	.02	.88	.05	.00
Group	2,46	.76	.47	.17	.03
Group x Time	2,46	1.19	.31	.25	.05
LDL					
Time	1,46	.02	.89	.05	.00
Group	2,46	1.62	.21	.32	.06
Group x Time	2,46	2.45	.09	.47	.09
Blood Pressure					
Systolic					
Time	1,47	23.08	.00	.99	.33
Group	2,47	.08	.92	.06	.16
Group x Time	2,47	.19	.83	.08	.01
Diastolic					
Time	1,47	6.83	.01	.73	.13
Group	2,47	.47	.63	.12	.02
Group x Time	2,47	.76	.47	.17	.03
Strength					
Time	1,45	252.41	.00	1.0	.85
Group	2,45	10.36	.00	.98	.31

Anthropometrics and Body Composition

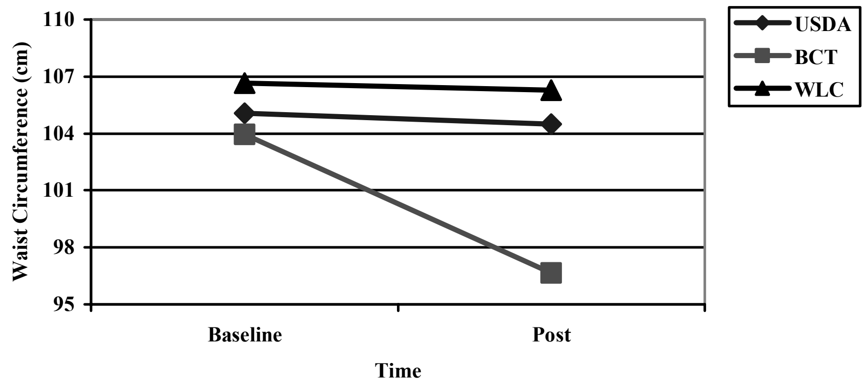
Body Mass Index (BMI). A repeated measures ANOVA showed a significant interaction between treatment group and time for BMI, $F(2, 47) = 10.27$, $p < .001$. Between-group testing indicated that there were no differences at post-test. As shown in Figure 10, within groups post hoc analyses indicated that only participants in the BCT group showed significant reduction in their BMI from baseline to post-test ($M = -1.83$, $SD = 1.13$) while the other two groups did not (USDA, $M = -.49$, $SD = 1.24$, and WLC, $M = -.13$, $SD = 1.08$, respectively), $t(16) = -6.66$, $p < .001$.

Figure 10. Body Mass Index (BMI) as a function of group assignment from baseline to post-test in Phase I.



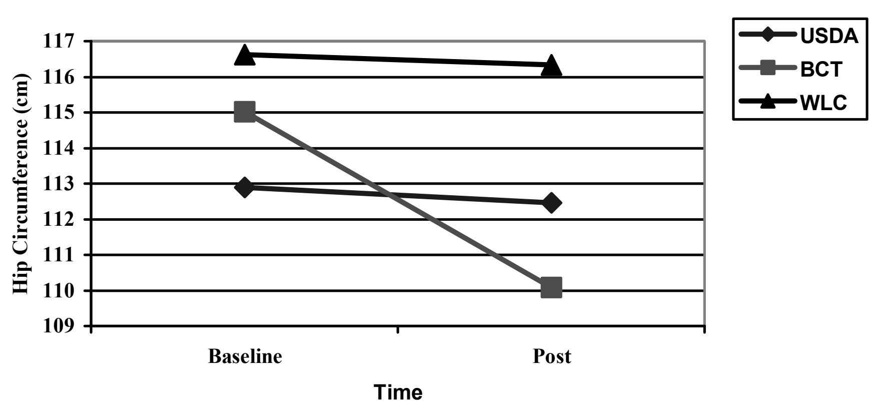
Waist Circumference. A repeated measures ANOVA showed a significant interaction between treatment group and time for waist circumference F(2, 46) = 15.59, p < .001. Between group testing indicated that there were no differences at post-test. As shown in Figure 11, within groups post hoc analyses indicated that only participants in the BCT group showed a significant waist circumference loss (6.9%) from baseline to post-test ($M = -7.28$, $SD = 3.28$) while the other two groups did not (USDA (.25%), $M = -.48$, $SD = 4.96$, and WLC (-.23%), $M = -.13$, $SD = .34$, respectively), $t(15) = -8.88$, $p < .001$.

Figure 11. Waist Circumference (cm) as a function of group assignment from baseline to post-test in Phase I.



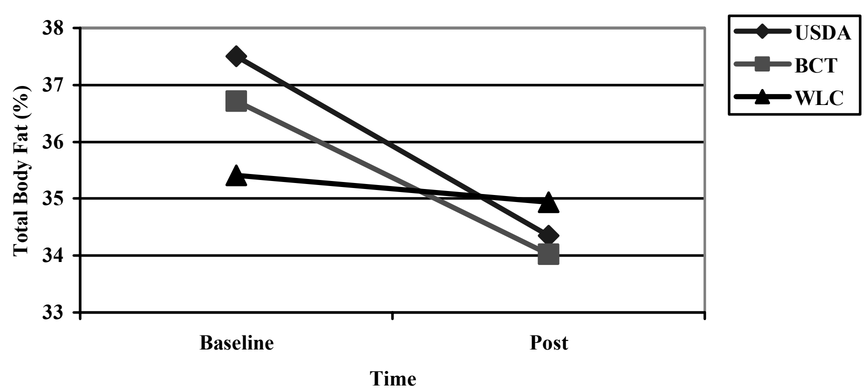
Hip Circumference. A repeated measures ANOVA showed a significant interaction between treatment group and time for hip circumference $F(2, 44) = 5.73$, $p < .01$. Between group post hoc analyses indicated that there were no differences at post-test. As shown in Figure 12, within groups post hoc analyses indicated that only participants in the BCT group significantly decreased their hip circumference (4.3%) from baseline to post-test ($M = -4.94$, $SD = 2.27$) while the other two groups did not (USDA (.14%), M = -.43, $SD = 5.94$, and WLC (.18%), $M = -.29$, $SD = 4.00$, respectively), $t\ (14) = -8.43$, $p < .001$.

Figure 12. Hip Circumference (cm) as a function of group assignment from baseline to post-test in Phase I.



Total body fat. A repeated measures ANOVA showed a significant main effect for time for total percent body fat, $F(1, 46) = 10.42$, $p < .01$. As shown in Figure 13, within-groups post hoc analyses indicated that only the BCT group showed a significant loss in total body fat from baseline to post-test ($M = -2.68$, $SD = 2.07$) while the other two groups did not (USDA, $M = -3.14$, $SD = 7.56$, and WLC, $M = -.47$, $SD = 1.36$), $t(16) = 5.34$, $p < .001$. It is important to note that while the USDA group did not show statistically significant changes in total body fat from baseline to post-test, the percent change was actually larger than that of the BCT group.

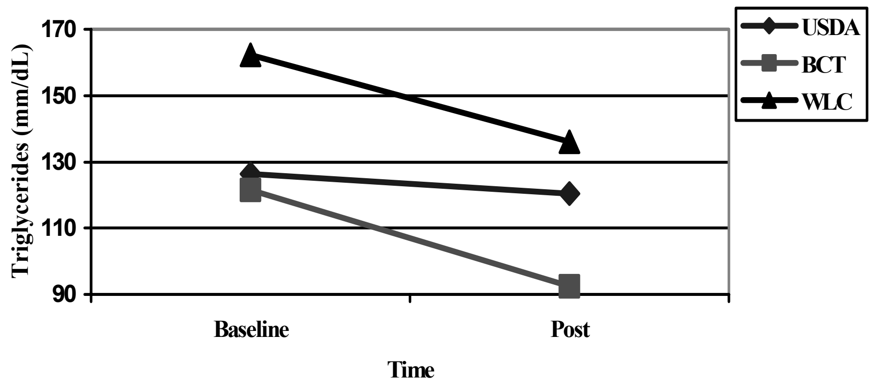
Figure 13. Total Body Fat (%) as a function of group assignment from baseline to post-test in Phase I.



Blood Lipid Analyses

Triglycerides. A repeated measures ANOVA showed a significant main effect for time on triglycerides $F(1, 44) = 7.46$, $p < .01$. As shown in Figure 14, within groups post hoc analyses indicated that only the BCT group showed significant reductions in their triglycerides from baseline to post-test ($M = -28.98$, $SD = 43.50$) while the other two groups did not (USDA, $M = -6.07$, $SD = 56.31$, and WLC, $M = -26.25$, $SD = 53.77$), $t(16) = 5.34$, $p < .05$. While it did not reach statistical significance, the WLC group did appear to have a marked decrease in triglycerides during their pre-treatment period.

Figure 14. Triglycerides as a function of group assignment from baseline to post-test in Phase I.



Total Cholesterol (TC). A repeated measures ANOVA did not show any significant main effects or interactions for time or group on TC ($p > .05$).

