EXAMINING THE EFFECTIVENESS OF BEHAVIORAL WEIGHT LOSS INTERVENTIONS AMONG AFRICAN AMERICAN WOMEN

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ABSTRACT

Loneke T. Blackman Carr: Examining the Effectiveness of Behavioral Weight Loss Interventions Among African American Women
(Under the direction of Deborah F. Tate)

African American women are disproportionately burdened with a high prevalence of unhealthy weight. Behavioral weight loss interventions are less effective for African American women, producing less weight loss, compared to non-Hispanic white women. The purpose of this dissertation was to determine why African American women lose less weight, and find strategies to increase weight loss in behavioral weight loss interventions. Aim 1 was a secondary data analysis of 170 African American and non-Hispanic white women who completed a primarily Internet-delivered behavioral weight loss intervention to determine if racial weight loss differences existed, and identify contributing factors. African American women lost significantly less weight than non-Hispanic white women ($p=0.0002$), a difference mediated by total website log-ins and change in self-regulatory weight control behaviors. Aim 2 compared the effects of a standard vs a culturally-based, physical activity-enhanced behavioral weight loss intervention among 85 African American women over 6 months. Contrary to our hypothesis, women lost more weight in the standard vs the enhanced group, though not significantly more ($p=0.43$). Objectively measured physical activity was also not different between groups ($p=0.45$). All participants' weight decreased, and physical activity increased, significantly from

baseline. Aim 3 determined if participants in aim 2 differed in physical activity-related psychosocial variables change. Employing a multiple linear regression model, we observed no between group differences in the 6-month change in self-efficacy, social support or autonomous motivation for physical activity, or perceived physical activity benefits and barriers. However, a significant change from baseline was observed in both groups for several variables. Results of this dissertation indicate that standard behavioral weight loss treatment was effective for overweight or obese African American women, but their study engagement and adoption of weight control strategies can be improved. However, treatment effectiveness remains suboptimal for this population. The continued identification of behavioral strategies that African American women partially or do not adopt may inform how weight loss can be maximized. Moreover, cultural adaptation of behavioral weight loss interventions above the individual level (e.g. policy, neighborhood, economic) may be necessary to improve weight loss in African American women.

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LIST OF ABBREVIATIONS

AA African American

BWI Behavioral weight loss intervention

EBI Eating Behavior Inventory

MVPA Moderate-to-vigorous physical activity

NHW Non-Hispanic white

PA Physical Activity

RCT Randomized controlled trial

CHAPTER 1

INTRODUCTION

Overview

The majority of American adults are overweight or obese (68.8%).[1] African American (AA) women are disproportionately affected by overweight or obesity (82.1%) compared to non-Hispanic white (NHW) women (59.5%).[1] Obesity increases the risk of developing numerous chronic diseases, including type 2 diabetes (T2DM), hypertension, cardiovascular disease (CVD), and some cancers. Fortunately, weight is a modifiable risk factor for reducing weight and improving weight-related disease risk.[2-5] Behavioral weight loss treatment is an effective solution for reducing weight by clinically meaningful amounts (5-10% of baseline weight).[6-8]

While behavioral weight loss interventions are an effective treatment, they are less effective for AA compared to NHW women, with AA women consistently losing less weight.[9-12] Evidence describing why the racial disparity in weight loss outcomes exists is lacking. No difference in dietary intake or body composition have been observed between AA and NHW women groups in a recently evaluated behavioral weight loss interventions (BWI).[11] The Obesity Reduction Black Intervention Trial (ORBIT), a BWI for AA women (n=213), found favorable dietary changes (increased fruit/vegetable intake) in AA women.[13] One explanation may be that AA women engage in less physical activity (PA) during these interventions. In ORBIT, AA women

engaged in almost no moderate-vigorous physical activity (MVPA) at follow-up.[13] In the standard behavioral weight loss arm of a stepped-care intervention, NHW achieved higher fitness and objective PA levels compared to AA.[11] Reduced energy needs suggest that to produce maximum weight loss, AA women may need to intake fewer calories or expend more calories through increased PA. Caloric restriction below the already reduced recommendation in BWI may be too burdensome; increasing AA women's PA is a practical target, given that activity produces energy expenditure important for as much as 20-25% of weight loss.[14-16] Performing high amounts of PA recommended for weight loss (250-300 minutes/week) may improve weight loss outcomes in AA women.[17]

Given that AA women consistently experience lower weight loss than NHW women in behavioral weight loss interventions, a three-phase study was conducted to understand the disparity in weight loss. Furthermore, this study aimed to develop and evaluate an intervention to maximize weight loss outcomes for AA women.

Specific Aims

Phase 1: Secondary Data Analysis

Aim 1: To examine, through secondary data analysis, the relationship between race and weight loss between African American and Non-Hispanic white women enrolled in a behavioral weight loss intervention.

Hypothesis 1a: Weight loss will differ significantly by race with NHW women achieving greater weight loss than AA women at 4-months post-baseline.

Hypothesis 1b: Behavior change strategies will differ by race such that NHW women will have more positive behavior changes compared to AA women at 4-months post-baseline.

Phase 2: Intervention Development and Implementation

Aim 2: To test the efficacy of a 6-month, randomized controlled trial for AA women, comparing a culturally-based, PA-enhanced treatment (enhanced group) compared to a standard behavioral weight loss program (standard group) to increase weight loss (primary outcome), and physical activity (secondary outcome).

Hypothesis 2a: African American women randomized to the enhanced group will have greater weight loss compared to women in the standard group at 6-months post-baseline.

Hypothesis 2b: African American women randomized to the enhanced group will engage in more PA (minutes/week), compared to women in the standard group at 6-months post-baseline.

Hypothesis 2c: African American women randomized to the enhanced group will have greater weight loss and PA compared to women in the standard group. Physical activity will be positively associated with weight loss. Thus, the relationship between treatment group and weight loss will be mediated by PA.

Phase 3: Examination of Intervention-Targeted Physical Activity Variables

Aim 3: To explore if differences exist between phase 2 intervention groups in physical activity variables targeted by the culturally-based, PA-enhanced treatment.

Hypothesis 3a: African American women randomized to the enhanced group will have a higher change in self-efficacy for PA compared to women in the standard group at 6-months post-baseline.

Hypothesis 3b: African American women randomized to the enhanced group will have higher change in social support for PA compared to women in the standard group at 6-months post-baseline.

Hypothesis 3c: African American women randomized to the enhanced group will have higher change in motivation for PA compared to women in the standard group at 6-months post-baseline.

Hypothesis 3d: African American women randomized to the enhanced group will have a higher change in exercise belief and barrier scores compared to women in the standard group at 6-months post-baseline.

CHAPTER 2

LITERATURE REVIEW

African American women and the Disparity in Obesity

Obesity affects 37.7% of adults in the United States.[1] Specifically, 57.2% of African American (AA) women are obese, compared to 38.2% of non-Hispanic white (NHW) women.[18,19] Obesity increases individual risk of developing diseases like type 2 diabetes (T2DM), hypertension, cardiovascular disease, and some cancers (e.g. postmenopausal breast and colorectal). Achieving and maintaining a healthy weight is a key recommendation for the prevention of postmenopausal breast and colorectal cancers.[5,20] Fortunately, behavioral weight loss interventions (BWI) have been shown to reduce body weight, a necessary change to improve health and disease risk.[2,4,6,7]

Efficacy of Behavioral Weight Loss Interventions

Behavioral weight loss interventions are an effective treatment for overweight and obesity. Studies such as the Diabetes Prevention Program (DPP), defined as comprehensive lifestyle interventions by the American Heart Association, and include diet, physical activity and behavior change components where strong evidence exists for the management of overweight or obesity in adults are discussed.[21] Studies derived from or very similar to these high-quality studies are also included. Clinically significant weight loss can be achieved (5-10% reduction in baseline weight), with behavioral treatment, which has been shown to improve health outcomes like lowering low-density lipoproteins and triglyceride levels.[22-25] Additional health

benefits include improvements in high-density lipoproteins, blood pressure, and HbA1c.[26] To achieve weight loss and its associated health benefits, diet, physical activity (self-directed and/or supervised), and behavior modification are the evidence-based intervention components typically used.[2,22] The Lifestyle intervention arm of the DPP included skills training in nutrition, exercise and behavior change was the most successful method for weight loss and reduced T2DM incidence (by 58%), when compared to metformin and placebo control treatments; results that have been replicated in other diabetes prevention trials.[3,24] Per kilogram of weight lost, a 16% reduction in T2DM incidence was achieved in the DPP.[3] The Look AHEAD trial to reduce CVD risk and mortality, modeled closely on the DPP, achieved significant weight loss (≥5%) at 1, 4 and 8 years (in 50% of participants at 8 years) post-baseline.[25,27,28] In Step-Up, a BWI that prescribed reduced-calorie intake, increased PA, and included behavior change strategies, participants lost a clinically significant amount of weight (7.5%) at 18 months post-baseline.[7] Behavioral weight loss interventions are effective solutions for weight loss, improved health, and reducing disease risk. Since health benefits are a result of weight loss, it is important to determine ways to help individuals achieve at least 5%, but preferably 10%, loss of initial body weight.

Reduced Efficacy for African American Women

Although behavioral weight loss interventions are an effective overweight/obesity treatment, AA women tend to lose less weight compared to NHW women.[9,10,12,29] Previous studies and reviews report weight losses of approximately 2.0-3.0kg less for AA than NHW women in multicenter and other interventions like the

DPP, PREMIER, Look AHEAD, The Hypertension Prevention Trial, and more.[6,11,12,27,30] It is important to note that although there is a pattern of lower weight loss for AA women, weight loss and associated health benefits are still achieved. However, there is room for improvement in both areas. Exploring the factors that contribute to the weight loss disparity is essential to crafting effective intervention solutions.

Pathways to Address the Behavioral Weight Loss Treatment Disparity

Understanding why and how the disparity in BWI outcomes exists may inform modifiable factors that can help reduce the disparity. Several factors have been explored in the literature that might explain the differential weight losses achieved with the same interventions including intervention engagement, physiological factors, and adherence to recommended dietary or PA behavior changes.