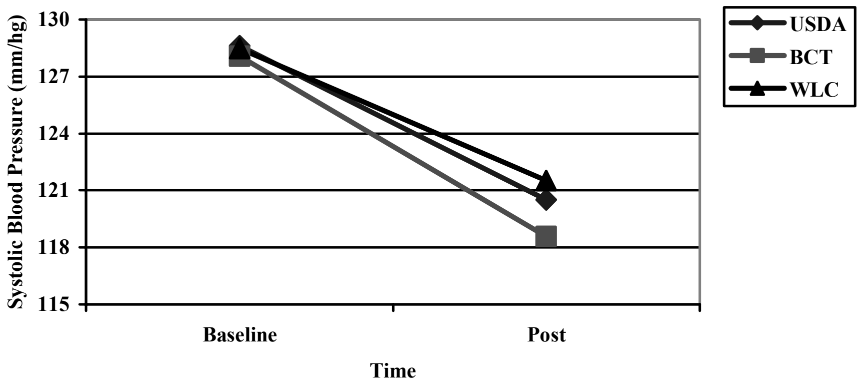
HDL. A repeated measures ANOVA did not show any significant main effects or interactions for time or group ($p > .05$).

LDL. Similar to HDL, a repeated measures ANOVA did not reveal any significant main effects or interactions for time or group ($p > .05$).

Blood Pressure

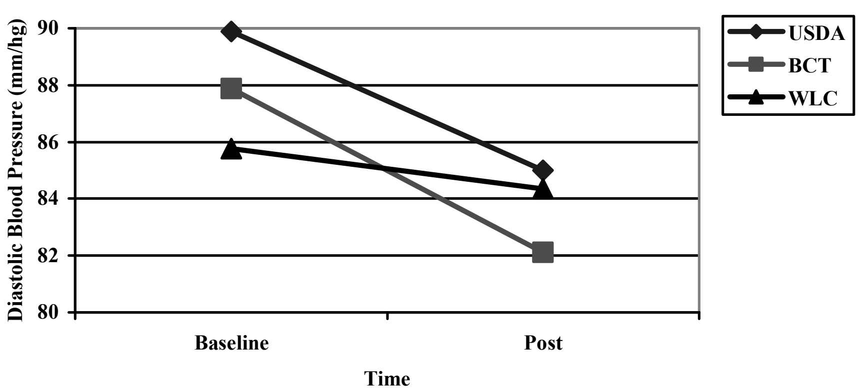
Systolic Blood Pressure. A repeated measures ANOVA showed a significant main effect for time on resting systolic blood pressure, $F(1, 47) = 23.08$, $p < .001$. As shown in Figure 15, within groups post hoc analyses indicated that participants in all three groups (BCT, USDA, and WLC) had a significant reduction in their resting systolic blood pressure at post-test (M = -9.47, SD = 13.45, M = -8.13, SD = 11.94, and M = -6.94, SD = 10.51), $t(16) = -2.90$, $p < .010$, $t(15) = -2.72$, and $t(16) = -2.72$, $p < .05$.

Figure 15. Systolic blood pressure as a function of group assignment from baseline to post-test in Phase I.



Diastolic Blood Pressure. A repeated measures ANOVA showed a significant main effect for time on resting diastolic blood pressure $F(1, 47) = .76$, $p < .05$. As shown in Figure 16, within-groups post hoc analyses indicated that only the BCT group showed a significant reduction in their diastolic blood pressure from baseline to post-test (M = -5.76, SD = 8.68) while the other two groups did not (USDA, M = -4.88, SD = 11.87, and WLC, M = -1.41, SD = 11.81, respectively), $t(16) = 2.73$, $p < .05$. It important to note the USDA group exhibited similar decreases in their resting systolic blood pressure.

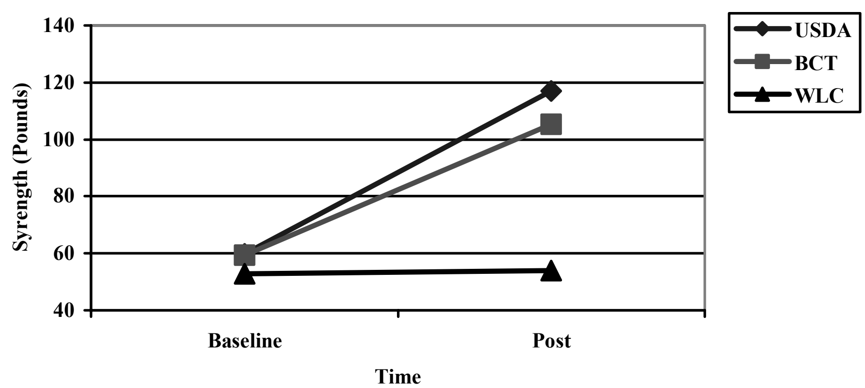
Figure 16. Diastolic blood pressure as a function of group assignment from baseline to post-test in Phase I.



Strength

A repeated measures ANOVA showed a significant interaction between treatment group and time on strength, $F(2, 45) = 61.90$, $p < .001$. Between group testing indicated that there was a significant group difference at post-test $F(47) = 22.31$, $p < .001$. Post-hoc analyses showed that both the BCT and USDA groups had a significantly higher mean strength at post-test compared to the WLC. As shown in Figure 17, within groups post hoc analyses indicated that both the BCT and USDA groups showed a significant increase in strength at post-test ($M = +45.96$, $SD = 20.11$, and $M = +57.23$, $SD = 16.61$, respectively) while participants in the WLC group did not ($M = -.95$, $SD = 2.71$), $t(15) = 13.78$, $p < .001$, and $t(15) = 9.14$, $p < .001$.

Figure 17. Strength as a function of group assignment from baseline to post-test in Phase I.



Taken together, the secondary outcomes from Phase I of the study have several notable findings. Similar to findings from the primary outcomes, with the exception of systolic blood pressure, both the BCT and USDA groups were significantly better compared to the WLC group on producing change in multiple health outcomes from baseline to post-test. In addition, participants in both the USDA and BCT groups made similar improvements in strength and decreased body fat. However, participants in the BCT exhibited significant changes in BMI, waist and hip circumference, triglycerides, and diastolic blood pressure while participants in the USDA did not. Notably, there were no changes in Total Cholesterol, HDL, or LDL across treatment groups or time.

SECONDARY OUTCOMES: PHASE II

As discussed previously, the goal of phase II of the study was to examine the impact of the USDA, BCT with maintenance and BCT w/o maintenance intervention programs on multiple health outcomes at post-test and at 3 month follow-up. Therefore, all secondary outcomes presented below relate specifically to Phase II of the treatment study. Means, standard deviations, and ANOVA tables for the secondary outcome variables are presented in Tables 11 and 12.

Table 11: Means and Standard Deviations for Phase II Secondary Outcomes as a Function of Group and Time.

Outcome	*USDA*		*BCT*		*BCT w/o maint*	
Variable	M	SD	M	SD	M	SD
Anthropometrics						
BMI						
Baseline	30.75	2.62	31.63	2.83	31.70	4.01
Post	30.33	2.82	29.76	2.63	30.68	3.66
Follow-up	30.27	2.94	29.35	3.11	30.26	3.84
Waist						
Baseline	105.07	11.03	103.43	12.67	106.60	15.35
Post	104.59	9.93	95.61	11.24	102.06	13.61
Follow-up	105.14	9.54	93.43	9.79	99.00	15.82
Hip						
Baseline	112.89	9.33	114.57	6.22	116.95	10.45
Post	112.46	7.85	109.47	5.68	114.04	10.41
Follow-up	112.48	7.26	107.32	6.29	111.62	11.02
% Body Fat						
Baseline	38.13	9.18	36.56	4.83	34.94	9.43
Post	34.82	6.28	33.74	5.27	33.78	10.62
Follow-up	35.06	6.05	33.70	5.31	33.36	10.83

Blood Lipids						
Total Cholesterol						
Baseline	228.77	32.24	226.25	41.59	235.56	42.62
Post	216.76	24.15	207.94	40.23	206.25	50.13
Follow-up	207.00	43.89	227.93	67.69	178.00	31.39
Triglycerides						
Baseline	132.92	51.05	123.50	75.50	136.06	81.34
Post	122.84	65.48	93.06	48.44	130.87	59.57
Follow-up	151.15	85.21	100.50	58.95	116.00	54.22
HDL						
Baseline	53.46	20.25	54.75	12.62	48.56	11.52
Post	51.31	15.55	51.69	10.67	54.87	14.80
Follow-up	71.15	22.10	63.00	13.96	41.56	9.47
LDL						
Baseline	149.54	33.84	146.75	36.79	159.81	35.67
Post	140.92	23.31	137.56	38.36	125.19	44.06
Follow-up	105.54	51.27	144.75	65.62	113.19	21.66
Blood Pressure						
Systolic						
Baseline	127.73	11.76	126.69	15.22	120.40	11.06
Post	120.13	15.70	114.61	11.29	115.33	12.73
Follow-up	119.33	11.20	117.08	12.30	117.60	13.59
Diastolic						
Baseline	89.73	7.16	86.31	12.27	83.60	11.49
Post	85.33	12.15	80.15	6.90	79.80	9.36
Follow-up	81.87	7.26	79.54	9.37	78.87	6.89
Strength						
Baseline	56.70	19.82	56.26	13.58	58.23	23.66
Post	113.40	31.12	100.35	28.37	108.88	43.50
Follow-up	108.18	35.60	107.32	31.98	109.56	53.49

Table 12: <u>Summary of Repeated Measures ANOVAs for Phase II Secondary Outcomes as a Function of Group and Time.</u>

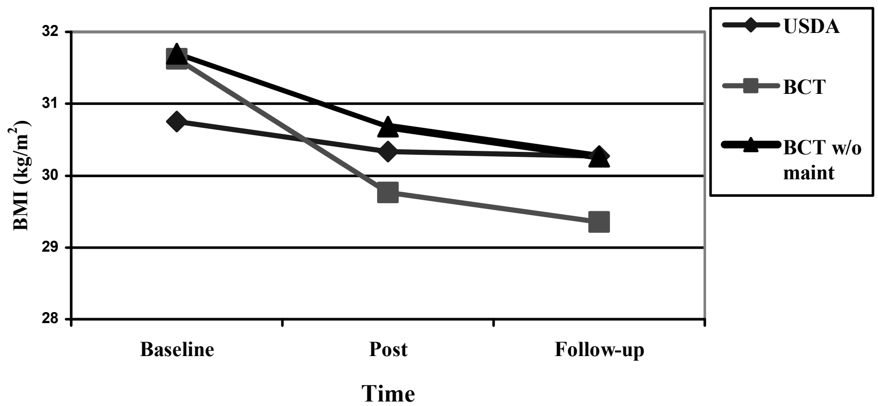
Outcome Variable	*Df*	*F*	*P*	Power	Effect Size
<u>Anthropometrics</u>					
BMI					
Time	2,41	24.43	.00	1.0	.54
Group	2,42	.16	.85	.07	.01
Group x Time	4,84	3.13	.02	.79	.13
Waist					
Time	2,42	25.87	.00	1.0	.55
Group	2,43	1.50	.23	.30	.06
Group x Time	4,86	5.46	.00	.97	.20
Hip					
Time	2,40	15.27	.00	.99	.43
Group	2,41	.73	.49	.17	.03
Group x Time	4,82	3.19	.02	.80	.13
% Body Fat					
Time	2,42	6.09	.00	.86	.22
Group	2,43	.27	.76	.09	.01
Group x Time	4,86	.85	.49	.26	.04
<u>Blood Lipids</u>					
Total Cholesterol					
Time	2,41	13.06	.00	.99	.34
Group	2,42	.61	.55	.15	.03
Group x Time	4,84	3.62	.01	.86	.15
Triglycerides					
Time	2,41	1.86	.17	.36	.08
Group	2,42	1.16	.34	.23	.05
Group x Time	4,84	2.15	.08	.61	.09
HDL					
Time	2,41	3.03	.06	.55	.13
Group	2,42	3.37	.04	.60	.14

Group x Time	4,84	5.84	.00	.97	.22
LDL					
Time	2,41	13.35	.00	.99	.39
Group	2,42	.52	.59	.13	.02
Group x Time	4,84	3.72	.01	.87	.15
Blood Pressure					
Systolic					
Time	2,39	10.59	.00	.98	.35
Group	2,40	.77	.47	.17	.03
Group x Time	4,80	.89	.47	.27	.04
Diastolic					
Time	2,39	6.55	.00	.89	.25
Group	2,40	1.96	.15	.38	.90
Group x Time	4,80	.27	.89	.11	.01
Strength					
Time	2,39	143.72	.00	1.0	.88
Group	2,40	.10	.90	.06	.00
Group x Time	4,80	1.93	.11	.56	.09

Anthropometrics and Body Composition

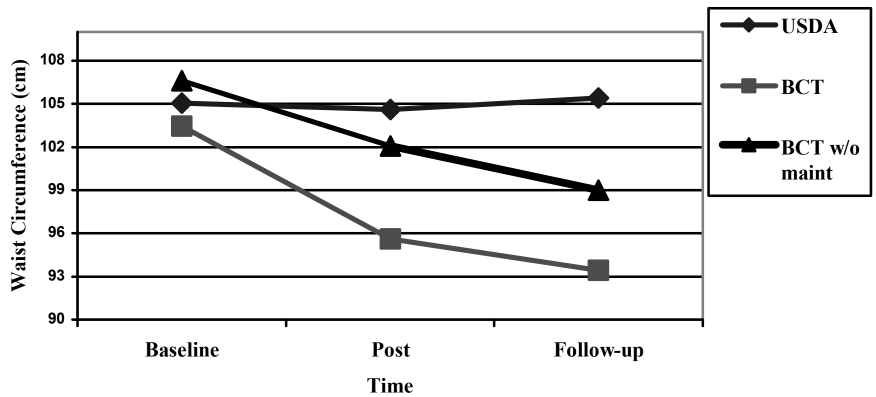
Body Mass Index (BMI). A repeated measures ANOVA showed a significant interaction between treatment group and time for BMI, $F(2, 84) = 3.13$, $p < .05$. Between-group testing indicated that there were no differences at either post-test or follow-up. As shown in Figure 18, within groups post hoc analyses indicated that only participants in the BCT and BCT w/o maintenance groups significantly reduced their BMI from baseline to post-test ($M = -1.87$, $SD = 1.09$, and $M = -1.02$, $SD = 1.06$; $t(13) = 6.42$, $p < .001$ and $t(15) = 3.83$, $p < .01$, respectively) and continued to decrease their BMI at follow-up testing ($M = -2.28$, $SD = 1.94$, and $M = -1.44$, $SD = .97$; $t(13) = 4.40$, $p < .001$ and $t(15) = 5.92$, $p < .001$). The BMI changes in the BCT group are particularly noteworthy in that by follow-up, participants in this group were no longer considered obese, based on their BMI of 29.35 (<30). Participants in the USDA group showed no significant decreases in their BMI across treatment or follow-up ($p > .05$).

Figure 18. Body mass index (BMI) fat as a function of group assignment from baseline, post-test, and follow-up in Phase II.



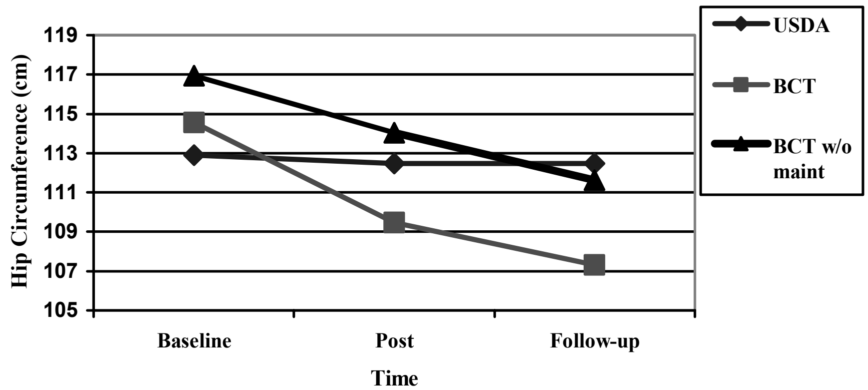
Waist Circumference. A repeated measures ANOVA showed a significant interaction between treatment group and time on waist circumference, $F(4, 86) = 5.46$, $p < .001$. Between group testing indicated that there were significant differences in waist circumference at follow-up $F(43) = 3.47$, $p < .05$. Post-hoc analyses showed that both the BCT and BCT w/o maintenance groups had significant waist circumference losses at follow-up compared to the USDA. As shown in Figure 19, within groups post hoc analyses indicated that participants in the BCT and BCT w/o maintenance groups lost a significant amount of centimeters off their waist from pre-to-post-test ((6.9%) $M = -7.82$, $SD = 3.09$, and (3.6%) $M = -3.05$, $SD = 5.76$, respectively), $t(13) = 9.46$, p <.001, and $t(15) = 4.06$, $p < .001$. While participants in both the BCT and BCT w/o maintenance groups continued to lose centimeters from post to follow-up, only the loss in the BCT w/o maintenance group reached statistical significance ((3.1%) $M = -3.05$, $SD = 5.76$), $t(15) = 2.12$, $p < .05$. Overall, both the BCT and BCT w/o maintenance groups maintained their waist circumferences losses from baseline to follow-up ((8.8%) $M = -10.00$, $SD = 9.07$, and (7.3%) $M = -7.60$, $SD = 2.90$, respectively), $t(13) = 4.12$, $p < .001$, and $t(15) = 10.48$, $p < .001$.

Figure 19. Waist circumference as a function of group assignment from baseline, post-test, and follow-up in Phase II.