Intervention engagement

Intervention engagement is necessary for individuals to receive the full effect of the intervention. Effective recruitment and retention strategies have been identified for AA, and will be incorporated into aim 2.[31] In order to improve intervention engagement, we must determine which parts of behavioral weight loss interventions AA, especially women, engage. At 1-year post-baseline in the Look AHEAD study, NHW and AA had similar adherence to session attendance .[27] Session attendance has also been reported as comparable between these race groups.[32] Although AA did increase consumption of DASH foods (a dietary pattern rich in fruits and vegetables, low in fat), their adherence was significantly lower after treatment compared to NHW, consuming more meat, sweets, fat, and less fruits, which authors concluded may be due to cultural differences in the role of food, identity, traditions,

lack of familial support, and high food cost.[32] Some studies have found no difference between AA and NHW women's dietary intake, but have observed significantly higher objectively measured PA and fitness in NHW women, compared to AA women.[10,11] Higher PA in NHW, compared to AA, women was also found in Look AHEAD, with PA being the adherence variable most strongly correlated to weight loss.[27] This is an important consideration given that PA is a component of weight loss interventions that can account for as much as 20% of weight loss.[14,15]

Address Physiological Differences

In addition to considering intervention engagement for AA, metabolic differences between races may also contribute to the intervention weight loss disparity. A review of 15 studies on the metabolic differences between AA and NHW women's energy expenditure concluded that resting metabolic rate (RMR) is the largest component of energy expenditure, and PA energy expenditure the most variable, with differences ranging from 81- 274 kcal/day.[33] Small organs (brain, liver, heart, kidneys), which contribute 60-70% of resting energy expenditure (REE), have been documented as smaller in AA, compared to NHW, and accounted for 50% of the difference in REE.[34] Sleeping metabolic rate and 24-hour energy expenditure have been found to be lower in AA, compared to NHW women. These findings have also been confirmed in normal weight and sedentary AA and NHW women.[35] In a controlled feeding study by Brewer, et al., no difference in calorie intake between AA and non-AA women was found to hold weight constant, an unexpected result.[36] However, it has been suggested that metabolic differences may be overcome by increasing PA.[37]

Increasing PA may be a strategy to overcome metabolic differences. Authors have pointed to the benefit of high PA (250-300 minutes/week) for weight loss in the short- and long-term.[14,15,38-40] Physical activity also appears to be a behavior that AA are not engaging in as much as NHW, as indicated above. AA women may also benefit from strict adherence to calorie recommendations, or even reduced calorie recommendations below the standard 1200 or 1500 calorie/day metrics provided in BWI.[41] However, greater restriction on energy intake to compensate for physiological difference may be too burdensome for AA participants, even with strict adherence. Strategies to increase PA in AA women during BWI may help overcome the metabolic differences to maximize intervention efficacy for AA women.

There is an opportunity and challenge to engage AA women in PA, especially high amounts, given their low rates of regular PA nationally (36.1% compared to 49.6% of NHW women).[42] African American compared to NHW women also have higher rates of physical inactivity, defined as not meeting the Centers for Disease Control and Prevention PA recommendations of 150 minutes/week of moderate intensity PA (43 vs 22 per 100 women).[43] Currently, there is a dearth of evidence in PA interventions for or including large samples of AA women, but some evidence on AA women exists that will help identify gaps, strategies and directions to improve PA in this group. A review of best practices and strategies from 1985-2006 suggest that PA interventions: use the RCT design (often not done in studies included in the review), incorporate supervised PA, objectively measure PA, provide PA goals, and incorporate the barriers and enablers of PA for AA women.[44] Other reviews suggest having a run-in period, measuring adherence, including social PA determinants, group exercise, social

support, problem-solving, and other commonly employed intervention components (self-monitoring, modeling, feedback).[45-48] Few studies for AA have included the above, but these tactics may be helpful for designing an effective intervention for PA improvement.

CHAPTER 3

THEORETICAL FRAMEWORK

Introduction

Theory allows investigators to define the components of interventions, and compare findings across studies.[49] Kumanyika et al. recommend that cultural concepts be articulated into theoretical frameworks to help specify the role of cultural components and meet methodological standards.[50] For this study, Social Cognitive Theory and Self-Determination Theory guided the development.[51,52] The Expanded Obesity Research Paradigm that incorporates the sociocultural context of behaviors affecting weight was also applied.[53] Constructs and the paradigm important to this research are described below.

Social Cognitive Theory

Social cognitive theory (SCT) focuses on the concept of reciprocal determinism, the bidirectional interaction between individuals and their environment, which influences behavior.[54] A 2012 review of BWI that reported outcomes on AA women, showed that SCT is a commonly used theory. Applied alone or with other theories, in multi- and single-site studies.[10] Short- and long-term improvements in dietary intake and MVPA have been observed in BWI that incorporated SCT for AA.[55–57] A 2014 review of PA interventions with AA identified SCT as a commonly applied theory.[58] The SCT constructs of self-efficacy, social support, and self-regulation were found to be determinants of PA.[59] Behavioral interventions to reduce weight or increase PA based

on SCT have produced modest to good outcomes.[5956,60,61] The following SCT constructs were targeted for the current research: self-efficacy, self-regulation, outcome expectations, and observational learning.

Self-Efficacy

Self-efficacy is defined as one's belief in their ability to perform a behavior to achieve a targeted outcome.[54] To increase self-efficacy, mastery experiences, social modeling, and verbal persuasion can be applied.[62] Mastery experience is the major pathway by which self-efficacy is increased by engaging the individual in challenging yet achievable performance of desired behaviors.[63] Social modeling involves demonstrating that individuals similar to the person can perform the behavior, and presenting the steps necessary to achieve a goal.[63] Encouraging an individual that they are able to perform a behavior is verbal persuasion.[63]

Self-Regulation

Acquiring skills to manage oneself and persist through short-term discomfort to achieve long-term desired outcomes is self-regulation.[49,64] To achieve self-regulation in participants, we employed Bandura's methods: 1) observation of behaviors through self-monitoring, 2) goal-setting by identifying changes one can make, 3) feedback about behaviors and how to improve them, 4) self-determined rewards for behaviors performed, and 5) gathering of social support to encourage positive behaviors.[62]

Outcome Expectations and Observational Learning

Outcome expectation is defined as "beliefs about the likelihood and value of the consequences of behavioral choices".[49] In SCT, Individuals personally evaluate how they will feel if they do, or do not, perform a behavior. Expectancies about

outcomes are self-determined. Observational learning is defined as an interpersonal or media demonstrated peer modeling of new behaviors.[51,65] Attention or exposure to behavioral models, retention or comprehension of the behavior, production or engagement in the behavior, and motivation for the behavior are the processes involved in observational learning.[51,65]

Social Support through Social Networks

A social network includes social relationships and linkages around an individual that serves various functions, including social support.[66] In a 32-year social network evaluation, Christakis, et al. determined that individuals connected to an obese individual central in a network had a 45% increased risk of becoming obese, which they attributed to changing social norms of weight-related behaviors.[67] This demonstration of social network effects may apply to PA behaviors. A network can provide: social influence (actions changed by actions of others), comparison, companionship (sharing activities with network members), and social support, among other structural and functional characteristics. Previous BWI have sought to take advantage of social support, one function of a network, by incorporating partners.[68,69] Studies have shown that participant weight loss success depended on the loss achieved by their partner(s), pointing to the importance that network shared aligned goals.[69,70] The proposed BWI-PA will create a social network for PA, to enhance social support, and change PA and other behaviors related to weight loss. The creation of a PA social network among participants with similar goals and desired outcomes is a strategy for study from previous studies where participants and partners had varied goals, participation, and outcomes.[70] In the BWI-PA, support partners (fellow

participants) will experience similar changes and have shared desired outcomes, factors that have been important conclusions to successfully operationalize social support through partners in previous BWI.

Self-Determination Theory

Self-determination theory (SDT) is an approach to motivation that identifies individuals' inherent needs for competence, relatedness, and autonomy.[71] Self-determination theory is appropriate for this research given the focus on increasing PA, where a lack of motivation is a consistently cited barrier.[56,72-75] A 2012 review of SDT in PA interventions found that human psychological needs for an autonomy supportive environment to stimulate motivation can be achieved with SDT.[76] Other recent studies have used SDT to successfully improve PA and weight loss.[77-80] Autonomy supports with weight loss partners predicted weight loss in a recent SDT-based BWI.[68]

Autonomy

Self-endorsed (or approved), intentional, and volitional behavioral performance is considered autonomous. An autonomy supportive environment reinforces behavioral choice when an individual's frame of reference and rationale for action is incorporated.[81] Creating an autonomy supportive environment that incorporates meaningful rationale, conveys choice in behaviors, and acknowledges individuals' feelings and attitudes may help increase motivation for behavioral performance.[82]

Relatedness

Relatedness is a sense of connection and belonging, by being cared for and included while performing an action. It is enacted by the level of involvement with others which builds connection with others, a tenet SDT posits is essential.[81]

Competence

Competence is the effectiveness and confidence an individual has with a behavior.[81] Supporting competence also includes the receipt of positive feedback about a behavior from people around an individual, which can increase motivation.[81]

Expanded Obesity Research Paradigm

It would be impractical to expect AA women to experience weight loss comparable to NHW women if differing cultural perspectives and experiences surrounding behaviors, diet and PA, are not incorporated into intervention design.[53] The Expanded Obesity Research Paradigm, proposed by the African American Collaborative Research Network (AACORN), posits that the behaviors connected to weight status are embedded in the social and cultural process of AA's daily life.[53,58] Central in the paradigm lies "expanded knowledge domains" that include cultural and psychosocial processes, historical and social contexts, and physical and economic environments deemed necessary elements for the promotion of energy balance.[53] The expanded knowledge domains lead to five areas of research content and methods critical to intervening on health behaviors connected to weight status: 1) community and family life, 2) historical legacy and core values, 3) ethnographic and literary content analysis, 4) engaging communities, and 5) leveraging insider status.[53] The research content areas of community and family life, and historical legacy and core values were central to this research, particularly the design of aim 2.