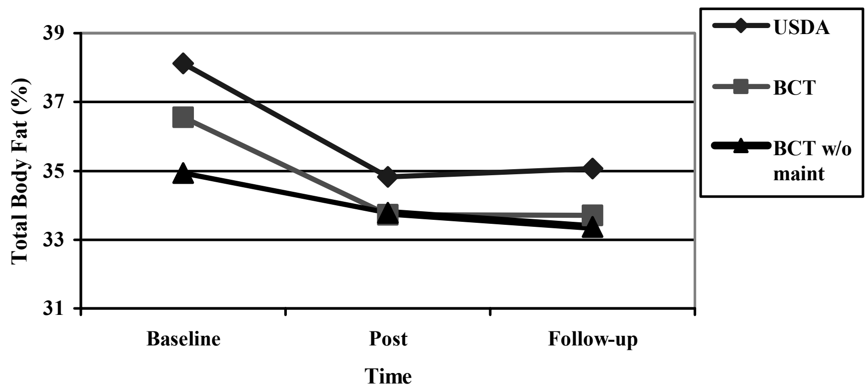
Hip Circumference. A repeated measures ANOVA showed a significant interaction between treatment group and time for hip circumference, $F(4, 82) = 3.19$, $p < .05$. Between group testing indicated that there were no differences at either post-test or follow-up. As shown in Figure 20, within groups post hoc analyses indicated that participants in the BCT and BCT w/o maintenance group had a significant decrease in hip circumference at post-test ((4.3%) $M = -5.09$, $SD = 2.36$, and (2.3%) $M = -2.9$, $SD = 2.42$, respectively), $t(12) = 7.77$, $p <.001$, and $t(15) = 4.55$, $p < .001$. While participants in both the BCT and BCT w/o maintenance groups continued to show a decrease in hip circumference from post to follow-up, only the loss in the BCT w/o maintenance group reached statistical significance ((2.1%) $M = -2.42$, $SD = 3.45$)) $t(15) = 2.80$, $p < .05$. Therefore the BCT and BCT w/o maintenance groups maintained their hip circumference losses from baseline to follow-up ((5.8%) $M = -7.24$, $SD = 6.49$, and (4.5%) $M = -5.32$, $SD = 3.78$, respectively)), $t(12) = 4.02$, $p < .01$, and $t(15) = 5.63$, $p < .001$.

Figure 20. Hip circumference as a function of group assignment from baseline, post-test, and follow-up in Phase II.



Percent Body Fat. A repeated measures ANOVA showed a significant main effect for time $F(1, 42) = 10.42$, $p < .01$. As shown in Figure 21, within-groups post hoc analyses indicated that only the BCT and BCT w/o maintenance groups lost a significant percent of body fat from baseline to post-test (M = -2.82, SD = 2.18, and M = -1.15, SD = 1.88, respectively) while the BCT group did not, $t(14) = 5.00$, $p < .001$, and $t(15) = 2.45$, $p < .001$. However, it should be noted that while participants in the USDA did exhibit a larger percent mean loss of body fat across treatment (M = -3.31, SD = 7.80). Post-test to follow-up analyses revealed no notable changes in body fat. Therefore, from baseline to follow-up, participants in the BCT and BCT w/o maintenance groups maintained over 100% of their reduction in total percent body fat (M = -2.86, SD = 3.17, and M = -1.58, SD = 1.85, respectively) while participants in the USDA did not exhibit significant changes in body fat (M = -3.07, SD = 7.58), $t(14) = 3.49$, $p < .01$ and $t(15) = 3.40$, $p <$ .01.

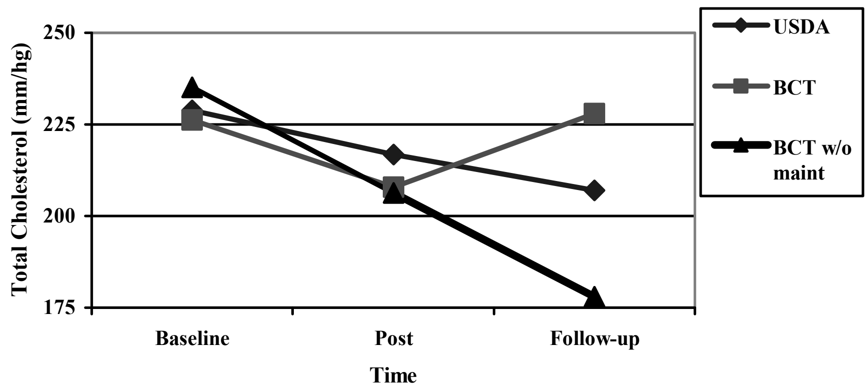
Figure 21. Total Body Fat as a function of group assignment from baseline, post-test, and follow-up in Phase II.



Blood Lipid Analyses

Total Cholesterol (TC). A repeated measures ANOVA showed a significant interaction between treatment group and time for TC, $F(4, 84) = 3.62$, $p < .01$. Between group testing indicated that there was a significance differences in total cholesterol at follow-up $F(42) = 3.96$, $p < .05$. Post-hoc analyses showed that the BCT w/o maintenance had significantly lower cholesterol compared to either the USDA or BCT groups. As shown in Figure 22, within groups post hoc analyses showed that participants in the BCT and BCT w/o maintenance groups had significant decreases in TC from baseline to post-test (M = -18.31, SD = 27.45, and M = -29.31, SD = 35.40, respectively), $t(15) = 2.67$, $p < .05$, $t(15) = 3.31$, $p < .005$. However, it is noteworthy that participants in the USDA did also show minimal reductions in TC across treatment (M = -11.89, SD = 23.24). From post to follow-up, participants in the USDA and BCT w/o maintenance group continued to exhibit decreases in their TC (M = -9.76, SD = 31.61, and M = -28.25, SD = 37.08, respectively). However, only the changes in the BCT w/o maintenance group were significantly different, $t(15) = 3.04$, $p < .01$. As a result, from baseline to follow-up, participants in the USDA and BCT w/o maintenance groups had significant decreases in their TC (M = -21.77, SD = 36.75, and M = -57.56, SD = 33.55, respectively), $t(12) = 2.13$, $p < .05$, and $t(15) = 6.68$, $p < .001$.

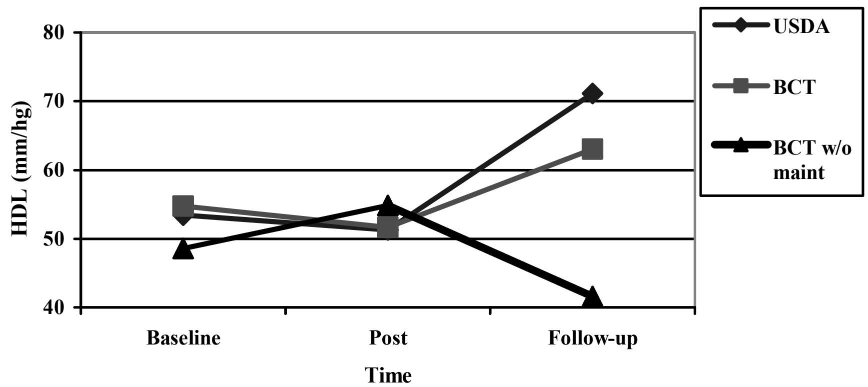
Figure 22. Total cholesterol as a function of group assignment from baseline, post-test, and follow-up in Phase II.



HDL. A repeated measures ANOVA showed a significant interaction for time by group on HDL, $F(4, 84) = 5.84$, $p < .001$. Between group testing indicated that there was a significant difference in HDL at follow-up $F(42) = 14.41$, $p < .001$. Post-hoc analyses revealed that at follow-up, participants in the BCT w/o maintenance group had significantly low HDL's compared to the USDA and BCT groups. Surprisingly, as shown in Figure 23, within groups post hoc analyses revealed that HDL's in both the USDA and BCT groups decreased from baseline to post-test. However, neither decreases were statistically significant ($M = -2.15$, $SD = 10.21$, and $M = -3.06$, $SD = 9.55$, respectively). Conversely, participants in the BCT w/o maintenance group slightly increased their HDL from pre-to–post-testing but not to a statistically significant level ($M = +6.31$, $SD = 15.58$). However, from post-test to three month follow-up, participants in the BCT w/o maintenance decreased their HDL significantly ($M = -13.31$, $SD = 15.29$), $t(15) = 3.49$, $p < .01$, while HDL's significantly increased in both the USDA and the BCT groups from post-test to 3-month follow-up ($M = +19.85$, $SD = 18.98$, and $M = +11.31$, $SD = 17.23$, respectively), $t(12) = 3.77$, $p < .003$, and $t(15) = 2.63$, $p < .01$. Therefore, across treatment and follow-up, participants in the USDA group significantly increased their HDL's ($M = +17.69$, $SD = 21.77$), $t(12) = 2.93$, $p < .01$, and participants from the

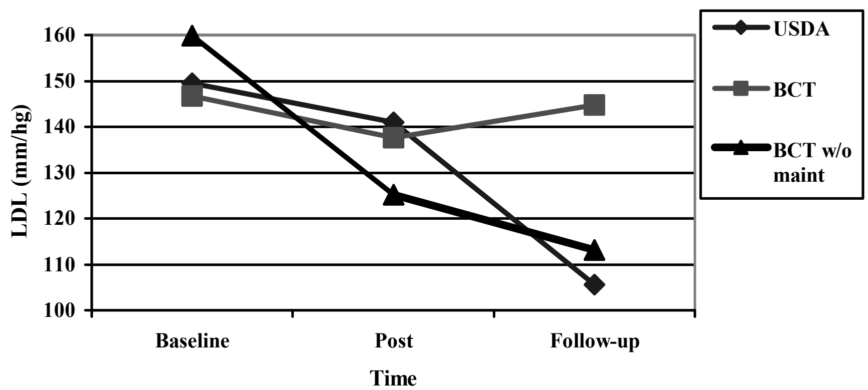
BCT w/o maintenance significantly decreased their HDL's (*M* = -7.00, *SD* = 10.64), $t(15) = -2.63$, $p < .01$.

Figure 23. <u>HDL as a function of group assignment from baseline, post-test, and follow-up in Phase II.</u>



LDL. A repeated measures ANOVA showed a significant interaction for time by group on LDL, $F(4, 84) = 3.72$, $p < .01$. A between groups analysis revealed no significant differences betweens groups at either post-test or follow-up. As shown in Figure 24, within groups post hoc analyses revealed that only participants in the BCT w/o maintenance group significantly decreased their LDL from baseline to post-test (*M* = -34.62, *SD* = 32.14), $t(15) = 4.31$, $p < .001$. From post-test to follow-up, only participants in the USDA group significantly decreased their LDL's (*M* = -35.38, *SD* = 36.36), $t(12) = 3.51$, $p < .01$. While participants in the BCT w/o maintenance group also continued to decrease their LDL's, the changes did not reach statistical significance (*M* = -12.00, *SD* = 37.92). Therefore, from baseline to follow-up, only participants in the USDA and BCT w/o maintenance groups showed significant decreases in their LDL (*M* = -44.00, *SD* = 43.69, and *M* = -46.62, *SD* = 31.24, respectively), $t(12) = 3.63$, $p < .01$, and $t(15) = 5.96$, $p < .001$.

Figure 24. LDL as a function of group assignment from baseline, post-test, and follow-up in Phase II.

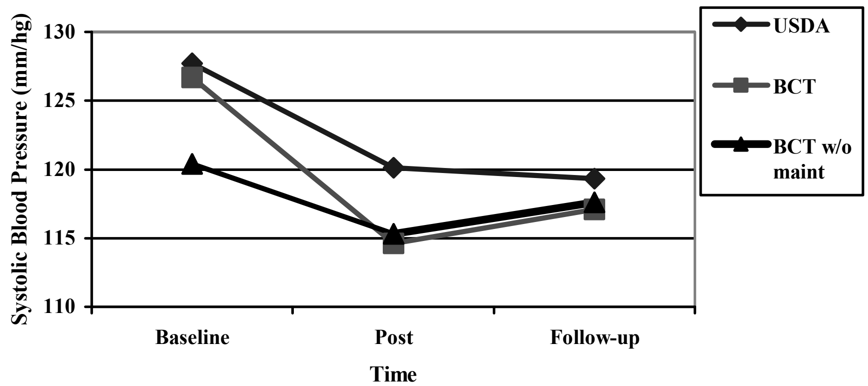


Triglycerides. A repeated measures ANOVA did not show any significant time or time by group effects for triglycerides ($p > .05$).

Blood Pressure

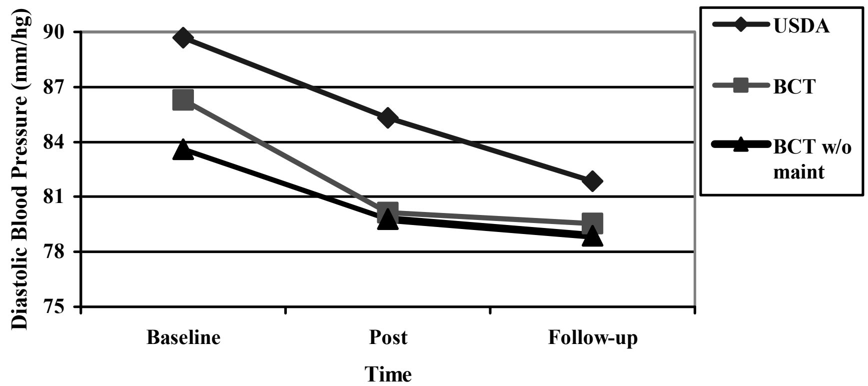
Systolic Blood Pressure. A repeated measures ANOVA showed a significant main effect for time for systolic blood pressure, $F(2, 39) = 10.59$, $p < .001$. As shown in Figure 25, within groups post hoc analyses indicated that participants in the BCT and USDA group had a significant reduction in their resting systolic blood pressure at post-test ($M = -7.60$, $SD = 12.17$, and $M = -12.08$, $SD = 14.29$, respectively), $t(14) = 2.42$, $p < .05$, and $t(12) = 3.05$, $p < .01$. No significant changes were noted from post-test to follow-up. Across treatment and follow-up, only participants in the BCT and USDA groups significantly reduced their resting systolic blood pressure ($M = -8.40$, $SD = 8.91$, and $M = -9.61$, $SD = 15.30$, respectively), $t(14) = 3.65$, $p = .003$, and $t(12) = 2.26$, $p < .05$.

Figure 25. Systolic blood pressure as a function of group assignment from baseline, post-test, and follow-up in Phase II.



Diastolic Blood Pressure. A repeated measures ANOVA showed a significant main effect for time $F(2, 39) = 6.55$, $p = .004$. As shown in Figure 26, within groups post hoc analyses indicated that only participants in the BCT group had a significant reduction in their resting diastolic blood pressure percentage from baseline to post-test ($M = -6.15$, $SD = 9.64$), $t(12) = 2.30$, $p < .05$. While participants in the USDA and BCT w/o maintenance groups also exhibited reductions in their diastolic blood pressure from pre-to-post-test, they did not reach statistical significance ($M = -4.40$, $SD = 12.12$, and $M = -3.80$, $SD = 11.92$, respectively). None of the groups had statistically significant changes in their resting diastolic blood pressure from post-test to follow-up. However, participants in the USDA group exhibited notable decreases during this time ($M = 3.47$, $SD = 11.96$). Therefore, from baseline to follow-up, participants in the USDA and BCT groups exhibited significant reductions in their resting diastolic blood pressure ($M = -7.87$, $SD = 11.17$, and $M = -6.77$, $SD = 11.56$, respectively), $t(14) = 2.73$, $p < .05$, and $t(12) = 2.11$, $p < .05$.

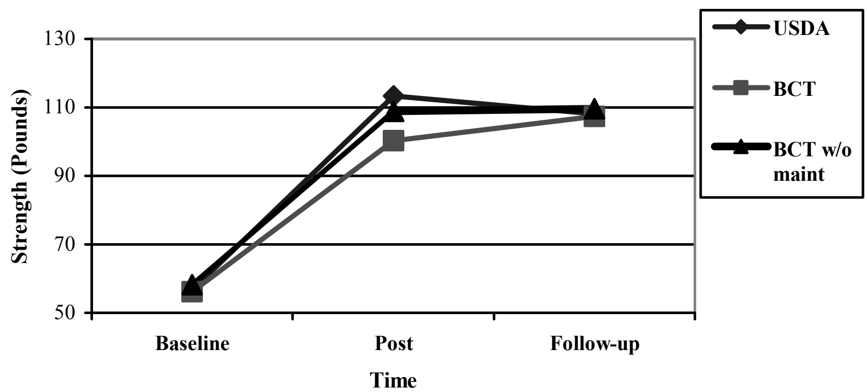
Figure 26. Diastolic blood pressure as a function of group assignment from baseline, post-test, and follow-up in Phase II.



Strength

A repeated measures ANOVA showed a significant main effect for time on strength $F(2, 39) = 143.973$, $p < .001$. As shown in Figure 27, within groups post hoc analyses indicated that all three groups (BCT, USDA, and BCT w/o maintenance) significantly improved their strength from baseline to post-test ($M = +44.09$, $SD = 18.73$, $M = +56.70$, $SD = 17.05$, and $M = 50.65$, $SD = 22.22$, respectively), $t(13) = 8.81$, $p < .001$, $t(14) = 12.88$, $p < .001$, and $t(13) = 8.53$, $p < .001$. However, from post-test to follow-up, only participants in the BCT group continued to show improvements in their strength ($M = +6.97$, $SD = 10.59$), $t(13) = 2.46$, $p < .05$. Participants in the USDA and BCT w/o maintenance relatively maintained their strength during the follow-up period. Therefore, from baseline to follow-up, all three groups (BCT, USDA, and BCT w/o maintenance) showed a significant improvement in strength ($M = +51.06$, $SD = 21.55$, $M = +51.48$, $SD = 20.78$, and $M = +51.32$, $SD = 35.24$, respectively), $t(13) = 8.86$, $p < .001$, $t(14) = 9.60$, $p < .001$, and $t(13) = 30.98$, $p < .001$. The improved strength from post-test to follow-up for only the BCT group is also noteworthy, and is consistent with the apriori hypothesis that participants in the BCT group would exhibit improved maintenance of the training behavior (i.e., strength) compared to either the BCT w/o maintenance or the USDA groups.