Community and family life

The context of community and family life incudes women as a central focus. Women as a central role is important given the evidence gap this research aims to

understand. To properly address the disparity in obesity prevalence and BWI outcomes affecting AA women, their cultural role and norms of regarding weight-related behaviors are important. African American women often hold respected roles in the AA community (religious and civic organizations), including valuable food-specific social roles. Food, specifically binge eating, has also been cited as part of maladaptive coping strategies for race- and gender-based stress.[53,83] Finally, AA women may find value (strength, power) and physical protection in larger body sizes.[53] The paradigm calls for more effective intervention design by aligning content with AA women's food and activity behaviors, while providing strategies appropriate with their lived experiences.[53]

Historical legacy and core values

The subtheme of collective trauma includes the intergenerational post-traumatic stress from the long-standing effects of slavery, economic, and political distress. This subtheme of the model specifies the continuous exposure to "race-related adverse experiences" that determine the higher priority of social concerns above health behaviors in AA life. Coping strategies, such as overeating, in response to stress may be normative, and may contribute to burdensome health issues.[53,83]

By acknowledging and incorporating AA's culturally relevant influences and processes on health behaviors and related outcomes, we may promote behavior change and improve BWI outcomes in AA. A 2014 review of obesity treatment and prevention for AA, recommends that cultural concepts and contexts become a standard part of interventions.[50]

Determinants, Barriers, and Enhancers of Physical Activity in African American Women

Increasing PA may be a strategy for increasing the energy deficit necessary for weight loss, and holds potential for reducing the racial weight loss disparity in BWI between AA and NHW women. Research has explored reasons AA women may not engage in as much PA. Factors such as their confidence in being active in the face of barriers (self-efficacy), social support, culture-specific barriers (hair maintenance, social role overload), and self-regulation for PA have been identified as correlates or predictors of physical activity.[38-40,59,84] Lack of time and motivation are consistently mentioned in the literature as necessary for engaging in PA.[79,80,84-88] These constructs should continue to be included in interventions designed to support PA behaviors and weight loss.

Physical Activity Determinants

To increase PA, its determinants should be incorporated. A cross-sectional study of AA and NHW women found that self-efficacy was the only positive predictor of PA among factors studied.[89] A 2012 review of correlates and determinants of PA found health status and self-efficacy to be PA determinants.[90,91] In a survey of 921 AA women in South Carolina (20-50 years old) again it found that perceived health status and current PA level were positively correlated with self-efficacy, a construct whose effect was found to operate through self-regulation, which exerts a strong, independent effect on PA.[91,92] Social support was also related to PA For AA women.[91]

African American Women's Barriers to PA Engagement

A critical part of addressing the BWI disparity through cultural adaptations is to intervene on the PA barriers relevant to AA women, addressing specific cultural needs to support PA engagement, that may impede the high level of PA (250-300 minutes/week) necessary to address obesity through weight loss.[38,39,50,93,94] Following the AACORN recommendations, qualitative results are included to compliment quantitative findings to deepen our understanding of the correlates, predictors, barriers and enhancers to PA for AA women.[53]

In addition to lacking time, willpower, and motivation, seeing and knowing others who exercise has been positively related to PA for AA women, connected with benefits like improved appearance and health.[72,73,95] African American women perceived NHW women's PA motivations to be thinness and keeping husbands, but AA women prefer higher body weight, and feel guilty when not prioritizing family needs.[85,96] Familial obligations and other actions to sustain daily life, like finances are most important to this group.[96] Many African American women take pride in their multiple social roles (family, caregiving, church, work, etc.) and guilt for not completing daily responsibilities, but social role constraint is negatively correlated with PA self-efficacy.[92] The multiple social roles, prioritization of others' needs before their own, refusal of aid from others, and assuming overwhelming obligations lead to postponed self-care, and has been connected to maladaptive coping strategies like binge eating and stress, which are inversely related to decreased PA.[83,90] The benefit of engaging in PA to families and communities should be communicated.[96]

Problem-solving how AA women can manage or reduce stressors from social obligations may increase their PA.

Cosmetic Barriers

Hair maintenance is a major barrier to PA because AA women invest considerable time, effort and money to achieve and maintain hairstyles. [94,96-101] These styles communicate messages to society about personal value and self-worth.[101] Hence sweating during PA can severely diminish their return on investment, which has deterred women from engaging in PA.[97,101] Versey states that in recent history, popular social support venues like YouTube for AA women help them learn how to balance hair needs and health priorities.[101] African American women have also shown preference to not becoming disheveled in front of others because of PA.[85] Providing strategies for hair maintenance during and after engaging in PA may support AA women's activity effort.

Physical Activity Enhancers & Perspectives

Not all cultural perspectives or processes must be challenged, but they may be utilized for health behavior promotion. Collectivism, a sociocultural perspective that prioritizes community over individual need, may be useful when promoting PA.[102] Community benefit and support links with collectivism, civic engagement, the formation of non-kin networks and sisterhood bonds that are all characteristics of AA culture.[103,104] Extended family and interdependence stem from African culture, and are beneficial for providing support, nurturing, and protection.[104] African American women want PA role models and partners to engage in activity with, which could protect against negative comments about PA.[96] A positive association has been

observed between a sense of community and self-efficacy for PA in AA women, so connecting health behaviors, like PA, to community benefit, may support AA women's behavior change.[92,103]

Some cultural perspectives and norms may need reframing in order for AA women to engage in health promoting behaviors. One such cognition is that PA is necessary only for weight loss, or to prolong life, a perception that competes with the AA cultural concept of fatalism (predetermined path and outcome), and could lead to inaction in health behaviors.[99,105] Focusing on health outcomes from increased PA, not weight or thinness, and considering the cultural value of rest (rest ethic) may be explored to respect cultural norms and perspectives while promoting PA and weight loss.[53,55,93,103,106–108] Interventions doing so support the expanded obesity research model which guides the increase in PA and weight loss outcomes.[53]

Conceptual Model

The intervention conceptual model's constructs were chosen based on evidence from quantitative and qualitative literature, where SDT and SCT have been used or discussed in detail.[55,9560,61109110,111] The theoretical constructs will be employed in a culturally relevant manner by framing them in the AACORN paradigm of expanded knowledge, including the aforementioned cultural, psychosocial, historical and social contexts surrounding behaviors related to PA and diet.[53] When framed in the AACORN paradigm, the conceptual model may explain the relationships between the labeled factors, PA, diet and ultimately weight loss in AA women (Figure 5.1).

In summary, BWI are efficacious, but less so for AA women. There is an established disparity in the efficacy of BWI for this subgroup disproportionately

affected by overweight and obesity. Many factors have contributed to the current state of intervention science concerning AA women's outcomes including: lack of subgroup analysis by race, difficulty recruiting and retaining minority participants, lower energy needs in AA compared to NHW women, inconsistent reporting of and variable cultural adaptations made and variable outcomes from adaptations. We will explore a recent study to further inform our understanding of racial weight loss difference among women in a BWI. By applying Self-Determination and Social Cognitive Theories, and using the AACORN expanded obesity research paradigm, an enhanced intervention for AA women only will be conducted to determine its potential efficacy, and contribute to closing the weight loss gap.

CHAPTER 4

RACIAL DIFFERENCES IN WEIGHT LOSS MEDIATED BY ENGAGEMENT AND BEHAVIOR CHANGE

Overview

Weight reduction through behavioral weight loss treatment is an effective solution for overweight and obesity. The adoption of a lower calorie dietary pattern, higher physical activity for increased energy expenditure, and behavior change produce the desired effect of weight loss through interventions. Unfortunately, the standard approach to weight loss is less effective for African American (AA) women, who commonly lose less weight, compared to non-Hispanic white (NHW) women. This secondary analysis aimed to determine if a racial disparity in weight loss existed between AA and NHW women in a primarily Internet-delivered behavioral weight loss intervention. Furthermore, this study examined behavioral factors that may mediate the race-weight loss relationship.

We analyzed data from 170 participants from a larger study that compared behavioral weight loss treatment delivered in a small vs large group. For this analysis, participants were collapsed across groups. A multiple linear regression model was used to determine differences in weight loss. Multiple mediation with bootstrapping evaluated the effect of study adherence and behavioral variables that were significantly different between groups. Non-Hispanic white women lost significantly

more weight than AA women at 4 months (mean(SD): -5.03% (4.54) vs.-2.39% (3.82); (ß(SE) = -2.85 (0.74), p=0.0002)). The total number of website log-ins and change in Eating Behavior Inventory (EBI) mediated the relationship between race and change in weight at 6 months.

Findings align with the evidence demonstrating that AA women lose less weight than NHW women in behavioral weight loss interventions. Results suggest that greater study engagement and higher change in weight control behaviors, as measured by change in the EBI score, may reduce the racial weight loss disparity.

Introduction

Overweight and obesity are significant public health problems, affecting 68.8% of adults in the United States.[1] Unhealthy weight increases risk of developing diseases like type 2 diabetes, hypertension, cardiovascular disease, and some cancers (e.g. postmenopausal breast and colon cancer). African American (AA) women experience a higher burden of overweight and obesity compared to non-Hispanic white (NHW) women, 82.1% compare to 59.5%, respectively.[1] A higher prevalence of type 2 diabetes, cardiovascular disease, and death from weight-related cancers has been observed in African Americans.[2] Solutions to optimize weight loss and realize the benefits of modest weight reduction are needed to reduce the disproportionate burden of unhealthy weight on African American women.[3-4]

Behavioral weight loss interventions (BWI) are an effective treatment for overweight and obesity. Clinically significant weight reduction by 5-10% of baseline weight improves health outcomes by lowering low-density lipoproteins, triglyceride, blood pressure, and Hemoglobin A1c, while increasing high-density lipoproteins.[5-9] Evidence-based behavioral weight loss programs including diet, physical activity (self-directed and/or supervised), and behavior modification produce clinically meaningful weight loss for positive health outcomes. Several large multi-center trials (e.g. Diabetes Prevention Program, The Action for Health in Diabetes (Look AHEAD), The Weight-Loss Maintenance, PREMIER), and smaller multi-center investigations (e.g. Step-Up) have demonstrated significant weight reduction through behavior modification for participants, including AA.[10-14]

Although evidence based behavioral weight loss programs produce beneficial levels of weight loss, a racial disparity exists in their effectiveness for women. In these trials, compared to NHW women, AA women consistently lose less weight (2-3kg).[5,15–17] African American women may still lose an amount of weight associated with positive health changes in BWI, however, smaller weight losses reduce their potential to reach maximal health benefits.[9,18] The field lacks a definitive understanding of the reasons for the weight loss disparity. Racial differences in dietary intake and physical activity (PA) outcomes in BWI are mixed.[16,19] Difficulty recruiting and retaining minorities, insufficient sample size for racial subgroup analyses, and a lack of conducting or reporting such analyses contribute to the persistence of the knowledge gap.[20,21] More evidence is needed to better understand the racial weight loss outcome disparity and to develop more effective interventions.

Therefore, we conducted a secondary data analysis to examine the effect of race on women's weight loss and behaviors to add to our understanding of the outcome disparity. We hypothesized that weight loss would differ significantly by race with NHW women achieving greater weight loss than AA women at 4 months post-baseline. Furthermore, we hypothesized that behavior change (dietary, PA) and study engagement would differ by race such that NHW women will have better changes compared to AA women at 4 months post-baseline, and these changes will mediate the relationship between race and weight loss.

Methods

Data Source, Collection, and Sample

A randomized controlled trial conducted in 2012 by researchers at the University of North Carolina at Chapel Hill provided data for this analysis (Clinical Trial Registration Number: NCT01615471).[16] Inclusion and exclusion criteria are explained in full elsewhere.[16] Briefly, eligible participants were overweight or obese (BMI >25 kg/m^2), had Internet access at least once weekly, had or were willing to create an email address, were able to attend the 4 monthly sessions, and lived within 30 miles of the study site. Physician consent was required for participants with a history of myocardial infarction, undergoing cancer treatment, or with a BMI >50. Individuals were excluded if they could not read or write English, took insulin, were pregnant in the past 3 months or planning pregnancy within the next 6 months, participating in another weight loss study, or taking weight loss medications. Measurements were collected in person and questionnaires were completed online at baseline (prior to randomization) and 4 months. For this analysis, the study sample (n=170) was composed of women who self-identified as NHW (n=76) or AA (n=94).

Study Design

The larger study was a 4-month standard BWI based on the Diabetes Prevention Program, previously modified for face-to-face and Internet delivery.[18,22-24] To promote weight loss, the intervention supported participant adoption of a lower calorie dietary pattern (1200-1500 calories/day) and increased moderate-intensity PA. Participants were randomized to monthly face-to-face treatment in a large (approximately 100 participants) or small (approximately 20 participants) group format led by trained

weight control interventionists. Intervention delivery was primarily via Internet. Groups received the same Internet components that included weekly automated tailored feedback, self-monitoring tools, written lessons, video resources, problem solving and exercise action planning tools, and social support through message boards. Participants were instructed to utilize the Internet component between the monthly face-to-face sessions. Participants provided informed consent online. The Institutional Review Board of the University of North Carolina at Chapel Hill approved the study.

Measures

Data were collected at baseline and 4-months. Measures included weight, physical activity and weight-related psychosocial and process variables. Variables relevant to this analysis included the Eating Behavior Inventory (EBI), adherence to a daily calorie goal, following a structured meal plan, total website log-ins, and session attendance. Change in weight and PA were the primary and secondary outcomes, respectively.

Demographic variables: At baseline, age, marital status, and annual income were assessed via questionnaire.

Weight: Weight (primary outcome) was measured with participants in light clothing, without shoes using a digital scale. Weight was measured in duplicate; if the first two measurements did not fall within 0.1 kg, a third measurement was recorded. Values within 0.1kg of one another were used in analyses.

Diet-related: Calorie intake was measured with the Automated Self-Administered-24 dietary Assessment (ASA-24). The tool has been used in weight-related studies to estimate energy intake.[17] Positive and negative weight control

behaviors were assessed with the 26-item Eating Behavior Inventory (EBI). Item response options were on a 5-point Likert scale (1= never or hardly ever to 5 = always or almost always). Negative weight control items are reverse scored so the higher sum of all items reflects adoption of behaviors that support weight loss.[25]

Physical activity: Physical activity was measured with the 7-item, self-report Paffenbarger Physical Activity Questionnaire. This tool assessed leisure time PA in total calories in the past week. It has been used in previous weight loss trials to estimate weekly energy expenditure from habitual PA.[18,19]

Exploratory study engagement measures: We assessed study engagement with website log-ins and session attendance. Total website log-ins were captured with participant utilization tracking. Monthly session attendance was measured with attendance logs completed during weigh-ins at each face-to-face session.

Statistical Analyses

The larger study included 195 participants.[16] We excluded men (n=19) and participants who did not self-identify as AA or NHW (n=6). Data for this secondary analysis included only AA and NHW women (n=170) and were collapsed across intervention groups. All analyses controlled for group assignment. We conducted a complete case analysis (n=124 for change in weight, the primary outcome). Data on the primary variable of interest (change in weight) from our sample were missing for 27.06% of participants. No association was observed between any outcome variables and baseline demographic variables, so missing data were assumed to be missing at random. Non-normally distributed right-skewed variables were log transformed. Descriptive statistics were calculated for demographic variables, weight, dietary

calorie intake, calories expended from physical activity, and the exploratory measures.

A multiple linear regression model was used to examine the association of race on 4-month change in weight, physical activity, daily calorie intake, EBI score, total website log-ins and session attendance. The regression assumptions of multicolineraity, homoscedasticity, autocorrelation, linearity, and normal distribution of the residuals were tested. The assumptions held for all variables. Diagnostics to identify outliers and influential observations were undertaken. No observations were excluded. Dependent variables (weight loss, EBI) were represented as change in the value of those variables. Change was calculated with the following formula: value at 4 months post-baseline – value at baseline. Weight change was evaluated by percent change in weight, calculated with the following formula:
weight at 4 months - weight at baseline) x 100) /weight at baseline.

We investigated potential mediators of the race-weight loss relationship with variables that differed significantly by group at 4-months post-baseline. The PROCESS macro was used to run a multiple mediation model and assess the total effects of mediators.[26] The macro applied bootstrapping, a more robust method than the Sobel test, to determine the significance of the mediated effect with 5,000 sampling distributions. For mediators expressed as change in a variable, we controlled for baseline differences by including the baseline variable in the mediation model.

For all analyses, a p-value of <0.05 was considered significant. Demographic variables were tested for association with the primary outcome variable. Differing baseline variables did not significantly impact regression parameter estimates, and

therefore were not included in analyses. Mediation analyses controlled for group randomization. All analyses were conducted using SAS software version 9.3 (Cary, NC, USA).

Results

Sample Characteristics

Participants (n=170) included 55.3% AA and 44.7% NHW women with an average age of 46.10±10.8 years old (Table 4.1). Baseline BMI was 39.6±8.0 and 35.8±7.3 for AA and NHW women, respectively. Participants differed marginally in age (p=0.07), significantly in annual income (p<0.0001) and marital status (p=0.0002) by race. Non-Hispanic white women were older (mean(SD): 47.79(11.48) years), more had an annual household income of ≥$50,000 (70.42%) and were married or living as married (77.63%) compared with AA women.

Weight, Physical Activity and Dietary Intake Outcomes

Table 4.2 contains a summary of results. Compared to AA women, NHW women lost significantly more weight (mean(SD): -5.03% (4.54) vs.-2.39% (3.82); (β(SE) = -2.85 (0.74), p=0.0002)), but did not differ in physical activity or calorie intake.

Exploratory Study Engagement Variable Outcomes

Compared to AA women, NHW women had a significantly higher change in EBI score (β(SE) = 3.95 (1.73), p=0.02), reflecting adoption of self-regulatory weight management behaviors suggested by the intervention, and website log-ins (β(SE) = 0.67 (0.26), p=0.01). No race differences were observed in session attendance.

Multiple Mediation Outcomes

Behavioral and study engagement variables were assessed to determine differences by race and if they mediated the relationship between race and weight loss. Total website log-ins and change in Eating Behavior Inventory (EBI) score differed significantly by group, and were mediators between race and percent change in weight. Figure 4.1 depicts the multiple mediation models' effects. There was a significant total effect (c) of race on percent weight change, such that AA women had a smaller percent weight change than NHW women. The direct effect (c') of race on percent weight change was significant, such that AA women had a smaller percent weight change than NHW women when both mediators were present. Table 4.3 shows the indirect effects of the model. Total website log-ins and change in EBI score partially mediated the relationship between race and percent weight change, as indicated by the significant indirect effects when controlling for group assignment and baseline EBI score. The race-weight loss relationship was attenuated by the presence of the mediators, suggesting partial mediation. Lower EBI score is partially due to the adoption of fewer EBI-measured strategies among AA vs NHW women (Table 4.4).

Discussion

This study examined the effect of race on weight loss in women in a primarily Internet-delivered behavioral weight loss intervention. We observed significantly greater weight loss in NHW women compared to AA women at 4 months post-baseline. This finding aligns with the literature on racial differences in weight loss with other program delivery methods. We also studied participants' behaviors and intervention strategies to explore potential reasons for this weight loss difference. Better study

engagement, demonstrated by more website log-ins and greater adoption of weight control behaviors (change in EBI score), was observed in NHW compared to AA women. Session attendance, change in self-reported PA calorie expenditure and dietary calorie intake did not differ by race group. Furthermore, website log-ins and change in EBI score partially mediated the racial difference in weight loss. These findings begin to identify potential intervention targets to reduce the disparity in effectiveness of weight loss interventions between AA and NHW women.

Behavioral weight loss interventions that examined weight loss outcomes by race have reported results similar to ours; we found an approximately 3.0% greater WL in NHW than AA women in our sample (-5.03% vs -2.39%, respectively). Similar weight loss results were seen in the lifestyle arm of the Diabetes Prevention Program, noting differential weight loss outcomes by race, where AA women lost 4.5% of their baseline weight, compared to 8.1% loss in NHW women at 12 months post-baseline.[28] Step-Up, another face-to-face behavioral intervention, reported findings comparable to the DPP (8.6% vs 5.5% for NHW and AA, respectively).[22] Prior Internet delivered programs have shown weight losses of 4.0-8.0%, and seem to vary with the dose of human e-counseling delivered (e-mail or chat).[18,24,29-31] Among minorities, low to moderate weight loss (<3kg) has been observed in a review of weight management eHealth interventions.[32] In our study, NHW women achieved modest weight loss at 4 months, while, on average, AA women did not. The weight loss we observed in AA women aligns with intervention evidence across modalities of delivery. Since modest reduction of baseline weight (5.0-10.0%) confers clinical health benefits it is critical that investigators seek to improve weight loss for AA women.[33,34]

Weight loss differences may be due to varying adherence to recommended daily calorie intake. Our results showed no significant difference in self-reported daily calorie intake between racial groups. A previous face-to-face intervention, conducted by Davis and other members of our research team, also found that despite a weight loss difference, AA and NHW women did not differ in self-reported daily calorie intake.[11] Racial differences in diet adherence by race have been observed in an ancillary Dietary Approaches to Stop Hypertension study. Self-reported dietary data has been underreported in AA women, and predicted by increasing BMI.[35,36] The higher weight status of AA women in our study suggests that energy underreporting may be one factor in the observed weight loss differences or other problems with inaccuracies of self-reported dietary data.