Figure 27. Strength as a function of group assignment from baseline, post-test, and follow-up in Phase II.



Taken together, the secondary outcomes from Phase II of the study have several findings of note. Similar to the primary outcomes from Phase II, the BCT, BCT w/o maintenance, and USDA groups were effective in producing change on multiple health outcomes. However, there were notable differences between groups on relative changes at post-test and their ability to maintain their changes at follow-up. As expected, participants in all treatment groups made similar improvements in strength from baseline to post-test and were able to maintain the gains at 3-month follow-up. However, it is noteworthy that only participants in the BCT group increased their mean strength while the other two groups exhibited slight declines in their strength from post to follow-up across time. In addition, participants in the BCT and BCT w/o maintenance groups exhibited greater decreases in BMI, waist and hip circumference, and total body fat both during treatment and were able to maintain their losses at follow-up compared to the USDA group. However, BCT had more pronounced decreases in body weight and total body fat compared to the BCT w/o maintenance group. Alternatively, on the blood lipid and blood pressure measures, the outcomes are markedly different. The USDA and BCT groups appeared to be more effective in decreasing total cholesterol and LDL while improving HDL lipids compared to the BCT w/ maintenance group. No differences were noted on participants Triglycerides. Similarly, participants in the BCT and USDA exhibited significant decreases in both systolic and diastolic blood pressure across time compared to the BCT w/o maintenance group.

Overall, this pattern of results would suggest that both BCT treatments appeared to be more beneficial in producing significant positive changes in BMI, waist and hip circumference, and total body fat in comparison to the USDA group. However, participants in the BCT and USDA groups exhibited initial change and maintenance of Total Cholesterol, HDL, LDL, systolic, and diastolic blood pressure in comparison to the BCT w/o maintenance group.

CHAPTER IV

DISCUSSION

There has been a dramatic increase in the prevalence rates of obese and overweight individuals in the past 30 years. In the past decade alone, rates of obesity have doubled. With little evidence for decline in the future, the obesity epidemic has become a major public health challenge. While studies in the area of weight management have been effective in producing greater initial weight loss, long-term maintenance of weight loss has remained elusive. Recently, there has been a call for innovative ideas in order to push the field forward (Jeffery et al, 2000; Wing, 2000). Therefore, the goal of the present study was to evaluate the efficacy of a maintenance-oriented weight management program (BCT) based on learning theory to produce changes in multiple health outcomes at post-treatment and three-month follow-up.

In order to examine the potential benefit of a maintenance-oriented approach compared to various other treatment components and programs, a two-phase study design was developed. The first phase of the study served to determine the efficacy of the BCT program compared to a more educationally-based lifestyle change program utilizing the USDA food guide pyramid (USDA) and a wait list control group (WLC) group on multiple health outcomes following a 16 week period. After completion of the first treatment phase of the study, the second phase of the study was implemented to examine the impact of different interventions on participants' abilities to maintain their multiple health benefits following treatment and a non-intervention period of time. However, due to the complexity of the BCT treatment, it was impossible to identify what, if any, treatment component was responsible for either good or poor behavior maintenance. As such, during the second phase of the study, the WLC group was transitioned into a treatment program consisting of all components of the BCT treatment group with the exception of the transfer of training maintenance components. Therefore, the second phase served to determine the potential added benefit of a maintenance-oriented framework above an existing comprehensive BCT treatment versus a more traditional, educationally-based center-based program (USDA) on all primary and secondary outcomes of interest at both post-test and three-month follow-up.

Participants in the present study were a free-living community sample of middle-aged, overweight or obese, moderately educated, men and women. At baseline, participants were sedentary (0 days of structured activity or exercise per week), unfit (<25ml/kg/min) with high levels of intra-abdominal (visceral) fat (> 36%; men's waist circumference > 108 cm, women > 103 cm, respectively) and high levels of total and LDL cholesterol ($M = 223$, and $M = 140$, respectively). However, participant's triglycerides, HDL, blood pressure, and fasting glucose were all within normal limits. This sample was relatively unique in that while they were obese, they were relatively healthy and did not exhibit many significant risk factors for disease. However, it was important to note that participants who had existing disease or were at high risk for disease based on the ACSM guidelines (2000) were screened out. Interestingly, a large number of participants were unaware of their increased lipids, blood pressure, or diagnosis of obesity at the outset of the study. These findings suggest that this particular sample was just beginning to experience some neuroendocrine changes, in addition to increased inches around the waist, which are both consistent with markers for the metabolic syndrome. Given the recent development of metabolic syndrome and its clear link to future risk of disease, further research targeting this type of population for intervention is warranted (Arden, Katzmarzyk, Janssen, & Ross, 2003).

Results from the present study clearly showed that participating in any treatment program (either the BCT or USDA treatments) resulted in positive changes in all primary and secondary outcomes compared to a wait list control group (WLC). In fact, participants not engaging in any intervention tended to gain weight and decrease fitness across the 16-week period. Based on these findings, the decision to transition the WLC control group to a treatment group immediately following post-test appeared particularly prudent given the continued upward trend of weight gain without intervention. Moreover, transitioning the WLC group to a BCT w/o maintenance treatment allowed us to better identify whether or not there exists potential added benefit of maintenance specific-components to an already comprehensive lifestyle change program.

Another notable finding from the present study was that BCT appears to offer greater health benefits compared to a more educationally based lifestyle change program for overweight and obese men and women. Both BCT treatment programs showed greater effectiveness in producing more pronounced weight loss, intra-abdominal fat loss, and increased physical activity as compared to the USDA group. In addition, both BCT treatments were more effective at producing positive changes in BMI, waist and hip circumference, total body fat, and LDL cholesterol as compared to the USDA group.

Even more impressive are the findings across the two BCT treatments following the completion of treatment. From post-test to follow-up, participants in both BCT groups either maintained or exhibited continued improvements in weight loss, BMI, waist and hip circumference, total and intra-abdominal fat, physical activity, and LDL cholesterol. Given the tendency for weight regain and for decline in physical activity and fitness to begin immediately following the completion of treatment (Perri, 1995), these continued improvements are particularly noteworthy.

Perhaps the most encouraging findings, however preliminary, were the pattern of results exhibited by the BCT with maintenance group. First, participants in the BCT group were the only group that exhibited maintenance of their fitness improvements. Moreover, while not statistically significant, participants in the BCT group also exhibited continued improvements in strength, displayed a small, but continued, weight loss, and 100% maintenance of their increased lifestyle physical activity compared to the BCT w/o maintenance group. Given the consistent finding that weight loss is initially rapid and then begins to slowly decline (Corsica & Perri, 2002) until it asymptotes at six months, it is hopeful that participants in the BCT group were continuing to exhibit weight loss seven months after treatment was completed. However, the differential loss and level of maintenance between the two BCT groups warrants further discussion.

Consistent with the literature examining the impact of treatment length on weight loss (Perri & Fuller, 1995), it is possible that the greater treatment length in the BCT with maintenance group could have contributed to the increased weight loss. However, alternative explanations warrant consideration. First, given the similar increases in physical activity during the treatment between the two groups, differences attributable to activity are unlikely. Second, it is possible that the favorable weight loss may be due, in part, to participants in the BCT w/o maintenance group following a less restrictive diet. In order to answer this question, we analyzed participant's food records at baseline, mid-treatment, and at post-test. Although we understood that the total number of completed records were significantly smaller than the overall sample ($n = 35$), anecdotally we were interested in participants' caloric intake. We found between-group differences at both mid-treatment ($p < .05$) and post-test ($p < .05$) on total caloric consumption. Post-hoc analyses revealed that the BCT group reported eating significantly fewer calories ($M = 1579$) compared to the BCT w/o maintenance group ($M = 2076$). Although this could explain the difference in loss, the validity of the food records is brought into question. There is a growing body of literature suggesting that overweight men and women tend to underestimate food intake anywhere from 20-50% percent (Lichtman et al., 1992). Given that argument, it is also interesting that participants in the USDA group also reported a similar food intake to the BCT group ($M = 1645$) in the present study, thus making the interpretation of the results through the mechanism of (self-reported) caloric consumption less clear.

In order to examine the potential effect of length of treatment on weight loss, we analyzed the two groups' weight loss across treatment at weeks 4, 6, 8, 10, and 12. A consistent weight loss was found across groups each week (BCT = .67 pounds, and BCT w/o maintenance, .65 pounds per week, respectively). Assuming that this rate of weight loss in the BCT w/o maintenance group would have continued at a similar rate if treatment had been extended for another month, the total weight loss would have been almost identical to that of the BCT group ($M = 10.36$ vs. $M = 10.68$). Taken together, although it is likely that differential weight loss was attributable to several factors, length of treatment may have been a significantly contributing variable. However, it is important to note that the USDA was of the same duration as the BCT thus indicating that length of treatment per se is not the critical factor. Rather, using more effective treatment components for a longer duration seems a vital aspect of successful intervention.