This study also examined adherence to the recommended amount of physical activity. No group difference was observed in self-reported PA. The Look AHEAD study found that self-reported PA was significantly greater in NHW compared to AA.[11] However, similar amounts of self-reported PA have been observed between race groups in other multicenter trials. [37] A recent RCT comparing AA and NHW women found no group differences in self-reported PA.[13] Previous findings reveal that before and after weight loss, AA women overestimated self-reported PA, whereas NHW women reduced their overestimation to levels similar to control subjects.[38] Performance of less PA from baseline to study end by AA compared to NHW women has been observed through objective PA measurement.[13] Our self-reported PA results may reflect an overestimation by AA women after weight loss. A set of specific strategies to increase PA among AA women in BWI may be especially important given

the high PA recommendation for weight loss (250-300 minutes/week).[39] Importantly, we used the Paffenbarger PA questionnaire, which captures leisure time PA.[40] Therefore, other PA types were not assessed (e.g. occupational). Objective PA measurement is needed to better evaluate AA women's PA behaviors within BWI.

To better understand the difference in weight loss observed in our study we also investigated women's intervention engagement through attendance, website log-ins, and adoption of weight control behaviors as measured by the EBI. We found no difference in session attendance, which has often been associated with weight loss in other multicenter weight control trials.[11] Higher attendance has also been correlated with greater weight loss.[41] Our findings on attendance may have been limited by the few face-to-face sessions offered (4 total sessions) and differences may have emerged if more opportunities to attend face-to-face sessions were offered.

Engagement with website self-monitoring features has been associated with better weight loss outcomes.[31] In our study, AA women logged into the website, the primary mode of intervention, significantly less than NHW women over 4 months (mean(SD): 31.0(55.7) vs. 51.8(68.2)). Website-log-ins also mediated the race-weight loss relationship in our multiple mediation model, suggesting that the racial difference in weight loss is partially explained by fewer log-ins. More log-ins and use of website features have been associated with greater weight loss and better weight maintenance across studies.[42,43] African American participants were more likely to be minimal vs consistent users of the interactive Internet maintenance group in the Weight Loss Maintenance trial.[43] Our results align with previous evidence, which highlights the association between website engagement, and that AA women are less

engaged with web-based features of interventions thus impacting their weight outcomes.

While all women improved EBI score, change in EBI score was significantly smaller (mean(SD): 5.94(9.13) vs 9.55(10.03)) and fewer EBI strategies were adopted in AA compared to NHW women. After accounting for differences in website log-ins, the change in EBI score partially mediated the race-weight loss relationship in our multiple mediation model. Consistently, weight loss studies demonstrate that increased EBI score is associated with weight loss.[25] Jakicic et al. found that after 18 months in a BWI program, women with the highest change in EBI score lost significantly more weight than those with the smallest EBI change.[44] Future studies may need to employ strategies to increase the adoption of these weight control behaviors, and understand why less strategies are adopted by AA women.

Strengths and Limitations

Strengths of this study include the large proportion of AA women (55%), which allowed for evaluation of the intervention by race. This subgroup analysis may further our understanding of weight loss disparities in BWI. Application of a multiple mediation model allowed us to determine how weight control and study engagement behaviors affected weight loss outcomes simultaneously. The primarily Internet-based nature of this intervention complements evidence from mostly face-to-face interventions. Self-reported measures of adherence, dietary intake, and PA are a limitation of this study. By nature, self-reported data may be inaccurate. We did not investigate variables other than race that may help us understand what factors influence website engagement. This study adds to the scant evidence regarding race

and mediators of weight loss between AA and NHW women in Internet-based studies. Knowledge of intervention effectiveness across modalities expands our understanding of the weight loss disparity and potential paths to maximize effectiveness for AA women.

There are many directions investigators could follow to move towards equity in outcomes from behavioral weight loss interventions. Researchers may choose to develop research questions with a primary goal to study the weight loss disparity between AA and NHW women. Recruitment and retention of large samples of racial/ethnic minority participants are required to answer such questions. The recruitment of diverse samples will enable subgroup analysis, which should become a reporting standard. Doing so will expand the evidence base and improve our understanding of outcomes and strategies for behavior change. Where possible, including objective measurement of behaviors and study engagement will lead to more definitive conclusions in future interventions. While modest weight loss (5-10% reduction of baseline weight) is the standard goal, it largely remains an elusive target for AA women. Maximizing their outcomes is an important objective.

Our assessment focused solely on quantitative data. Mediation analyses were valuable to identify the pathways through which racial weight loss differences may occur, and should be conducted more to assess the underpinnings of weight disparities. Qualitative investigations may complement quantitative findings, providing a deeper understanding of perceptions and processes that may impact racial weight loss differences.[20,45] A well-rounded body of evidence may specify additional methods to change the weight control behaviors measured with the EBI, and website

engagement in AA women. Research directed at racial differences in BWI may increase the effectiveness of future behavioral weight loss interventions for AA women.

Conclusions

Results from this study suggest that a predominantly Internet-delivered behavioral weight loss intervention was less effective for AA compared to NHW women. We observed similar self-reported dietary and PA adherence, similar session attendance, but differing website and weight control behavior engagement that partially explain the race-weight loss relationship. The current study aligns with earlier evidence showing significantly lower weight loss, behavior change and study engagement in AA compared to NHW women. Greater understanding of study engagement and weight control behaviors in AA enrolled in behavioral weight loss interventions is needed to reduce the racial disparity in women's weight loss.

Table 4.1. Baseline Demographic Characteristics of Participants by Race

Variable	AA (n=94)	NHW (n=76)	Bivariate p-value
Age (y)	44.73 (10.13)	47.79 (11.48)	0.07
Annual Income, n (%) • **< $50,000/year** • **≥ $50,000/year**	 53 (63.86) 30 (36.14)	 21 (29.58) 50 (70.42)	 <0.0001
Marital status, n (%) • **Married or living as married** • **Single, divorced, separated**	 47 (50.00) 47 (50.00)	 59 (77.63) 17 (22.37)	 0.0002
Weight (kg)	106.60 (23.52)	95.50 (20.68)	0.002
BMI (kg/m^2)	39.57 (7.99)	35.82 (7.34)	0.002
Physical activity (kcal/day)	841.9 (953.90)	708.30 (910.00)	0.36
Daily energy intake (kcal/day)	1906.30 (614.9)	1893.80 (534.00)	0.90
Eating Behavior Inventory score	64.13 (7.89)	60.38 (9.24)	0.13

All values reported as mean and standard deviation, unless otherwise indicated.
AA= African American women
NHW = non-Hispanic white women

Table 4.2. Outcome Change Values and Regression Outcomes

			Mean (SD)	Regression Results		
Outcome	**N**	**Missing (%)**	**AA**	**NHW**	**Parameter Estimate (SE)**	***p*-value**
Change in Weight, %	124	27.06	-2.39 (3.82)	-5.03 (4.54)	-2.85 (0.74)	0.0002[a]
Change in physical activity, calories	123	27.65	158.86 (1092.71)	291.47(867.07)	151.66 (183.34)	0.4098
Change in dietary intake, calories	102	40.00	-406.84 (631.62)	-257.59 (786.84)	144.71 (142.76)	0.3132
Change in EBI Score	125	26.47	5.94 (9.13)	9.55 (10.03)	3.95 (1.73)	0.0240[a]
Session attendance	170	0	2.54 (1.40)	2.93 (1.28)	0.26 (0.20)	0.1957
Total website log-ins	170	0	31.0(55.7)	51.8(68.2)	0.67 (0.26)	0.0103[a]

[a] Indicates significant regression results
AA= African American women
NHW = non-Hispanic white women

Table 4.3. Multiple Mediation Indirect Effects

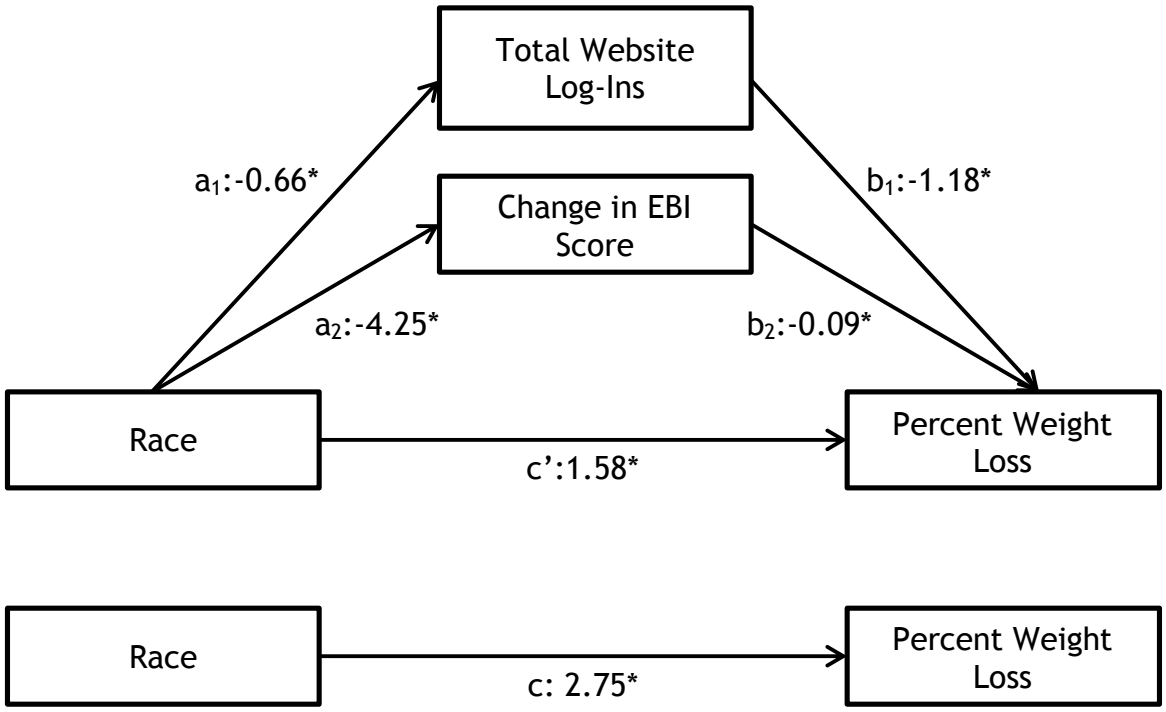
	Coefficient (SE)	95% Confidence Interval*
Total Indirect Effects	1.17 (0.42)	**0.4297,2.1007**
Total Website Log-Ins	0.78 (0.32)	**0.2327,1.4953**
Change in EBI score	0.38 (0.23)	**0.0532,1.0228**

*Bolded confidence intervals exclude zero and indicate significant indirect effects

Table 4.4. Comparison of the Adoption of Eating Behavior Inventory

	mean(SD)		Regression	
	AA	NHW	Parameter Estimate (SE)	p-value
Baseline EBI	0.68(0.11)	0.68(0.12)	0.003(0.02)	0.86
4 month EBI	0.74(0.10)	0.77(0.09)	0.03(0.02)	0.09

Figure 4.1 Multiple Mediation Model



CHAPTER 5

COMPARATIVE EFFECTIVENESS OF A STANDARD BEHAVIORAL AND PHYSICAL ACTIVITY ENHANCED BEHAVIORAL WEIGHT LOSS INTERVENTION IN AFRICAN AMERICAN WOMEN

Overview

The majority of African American (AA) women are overweight or obese (82.1%).[18] Lifestyle change through behavioral weight loss treatment is a solution that has yielded less weight loss for AA compared to non-Hispanic white women.[9-12,30] While some studies found no difference between AA and NHW women in dietary intake, higher objectively measured physical activity engagement has been observed in NHW women compared to AA women.[11,27,112,113] High amounts of physical activity (250-300 minutes/week) have been recommended for weight loss.[38,114] Performance of high amounts of physical activity (PA) can contribute approximately 20% of weight loss.[15,16]

To determine if adherence to the higher PA recommendation is effective for weight loss, overweight and obese AA women were randomized to a standard behavioral weight loss intervention (n=42) or a culturally-relevant PA-enhanced behavioral weight loss intervention (enhanced group, n=43). For 6 months, both groups received 18-group behavior change sessions, daily calorie intake and PA goals, daily self-monitoring recommendation and weekly feedback emails. The enhanced group received additional supports to bolster PA engagement. At baseline, 3- and 6-

months post-baseline, change in (primary outcome) and PA were measured (secondary outcome).

The intervention was evaluated using a multiple linear regression model including data from women who completed the study. The enhanced group lost less weight than the standard group (-2.83kg (-2.95%) vs. -2.08kg (-2.19%); β(SE)= -0.73 (0.92), p=0.43) and increased less minutes/week of physical activity (43.93(116.10) vs. 15.29(132.90); β(SE)= 23.08 (30.44), p=0.45), though neither was statistically significant. These findings suggest that the enhanced group treatment produced weight loss and PA outcomes not different from the standard group. Weight losses were comparable to previous evidence in African American women.

Introduction

African American (AA) women are severely affected by the epidemic of overweight and obesity. A disproportionate majority of AA women are overweight or obese (82.1%), compared to 59.5% of non-Hispanic white (NHW) women. [18] Unhealthy weight increases individual risk of developing diseases like type 2 diabetes, hypertension, cardiovascular disease, and some cancers (e.g. postmenopausal breast and colon cancer).[4,5,19,20,115] Achieving and maintaining a healthy weight is a key recommendation for the prevention of postmenopausal breast and colorectal cancer.[5,19] Additionally, clinically meaningful weight loss (5-10% reduction in baseline weight) can be achieved with behavioral treatment. Diet, physical activity (self-directed and/or supervised), and behavior modification are the evidence based intervention components typically applied in behavioral weight loss interventions to produce clinically meaningful weight loss and related health benefits.[2,7,22] Interventions have produced improved health outcomes like reduce low-density lipoproteins and triglyceride levels, increased high-density lipoproteins, reduced blood pressure, and hemoglobin A1c.[3,4,23,27]

Unfortunately, behavioral weight loss interventions are less effective for AA women. A racial disparity exists in the outcomes between AA and NHW women, where AA women often lose significantly less weight compared to NHW women in behavioral weight loss interventions.[11,12,30] Previous behavioral weight loss interventions and reviews report weight losses of approximately 2.0-3.0 kg less for AA compared to NHW women in multicenter randomized trials.[9,10,116] While small reductions in weight are

beneficial, the racial difference highlights a need for more effective behavioral weight loss interventions, which can reduce weight-related morbidity.[3,6,20]

There are several reasons for this persistent disparity in behavioral weight loss interventions. First, differential adherence to dietary and physical activity recommendations in behavioral weight loss intervention may influence the disparity in weight loss between AA and NHW women. For example, a 16-week randomized trial of diet and exercise found that race predicted adherence to dietary recommendations, with AA less adherent than NHW.[112] However, another randomized controlled trial found that AA and NHW women enrolled in a behavioral weight loss intervention did not differ in self-reported calorie intake.[11] Second, NHW women have exhibited significantly higher change in objectively measured PA and cardiorespiratory fitness levels compared to AA where PA was unsupervised.[11,113] In the lifestyle treatment arm of the Action for Health in Diabetes multicenter trial, at study end self-reported PA was the variable most strongly related to weight loss; and NHW were found to have higher PA compared to AA.[27] This suggests that adherence to study recommendations may improve weight loss.[27] Furthermore, developing strategies to increase and maintain PA for both races are needed.[11] Thus, while dietary adherence evidence is mixed, lower PA engagement among AA participants appears to be a more consistent finding, and may be a viable intervention target to improve weight loss outcomes in AA women.

Behavioral weight loss interventions promoting increased physical activity and decreased calorie intake produce greater weight loss than decreased intake alone. A review by Cuironi and Lourenco found that engagement in PA, in combination with an

energy-restricted diet, can account for as much as 20% of weight loss compared.[15] Goodpaster et al. observed approximately 25% more weight loss at 6 months post-baseline in their behavioral weight loss intervention that compared an initial PA (prescribed moderate-intensity PA) compared to delayed-PA treatment (PA after 6 months post-baseline).[16] That intervention, similar to many others, prescribed high amounts (250-300 minutes/week) of at least moderate-intensity PA, which has been assessed objectively.[16,38,114] High amounts of at least moderate-intensity PA have also been recommended for both short- and long-term weight loss.[15,17,38] Given the importance of PA in BWI, it is important to note that compared to NHW women, AA women have lower national prevalence of PA (≥ 150 minutes/week of moderate-to-vigorous PA; 36.1% vs 49.6%), and higher prevalence of physical inactivity (<150 minutes/week of moderate-to-vigorous PA; 43 vs 22 per 100 women.[42,43] Evidence from PA interventions for or including large samples of AA women suggests interventions include the following components to increase PA: offer supervised PA, provide PA goals, incorporate the barriers and enablers of PA, including social PA determinants, group exercise, social support, problem-solving, self-monitoring, modeling, and feedback. Incorporating supervised PA in a group format, and incorporating PA barriers and enablers may support AA women's PA engagement within BWI.[44–48]

Weight loss outcomes for AA may also be affected by relevant cultural influences on the outcomes and the related behaviors.[50] Some cultural perspectives and norms may need reframing in order for AA women to engage in health promoting behaviors. Therefore, a reframed behavioral weight loss intervention approach

incorporating the sociocultural norms and perspectives of AA has been proposed by the African American Collaborative Research Network.[53] With specific reference to PA, applying a sociocultural, race- and gender-based lens towards ways to increase PA in AA women during behavioral weight loss intervention may help reduce the disparity in weight loss outcomes between AA and NHW women.

The purpose of the Sisters in Health, a comparative effectiveness study, was to address the disparity in weight loss outcomes in AA women through a comparative effectiveness study in a randomized control trial design. The study tested whether a PA-enhanced behavioral weight loss intervention (enhanced) could produce greater weight loss compared a standard behavioral weight loss intervention (standard) in AA women. Frist, we hypothesized that AA women randomized to the enhanced would have greater weight loss at 6-months post-baseline compared to the standard group. Second, we hypothesized that AA women randomized to the enhanced group would engage in more objectively measured moderate-to-vigorous PA, compared to women in the standard group at 6-months post-baseline.

Methods

Participants

Women eligible for SIH self-identified as AA/black, had a body mass index of 25-45 kg/m^2, and were 21-65 years of age. Participants were required to be low active (≤75 minutes/week of self-reported moderate-to-vigorous PA), and willing to participate in face-to-face sessions. To support self-regulation behaviors during the study (self-monitoring and feedback), reliable Internet access with a regularly used email address was required. Exclusion criteria included weight loss (5-10%) in the last

6 months, concurrent participation in another weight-related program or study, and taking weight loss medication. The Physical Activity Readiness Questionnaire evaluated physical limitations and cardiac health.[117] Physician consent was required if an affirmative response was given to any of the 7 questionnaire items. Being or planning to become pregnant, use of insulin to manage type 2 diabetes, history of disordered eating, diagnosis of a major psychological disorder with change in medication dose in the past year, a medication regimen that affected weight, thyroid medication dose change in the last year, current or recent (last 5 years) cancer treatment, or relocation plans were also criteria for exclusion.

Recruitment

We used passive and active strategies for recruitment. Passive strategies included advertisement through a university listserv, local National Association for the Advancement of Colored People listserv emails, Facebook and flyers. Active recruitment strategies included meeting with community leaders (e.g. church pastors, community leaders) and participating in community events (e.g. health fairs) within a 30-mile radius of the study site to distribute flyers and collect interested individuals contact information for follow-up. All recruitment methods directed individuals to a study website to complete an initial screening form. If initially eligible, a phone screening was completed to assess final eligibility. If eligible, an invitation to an orientation session was extended. At orientation participants completed an informed consent document.

Study Design

Computer-generated randomization occurred after baseline data were collected. Women were randomized to either the standard or enhanced treatment group. Follow-up assessments were conducted at 3- and 6-months post-baseline. Participants received $25 for each follow-up assessment. The study was conducted in two cohorts from March 2016 to February 2017. The Institutional Review Board of the University of North Carolina at Chapel Hill approved the study.