In addition, there were significant differences in the total body and intra-abdominal fat loss between the two BCT groups that cannot be explained by length of treatment. Specifically, participants in the BCT group experienced over two to three times the amount of total and intra-abdominal fat loss (2.8%, and 3.1%, respectively) compared to the BCT w/o maintenance groups total and intra-abdominal fat loss (1.1%, and 1.3%, respectively) at post-test. One possible explanation for these differential losses could be related to the gender composition of the two groups. While the study design was constructed to match for gender and BMI, due to a limited sample size and a ratio of men to women interested in the program, we were unable to exactly match on both variables. Fortunately, however, the numbers of men between treatment conditions were similar (BCT =6, BCT = 7, and USDA = 5), suggesting that this variable alone could not contribute to the differential losses. However, in order to answer this question of gender and differential fat loss, we analyzed the intra-abdominal and total body fat outcomes by gender and group.

We observed that there were no significant differences in gender for total body fat loss. However, for intra-abdominal fat loss, there were significant gender differences in percent lost of intra-abdominal fat at post-test and follow-up (p's $< .01$). As expected, regardless of treatment condition, men lost more intra-abdominal fat (-10.9%) compared to women (-2.5%), and that the greatest losses for both men and women were exhibited in the two BCT treatments. Surprisingly however, this finding still could not account for the differences between the two groups. Upon closer analyses, data revealed that there was considerable intra-abdominal fat loss in men in both BCT groups during treatment (BCT = 10.5%, and BCT w/o maintenance = 11.1%). However, only women in the BCT group exhibited significant intra-abdominal fat loss (8.0%) while those in the BCT w/o maintenance experienced minimal intra-abdominal fat loss (.3%). These differences were striking, and suggest that our sample of women in the two BCT groups were different in some way. We can only speculate as to why this may be the case. It was noted that women in both the USDA and BCT groups were notably less wide in the waist at baseline (M = 102, and M = 100, respectively) compared to the women in the BCT w/o maintenance (M = 109), which may suggest that intra-abdominal fat loss may be more difficult for more viscerally obese women. However, these findings should be interpreted with caution due to the extremely small sample size and likelihood that these data are more prone to variation if there was the presence of an outlier within the groups.

Another noteworthy change was the significant increase in physical activity exhibited in the two BCT treatment groups from baseline to post-test. Consistent with the intervention program goal, participants in both groups were walking on average 10,000 steps per day by the end of the intervention. Although participants in all three groups were instructed to get approximately 30 minutes of lifestyle activity per day, only participants in the two BCT treatments were successful in achieving that goal. Perhaps this is related to the additional intervention focus on lifestyle activity, with the two BCT treatment groups setting weekly step count goals, being provided objective tools (pedometers) as a way to measure their daily activity, and receiving weekly feedback and dialogue about how to realistically incorporate lifestyle activity into their daily life. This approach to increasing lifestyle activity was a maintenance-oriented approach that was done in both BCT treatment groups because the use of a pedometer has been shown to be a relatively effective tool to increase physical activity in community-dwelling individuals (Talbot, Gaines, Huynh, & Metter, 2003; Wojcik et al., 2003).

In addition, from post-test to follow-up, participants in both BCT treatment groups maintained their increased level of physical activity (> 10,000 steps per day). This maintenance of activity across groups is particularly notable, as participants were not given the use of their pedometers over the course of the follow-up period. It is possible that during the treatment participants made several small increases in their activity throughout each day that became routine once the program ended, making the pedometers less necessary once the increased daily activity was incorporated into their life. It is important to note that from baseline to follow-up, participants in the USDA also significantly increased their step count by almost 3000 steps. This would suggest that some intervention (even educational in nature) might be beneficial to increase daily physical activity. Nonetheless, participants in the USDA were walking approximately 3000 steps less than (M = 7000) either of the BCT groups by follow-up, suggesting that the pedometer may be an inexpensive, highly effective tool to provide a means to increase total energy expenditure as a component of a weight management program.

Given the novel approach to strength and aerobic training used in the present study, we were pleased to see that all three groups exhibited significant increases in cardiorespiratory fitness (~19%) and strength (~ 55%) as a result of participation in the time-efficient aerobic and strength protocol. These consistent increases in fitness and strength across groups are particularly notable as two different trainers, at different time points, completed the training protocols for the three groups. These findings lend further support that a time-efficient, but prescriptive, protocol can provide significant improvement in fitness and strength. Indeed, the amount of improvement was about the same as longer duration, more frequent training but at the same level of intensity as used in the current project, lending support to the threshold model and its emphasis on brief, prescriptive training (Winett and Carpinelli, 2001; Winett et al., in press). However, from post-test to follow-up, as expected, only participants in the BCT group maintained their fitness gains while participants in the BCT w/o maintenance and USDA groups significantly decreased their fitness during the 12-week follow-up period. In addition, although not statistically significant, only participants in the BCT exhibited a continued increase in strength following the completion of treatment while the other two groups maintained their overall strength grains. With regard to fitness, existing literature suggests that once aerobic fitness is improved, it can be maintained with as little as one to two short-bouts of activity per week (Winett et al., in press, ACSM, 2000). However, if aerobic exercise is ceased for a period of approximately 8 weeks, a significant portion of the fitness increases will diminish (ACSM, 2000). As for strength, even with a detraining period of approximately 10 weeks, muscular strength can be maintained because of neuromuscular learning (ACSM, 2000). However, if no training is done for a period of longer than 10 weeks, small declines in strength are typically noted. While it could be argued that the maintenance of cardiorespiratory fitness and increased strength findings could be due to the additional energy expenditure put forth by participants in the BCT program, this is unlikely due to the fact that participants in both BCT groups were walking approximately 10,000 steps per day during the 12-week follow-up period and walking at low intensity would neither increase or maintain strength or aerobic fitness. Alternatively, it is possible that participants in the BCT group greatly benefited from the environmental training as it allowed them to cooperatively develop a program that was most adaptable to their lifestyle. As transitioning from a center-based to home-based program has been identified as a barrier to maintenance (Cioffi, 2002), perhaps the transfer of training program allowed participants to experience fewer barriers to initiation while promoting increased efficacy that they could maintain their training program after the cessation of the treatment program.

Although many of the results discussed thus far show clear support for the use of the BCT w/maintenance intervention, a small subset of findings were less clearly interpretable and/or consistent. Specifically, the blood lipid outcomes at post-test and follow-up, with one notable exception (i.e., LDL cholesterol), were inconsistent with study hypotheses. Specifically, participation in the intervention program resulted in a decrease in HDL for the BCT and USDA groups, while HDL increased in the BCT w/o maintenance. Conversely, from post-test to follow-up, participants in the BCT and USDA exhibited dramatic increases in HDL, while participants in the BCT w/o maintenance exhibited a dramatic decrease in HDL during the follow-up period. Moreover, while participants in both BCT groups exhibited significant decreases in total cholesterol during treatment, from post-test to follow-up only participants in the BCT w/o maintenance continued to decrease their cholesterol, while participants in the BCT group significantly increased their total cholesterol back to pre-treatment levels. Several possible explanations are put forth in an effort to better understand these findings.

One possible explanation for these atypical results in total cholesterol and HDL is related to the use of the new healthy pyramid put forth by Harvard University (Hu & Willett, 2002; Willett, 2001) in the two BCT intervention groups. Although this pyramid is based on 40 years of scientific research on all components of the food guide pyramid, there currently does not exist any data about the effects of a diet using the healthy pyramid on blood lipids. However, given the discrepant outcomes between the two BCT groups, it is unlikely that the dietary recommendations contributed significantly to the present findings. Another plausible explanation for the atypical blood lipids results may be due to measurement error. Due to the precise accuracy needed for the assay storage and analysis, it is possible that the samples may have been mistakenly stored or analyzed which greatly impacted the outcomes. Another possible explanation of the present findings could have been due to participant error. Specifically, while all participants had stated that they had fasted for a period of 12 hours prior to the their blood draw, it is possible that this was inaccurate for a small number of participants. Accordingly, if their lipids measurements were not fasting, this would have had a great impact on their outcomes. Taken together, questions remain as to the possible mechanism(s) for the exhibited changes in HDL and TC in the present study.

STUDY LIMITATIONS

There are several methodological issues that limit the findings of this study. A major limitation of the present study is related to the small sample size. As the sample size was smaller than what is generally used in treatment efficacy studies, it significantly reduced the power to detect between group differences. Therefore, few definitive causal conclusions can be made in the present investigation. In addition, due to the high number of post-hoc analyses that were completed ($n = 23$) based on significant ANOVA results, there was an increased chance that significant findings may have been spurious in nature. However, due to the consistent pattern of results between groups and across time, it is unlikely that the present findings are due solely to chance alone. Obviously, however, the use of Bonferonni corrections to correct for any Type I error would be been ideal.

Another methodological issue in the present study was the use of two different food pyramids between the three groups, with the BCT groups receiving the Willett pyramid and the USDA group receiving the more traditional pyramid. Without knowing the effect of using a revised pyramid, separate from the effects of other treatment components, it is difficult to determine the relative impact of differing food intake goals. As such, it may have been more appropriate to choose 1 of the food pyramids for all three treatment groups in order to directly compare the impact of the two intervention approaches alone, independent of the diet composition recommendations on blood lipids.