Intervention Description: Standard Group

Social Cognitive Theory and Self-Determination Theory informed the design of the standard intervention. The standard group included the following components: 18 face-to-face group sessions, self-monitoring with a mobile application, and weekly email feedback. Participants were prescribed daily calorie intake goals based on baseline weight (1200 kcal/day for 90 kg, 1500 kcal/day for > 90 kg, 1800 kcal/day for those ≥ 113 kg). Each participant received a registered dietitian-created meal plan and sample menus. Weekly PA goals were prescribed to progressively reach 300 minutes/week of moderate-to-vigorous PA by 6 months. Progression towards the PA goal was based on self-reported moderate-to-vigorous PA (minutes/week) during recruitment; plan A was assigned to participants with < 60 minutes/week, and plan B was assigned to participants with 60-75 minutes/week. Daily self-monitoring of weight, calorie intake, and PA was captured using Myfitnesspal (a mobile phone application). Weekly email feedback from the interventionist who delivered group sessions provided behavioral guidance based on weekly weight change, average daily calorie intake and total minutes of PA recorded in Myfitnesspal.

Intervention Description: Enhanced Group

Reducing race- and gender-based barriers to PA, not often included in standard BWI, were targeted to improve AA women's weight loss outcomes. The enhanced group contained all elements of the standard group: weight-based daily calorie intake goals, progressively increased PA goals, 18 face-to-face group sessions, self-monitoring with a mobile application, and weekly email feedback, plus additional components (enhancements) to support participants' ability to meet the high PA prescription. The enhancements were shaped by the AACORN expanded obesity paradigm, as well as information from qualitative and quantitative literature about PA in AA women (Figure 5.1).[53] Enhancements were designed to reduce PA barriers, incorporate cultural PA values, and increase PA opportunities. Components of the enhancement included: PA barrier reduction, supervised PA, weekly PA activities, and Exercise Ambassadors. The enhancements are detailed further below.

Physical activity barrier reduction: Reducing PA barriers specific to AA women was a central enhancement of Sisters in Health. Problem-solving and goal-setting behavior change techniques were implemented through small teams and barrier tip sheets. At the first session, participants were organized into small teams. During sessions, participants met in small teams for 15 minutes to discuss, problem-solve or goal-set to manage PA barriers emphasized in a tip sheet. Each barrier tip sheet focused on one race- and gender-specific PA barrier, but common PA barriers were also incorporated. Tip sheet content presented barriers, with strategies to overcome them, or enablers to support PA, and language that incorporated the sociocultural perspectives and experiences of AA women. Where necessary, on the tip sheets,

cultural perspectives on PA were reframed to promote PA engagement. The sociocultural perspectives of the value of sisterhood and non-kin bonds were essential elements for this enhancement.

Supervised Physical Activity: A review of PA interventions for AA women recommended that PA is practiced before attempted individually to increase participant adherence to prescribed intensity and duration.[58] During study sessions, a female AA certified group fitness instructor led 30 minutes of aerobic activity that included demonstration of exercises and duration through continuous exercise in at least 10 minute bouts. Participants were instructed to use the Talk Test to evaluate exercise intensity.[118,119]

Weekly PA Activities: To engage participants in PA between sessions, structured options were presented in lesson materials. The options included: 1) 30 minutes of exercise with a teammate, 2) 30 minutes of a home instructional exercise video, 3) 30 minutes of exercise in a group fitness class, and 4) 30 minutes of exercise of their choosing.

Exercise Ambassadors: A positive association has been observed between a sense of community and self-efficacy for PA in AA women.[92,103] Increasing AA women's PA community with role models, desired by AA women, may support PA behaviors and protect against negative comments about healthy behaviors.[96] We recruited Exercise Ambassadors (n=6) as role models for PA. Ambassadors were women who self-identified as AA/black, maintained ≥ 5% of weight loss over 6 months, maintained ≥150 minutes/week of moderate-to-vigorous PA over 3 months, with no contraindication to PA participation.

An Exercise Ambassador joined a group session monthly during the intervention. Two appearances were encouraged per ambassador to build familiarity with participants. The ambassador discussed how they problem-solved the PA barrier highlighted on the coordinating barrier tip sheet, and participated in supervised PA with participants. For one week after an appearance, ambassadors were required to engage with participants in the private Facebook group by commenting on the moderator's post, as well as liking and responding to participant comments. The online conversation focused on the barrier highlighted during their appearance.

Measures

All measures, except demographics, were collected at three time points: baseline, 3- and 6-months post baseline.

Demographics: Information on various descriptive variables was collected at baseline. Demographic variables included age, annual household income, and marital status.

Anthropometrics: Height was measured in duplicate with a wall-mounted stadiometer. If values did not fall within 0.5cm of one another, a triplicate measure was collected. Weight, the primary outcome, was assessed in duplicate using a digital scale, with participants in light clothing and no shoes. A third weight was collected if the preceding values did not fall within 0.1 kg of each other. After a 5-minute rest period, three blood pressure readings were captured using an automated device. A Gulik tape measure was used to assess waist circumference, which was measured in duplicate, triplicate if the first two measurements were not within 1.0 cm of each other.

Dietary Intake: The Block Food Frequency Questionnaires for fat and fruit/vegetable intake were used to assess fruit/vegetable servings (daily), total fat (g), and percent of calories from fat.[120]

Physical Activity: Physical activity was assessed with objective and self-report methods. The SenseWear Armband (BodyMedia, Pittsburgh, PA) accelerometer was used to evaluate moderate-to-vigorous PA (minutes/week). Previous studies have used and validated the armband.[38,121–123] SenseWear armband company software determined PA intensity by assigning estimated MET values to minute-by-minute data. Moderate-to-vigorous PA was defined as: moderate = 3-5.9 METs, vigorous = ≥ 6 METs. During wear, participants were instructed to continue their normal PA regimen and wear the armband for 7 days during all waking hours. Adherent wear was defined as at least 4 days, worn at least 10 hours/day.

The Paffenbarger Exercise Habits Questionnaire captured self-reported energy expenditure (kcal/week) from city blocks walked, flights of stairs climbed, and leisure-time physical activities.[124] Responses to the sport activities were classified as light (5 kcal/minute), moderate (7.5 kcal/minute), or vigorous (10 kcal/minute). Total energy expenditure included the sum of calories from blocks walked, flights climbed, and leisure-time activities reported. This was used previously and validated, shown to perform moderately well for determining individual habitual PA.[38,40,125]

Process measures: Participant engagement with the study was assessed using group session attendance checklists and tracking of the number of weeks of self-monitoring. A week of self-monitoring was defined as ≥3 days, with ≥1000 kcal

intake/day. Total Facebook likes and comments per individual were captured in the enhanced group.

Statistical Analysis

Differences in baseline characteristics were assessed with t-tests and chi-square tests. No baseline group differences were observed; therefore, all analyses were unadjusted. To determine the interventions' effects on weight, a multivariate linear model was used to compare groups. A linear mixed model was used to determine the main effects of group and time, and the group*time interaction. Change in weight was the primary outcome for which a sample size of 66 was a priori determined to detect a 3kg between group difference in 6-month weight change. The secondary outcome was moderate-to-vigorous PA from the SenseWear Armband. Any outcome variables that violated the assumption of normality were transformed to approximate a normal distribution of residuals. Self-reported physical activity and total weeks of self-monitoring were log transformed. Waist circumference underwent a square root transformation. We report the original variable means for ease of interpretation. Baseline values were included in all models. A p-value of <0.05 was considered statistically significant. One observation was excluded from analysis due to medical reasons. Analyses were conducted using SAS version 9.3 (SAS Institute, Cary, NC).

Results

Sample Characteristics

Baseline characteristics (n=85) of Sisters in Health participants can be found in Table 5.1. On average, participants were 48.30(11.02) years old with an average

weight of 97.90(14.22) kg and a BMI of 36.46(4.50) kg/m^2. Over half of participants were married or living with a partner (56.96%). No baseline demographic variables differed between groups. No baseline group differences were observed in self-reported PA energy expenditure (kcal/week), daily fruit/vegetable servings, total grams or percent calories from fat, or other demographic variables.

Retention

The CONSORT diagram in Figure 5.2 depicts the flow of participants through the study. We screened 315 individuals for eligibility and 146 were invited to an orientation session. The primary reason women screened for eligibility were excluded was self-reported participation in >75 minutes/week of PA. A total of 85 participants were randomized to either the standard (n=42) or the enhanced treatment arm (n=43). Retention for the 3-month (standard vs. enhanced: 78.57% and 85.71%) and the 6-month (standard vs enhanced: 80.95% and 92.86%) assessments was considered acceptable for this population.

Change in Weight

Weight loss was not significantly different between the groups at 6 months post-baseline (standard vs enhanced group: -2.83kg(-2.95%) vs. -2.08kg(-2.19%); β(SE)= -0.73(0.92), p=0.43). In fact, the greater weight loss of the standard group was in a direction opposite what was expected. There was a main effect of time for weight, which significantly decreased from baseline (p<0.0001). There was no effect of group or group*time interaction. Additionally, Pearson correlation shows that weight loss was inversely associated with session attendance (*r*= -0.39, p=0.0006) and the total number of weeks participants self-monitored (*r*= -0.35, p=0.0032). Groups

differed significantly in the number of participants who achieved at least 5% weight loss. More women in the standard group (17(39.53%)) lost at least 5% of baseline weight, compared to women in the enhanced group (9(20.45%), p=0.02). Overall, participants who lost at least 5% of baseline weight, compared to those who lost less, were not different in age, income, or marital status. However, among women who achieved at least 5% weight loss self-monitored for more weeks than those who did not (β(SE)= -4.43(1.70), p=01).

Physical Activity and Diet

Over 6 months, women in the standard group increased their average minutes/week of accelerometry-measured moderate-to-vigorous PA by 43.93(116.10), whereas among women in the enhanced group increased by 15.29(132.90). The larger increase in the standard group, is opposite what we expected. Six-month change in accelerometry-measured moderate-to-vigorous PA did not differ significantly between groups (β(SE)=23.08(30.44), p=0.45). Self-reported change in PA (kcal/week) was also not significantly different between groups at 6 months (β(SE)= 0.40(0.35), p=0.25). Furthermore, physical activity increased over time (p=0.0024) for all participants. We found no significant group differences in the 6-month change in daily fruit/vegetable servings (β(SE)= 0.18(0.25), p=0.47), total fat ((β(SE)= 3.41(3.54), p=0.34), or total percent fat ((β(SE)= 0.85(0.88), p=0.34) (Table 2). From baseline, total and percent calories from fat decreased (both variables p<0.0001), and fruit and vegetable intake increased (p=0.02).