Additional methodological limitations in the present study are related to the use of the seven-day dietary records. One area of disappointment was related to the decreased adherence for completion of the food records across the three testing periods. One possible reason for this is the time-intensiveness required of the participants to complete a food-diary over a seven-day period followed by having to bring/send the records back to the center. Perhaps a more reasonable alternative would have been to have participants fill out a questionnaire during one of their visits, such as the food frequency questionnaire (FFQ), may have resulted in improved adherence to this component of the study. A second issue with regard to the dietary records is related to the reliance on a self-report measure to estimate actual food intake. Given the literature that overweight individuals underestimate food intake (Lichtman et al., 1992), a more direct measure of dietary intake would have been ideal. However, the reliance on inaccurate self-report measures to estimate food intake is a major identified weakness in the area of nutrition and there currently is a call for the development of more reliable and valid ways to assess total caloric intake, types of dietary fat consumption, and other notable aspects (e.g., fiber, sodium) (Wing, 2000).

Another methodological issue in the present study relates to the potential leader effect on outcome differences exhibited between the three groups. As discussed earlier, one leader delivered the BCT w/maintenance treatment while a different individual delivered the other two groups. It could be argued, then, that the more favorable outcomes at post-test and follow-up exhibited by participants in the BCT group could be attributed to the interventionist. However, we do not think that this was the case. Based on leader evaluations by participants at the completion of their treatment program, only participants in the USDA group rated their leader less favorably than participants in either of the BCT treatments. Therefore, both leaders of the two different BCT treatments were evaluated favorably. Further, due to the similar rates of weight loss across treatment, it is unlikely that the leader in the BCT w/o maintenance group was less effective or it is possible to argue that the leader was intentionally less effective in the USDA group given their less favorable evaluation of their leader. However, several steps were taken in order to minimize bias on a part of the interventionist during delivery of the

USDA program (including not training her to deliver the BCT until completion of the USDA program). Nonetheless, while issues related to the optimal set of personality variables of a study interventionist remain, it is unlikely that the leader alone contributed to the differential outcomes.

Lastly, a further limitation of the present study relates to the generalizability of the findings given the previously discussed issue of treatment length. It could be argued that because of the shortened length of both treatments, particularly the BCT w/o maintenance treatment, that neither program was representative of the state-of-the-art behavioral programs, extending at least 4-6 months in length (Perri and Fuller, 1995). This point is clearly noteworthy. However, it is also important to note that this length of treatment is consistent with other clinical intervention programs that have used more moderate length treatment programs (8-16 weeks), which have produced favorable outcomes (Hill et al, 1989; Sbrocco, Nedegaard, Stone, & Lewis, 1999; Schlundt, et al, 1993). Had the treatment interventions been longer (20 + weeks), we would have expected participants in all treatments to lose more weight and exhibit continued beneficial changes on multiple health outcomes. Conversely, we also would have expected issues of compliance related to long-term participation in a center-based program to become more of a significant factor. However, we do not expect that participants in the USDA group would have exhibited a dramatic weight loss or further change in activity as a result of continuing the treatment program. Conversely, it would have likely been beneficial for participants in the BCT w/o maintenance group to continue the center-based treatment program for an additional four weeks in order to ensure adequate intervention contact and repetition of concepts and behaviors between the two treatment conditions. Future studies could benefit from examining the impact of these two approaches, matching for contact time, on maintenance of health-related behaviors following cessation of treatment.

STUDY STRENGTHS

Alternatively, there are also several notable strengths of the present study that warrant discussion. Perhaps one of the strongest features of the present study was that the

BCT intervention was theory-based. Given the current lack of success in promoting long-term weight loss maintenance with existing theoretical approaches, the present study offers a promising alternative theoretical approach (utilizing both learning theory and behavioral economics theory applied to weight management) to improving maintenance (Jeffrey et al., 2000; Kazdin, 2001; Sbrocco, Nedegaard, Stone, & Lewis, 1999; Wing, 2000).

Another major strength of the present study is the use of objective outcomes measures, with the exception of nutritional intake records, that included the most precise method of assessing body composition, direct physiological testing of fitness, and obtaining a direct measurement of physical activity. As the assessment of energy intake and energy expenditure, in addition to other risk factors have been identified as weaknesses in the field; the present study offered a comprehensive assessment battery. In addition, the present study had a relatively high retention rate across treatment (93%) and follow-up (85%) assessments. In a meta-analysis of long-term weight loss studies, they found that 50%-100% (median: 82%) of subjects returned for follow-up testing. Therefore, the current program is slightly above average. Given the intensive nature of the assessment battery, this high return rate was particularly encouraging since it appears that the use of more invasive and involved assessments was not a noticeable deterrent for participants to return for follow-up testing. Furthermore, in the present study participant's acceptance into the program was not contingent on completion of two weeks of self-monitoring food and activity behaviors. Unlike other studies (Sbrocco, Nedegaard, Stone, and Lewis, 1999) that used this screening technique as a way to dissuade individuals not fully committed, the present study accepted all individuals who were willing to accept randomization and complete the three objective baseline assessments. Lastly, while most cognitive-behavioral weight management treatments are delivered by psychologists (or doctoral level psychology students), the present study had a nutritionist to deliver one of the BCT treatments. Although there existed potential limitations associated with this approach (as discussed above), the use of a nutritionist to deliver the BCT could greatly increase the potential for clinical dissemination of this approach to other lifestyle change programs, namely cardiac rehabilitation facilities or programs for at-risk people delivered in other settings (see below).

CLINICAL IMPLICATIONS

The improvements exhibited by the BCT group have notable clinical implications. On the basis of NHLBI's guidelines, the typical participant in the BCT group went from being obese (BMI = 31.83) to being overweight (BMI = 29.35) after seven months. This represents a weight loss of 5.5%, which is less than recommended for initial weight loss from baseline (10%; NHBLI, 1998). However, there is a growing body of literature that suggests even more modest weight reductions (5-10%) can provide improvements on several risk factors associated obesity (Andersen et al, 1999; Gall, Wauter, & Leeuw, 1997; Vidal, 2002). In addition, although participants exhibited dramatic decreases in intra-abdominal fat, the current literature more heavily relies on the use of waist measurements as a predictive measure and proxy for intra-abdominal fat measures due to the cost and lack of accessibility to such measurement methods. As such, participants decreased their waist circumference by over four inches across treatment and follow-up. As increased waist circumference (intra-abdominal fat) is now identified as an additional, and in fact, likely the major, predictive variable for health risk (Arden, Katzmarzyk, Janssen, and Ross, 2003), the reductions in waist circumference/intra-abdominal fat in the BCT group suggests the potential for significant risk reduction, particularly in men. Taken together, BCT appears to be a comprehensive weight management program that can result in positive health outcomes and reductions in disease risk in this sample of free-living men and women.

While issues related to the cost-effectiveness of delivering the two different BCT treatments were not addressed in the present investigation, this issue does warrant some attention. Given the preliminary efficacy focus of the present investigation, cost-effectiveness was not a variable of interest. However, given that obesity is a chronic disease that requires continuous care (NHLBI, 1998), one mission in the field is to examine cost-effective methods for delivering continuous care to patients. It is well known that clinic-based maintenance programs are often poorly attended and not cost-effective (Jeffrey et al., 2000). Based on the present utility of adding a maintenance-oriented approach to a comprehensive cognitive-behavioral program, it is possible that transitioning individuals to a home/community-based program, and maintaining intermittent contact with them by either phone, mail, or in person contact may be more cost-effective (and appealing) compared to keeping individual's in treatment indefinitely. Fewer at-risk individuals as well as more diverse groups may also be more readily recruited and then intervened with in such community-based settings as YMCA's or community recreational facilities. These facilities typically have staff and equipment to deliver multi-risk factor reduction programs. The costs of the transfer of training phase in the BCT program could be markedly reduced if transfer of training involved more fading (through continuation) of staff supervision, more emphasis on self-regulation skills, and having people practice their exercise under different circumstances such as when a facility is crowded or a preferred exercise piece is not available.

FUTURE DIRECTIONS

Collectively, these patterns of results across all outcomes suggest the beneficial impact of BCT treatment, with and without a maintenance focus, on producing multiple beneficial outcomes at post-treatment and at three-month follow-up. Additionally, BCT with the maintenance training appears to have some additional benefit in producing maintenance of fitness, promoting continued weight loss, increased intra-abdominal fat loss, and maintenance of physical activity compared to the BCT without maintenance training program. While preliminary, these results warrant further investigation given the widespread problem of obesity, associated diseases, and the difficulty in maintaining weight loss. Further, in light of the financial constraints within the health care delivery system, a program that develops participants' independence and confidence to maintain positive changes' following cessation of a formal program is essential. Future studies should examine this approach in a larger sample to determine the effectiveness of this treatment to produce short-term and longer-term weight loss (two years or more). In addition, given the limited scope of small center-based trials, future studies, as suggested above, need to examine the effectiveness of this program in a more community-based setting where there is potential for greater public health impact.