Anthropometric and Cardiovascular Outcomes

There was no significant difference between groups in change in waist circumference ((β(SE)= -0.11(0.78), p=0.89) or change in systolic blood pressure ((β(SE)= 3.37(2.48), p=0.18) at 6 months (Table 2). Diastolic blood pressure decreased in both groups, but the change was not significantly different ((β(SE)= 3.06(2.41), p=0.21). By 6 months, all participants reduced their diastolic blood pressure from baseline (p=0.004). A nearly significant effect of group was observed in diastolic blood pressure (p=0.05), which decreased more in enhanced group participants. Notably, only enhanced group participants reduced systolic blood pressure, while women in the standard group had an increase.

Adherence to the Intervention

Standard and enhanced group participants did not differ significantly in session attendance (p=0.41). Of the 18 face-to-face group sessions offered, the standard group participants attended an average of 10.85(5.86) sessions, compared to 9.83(5.37) for enhanced group participants. Attendance was positively correlated with accelerometry-measured moderate-to-vigorous PA (*r*=0.30, p=0.02). Also, the mean number of weeks participants used the web-based self-monitoring application did not differ significantly between groups (standard vs enhanced group: 6.27(7.10) vs. 4.31(5.56), p=0.20). In the enhanced group, measures of engagement, including total likes and comments on Facebook, were not correlated with weight loss (*r*=-0.19, p=0.26 and *r*=0.01, p=0.94).

Discussion

We conducted a comparative effectiveness study to determine the effect of a PA-enhanced versus a standard behavioral weight loss treatment for AA women. At 6-months, both groups lost weight but weight loss was not significantly different between the two groups. Between group change in accelerometry-measured moderate-to-vigorous PA and self-reported PA at 6-months was greater in the standard vs enhanced group, though not significantly, but each group increased physical activity. There was no significant group difference in dietary outcomes, but fat intake decreased and fruit/vegetable intake increased within each group. Adherence to self-monitoring, session attendance, and retention, did not differ by group. Overall, participants attended approximately half of 18 study sessions and self-monitored weekly for approximately 25% of the study period. These findings indicate that the enhanced group treatment did not produce weight loss, physical activity, dietary, or anthropometric outcomes statistically significantly different from the standard group treatment.

Weight losses of -2.83kg(-2.95%) and -2.08kg(-2.19%), standard and enhanced group, respectively were observed in this study. The between group difference is much smaller than the expected 3kg difference the study was powered to detect. This may signal that the enhanced group treatment was not much different than the standard group. Similar modest weight loss was observed in a culturally-sensitive randomized controlled trial for obese AA women by Stolley et al. At 6 months, women in their intervention lost 3kg.[13] In the PREMIER trial, AA women observed an average by -3.2kg weight loss at 6 months.[6] An earlier review of interventions that included AA

women, reported weight losses of -1.9kg in the Trials of Hypertension Prevention and -2.6kg in the Hypertension Prevention Trial.[10] A recent review of standard behavioral weight loss interventions reported that across trials AA women lose -2.1-5.0kg at 6 months post-baseline.[9] The magnitude of weight loss observed in both study groups aligns with previous findings for AA women, which indicates that the interventions were similarly effective. Additional reasons for the modest mean overall and between group weight loss are discussed.

Notably, about 30% of women randomized to the standard group lost at least 5% of baseline weight, compared to about 20% of women in the enhanced group. This was surprising given that fewer of the enhanced group participants, which included greater support for reaching PA goals, achieved this weight loss target. While even small amounts of weight loss are beneficial, the common target for behavioral weight loss interventions remains 5-10% weight reduction to achieve more notable health benefits.[3] Standard predictors of at least 5% weight loss, such as age and adherence, were not predictive in this study.[8] More evidence is needed to determine factors connected to the achievement of at least 5% weight loss in AA women.

The similar mean weight loss, lower than 5%, observed in the enhanced relative to the standard group may be due, in part, to low physical activity participation. Change in objectively measured PA at 3- and 6-months post-baseline did not differ significantly between groups, but was greater in the standard group by 6 months. The prescribed PA goal in this study was to progress to 300 minutes/week, an amount neither group achieved. In fact, at both time points and in both groups, accelerometry-measured moderate-to-vigorous PA obtained was below 150

minutes/week. A similar finding was observed in a weight loss intervention with a similar PA goal where AA subjects participated in 150-200 minutes/week of accelerometry-measured moderate-to-vigorous PA at 6 months.[11] The findings align with similar evidence, and may explain why more women in the standard group , compared to the enhanced, achieved weight loss of at least a 5%. Future research may need to determine effective PA supports to facilitate AA women to reach high PA amounts.

Change in self-reported PA was not different between groups at 3- and 6-months, and were small in comparison to other studies.[11,38] Given that our PA findings are smaller than what has been observed in the literature, neither arm was particularly effective in producing high amounts of PA in a sample of AA women who were physically inactive at baseline. For both types of PA measured in this study, perhaps the intervention dose delivered was insufficient. Studies that produced higher PA at 6 months offered weekly sessions for 24 weeks.[11,38] The present study observed the highest PA levels at 3 months, after which point group sessions were delivered biweekly, and PA declined (Figure 4). Our study also enrolled low active AA women who may need more time or greater dose to adopt new PA behaviors.

The enhanced group treatment aimed to support achievement of the high PA goal by 6 months post-baseline. Results indicate that women in the enhanced group treatment minimally increased PA by study end. Session attendance was necessary to gain exposure to the majority of enhancements and support. The group sessions included discussions among groups of women who formed PA teams. Discussions and problem solving of PA barriers occurred in these teams. Therefore, low turnout meant

that some teams were very small and potentially less effective. Variable attendance may also have decreased opportunities of overall group interaction, which may have decreased cohesion. Cohesion has been related to group interaction in a study of minority women in a previous PA intervention.[126] As a result, the targeted formation of the culturally relevant non-kin and sisterhood bonds may have been reduced.

Attendance may have also reduced engagement with the Exercise Ambassadors. Ambassadors completed 100% of the planned monthly group sessions appearances. Thus, participants' attendance at 50% of sessions reduced their exposure to these women who were included to model successful PA adoption and provide social support. Involving Exercise Ambassadors only monthly may not have been sufficient enough to address AA women's need for PA role models and support to increase PA exposure and participation.[96,127,128]

Women may also have benefited from more structured opportunities for activity. Significant change in PA has been observed in studies that include enough structured PA opportunities to reach study-prescribed PA goals.[58] Our inclusion of 30 minutes of group activity during study sessions offered PA rehearsal time. It is possible that women in the enhanced group were reliant on the supervised PA (30 minutes/group session) to reach weekly PA goals; however, 30 minutes of supervised PA at group sessions would be insufficient to reaching the high PA goal. Thus, the small change in objective PA observed in the enhanced group may reflect low individual adoption of PA outside of the group sessions. Future studies may want to provide the structured opportunities needed for goal attainment in order to test whether higher PA does in fact facilitate weight loss in AA women.

Between enhanced group sessions, the Facebook component aimed to further engage participants in PA and barrier reduction. Participant Facebook engagement was low. However, total Facebook likes were directly correlated with objective PA. Modest engagement with Facebook has been observed previously in this population.[127] Facebook engagement has also been significantly associated with outcomes like weight loss.[129] Therefore, higher participant engagement may have produced better outcomes, as it would have provided continued interaction with the PA promotion and barrier reduction study content. Online social networking tools, such as Facebook, have been recommended for use in Internet-delivered PA interventions with AA women to provide social connections.[130] Including a Facebook component in future interventions may still be a practical tool for behavior change for PA and ultimately weight loss.

In addition to PA change, reduced caloric intake through dietary pattern change is essential for weight loss. While both groups made positive changes to self-reported daily intake, no group differences emerged on dietary intake of fruit/vegetable servings, total fat(g), or the percent calories from fat. Stolley et al., observed positive change in similar dietary variables in their sample of AA enrolled in a BWI.[13] Our dietary change findings are positive, and were likely responsible for the small weight losses observed.

Despite access to a web-based, mobile-compatible application for self-monitoring and group sessions that encouraged monitoring, on average participants monitored dietary and PA behaviors for only a few weeks. Self-monitoring adherence was, however, associated with greater weight loss in this and other behavioral weight

loss interventions.[131] The limited weight loss observed was likely impacted by low amounts of self-monitoring among participants. This lower adherence to monitoring in the current study was similar to that noted among AA, compared to NHW, in other interventions.[11] As noted previously, adherence to session attendance was only 50% of prescribed sessions and likely also impacted weight loss outcomes. Studies consistently show that higher attendance is associated with greater weight loss, but attendance can vary greatly in AA. [9,13,27,132] Among AA, attendance rates of 53% and 38% have been reported, which are in line with the attendance rate observed in the present study.[11,13] Investigators should seek to understand lower adherence in this population, and employ strategies to bolster adherence in AA women.

Strengths and Limitations

The randomized controlled trial design of this study allowed comparison of a culturally-relevant PA-enhanced behavioral weight loss intervention to a standard BWI. This study adds to the evidence on weight loss for AA women in BWI. The deep structure tailoring of the PA enhancements sought to incorporate the sociocultural perspectives and values of African Americans and was a strength.[105] Our study design was strengthened by the incorporation of the expanded obesity paradigm that promotes consideration of the context of weight-related health behaviors in AA.[53] We included PA barriers specific to AA women that are not commonly included in BWI. However, these barriers may not have applied to all enhanced group participants given that culture is a fluid concept. For instance, AA women with natural hair (free of chemical straighteners) may not avoid PA because their hairstyle may not be ruined by sweating, unlike women with chemically straightened hair that needs restyling,

which in turn has cost and time repercussions. Investigators have called for better conceptualization, operationalization, and assessment of cultural adaptations to interventions.[50,133] Objective PA measurement, and study strength, enabled clear assessment of PA engagement.

This study had many strengths, but is not without limitations. The lack of a formative phase prior to intervention development was a limitation that, if included, may have improved the cultural adaptation of the PA enhancements. Also, dietary intake was collected via a food frequency questionnaire, where participants' responses are limited by foods included on the tool. Participants' ability to recall typical eating patterns retrospectively may also be a limitation of the food frequency questionnaire. Finally, PA adoption was low and did not allow examination of the central question of whether achieving higher PA goals would contribute to greater weight loss in AA women.

Our culturally-based PA enhancements were designed to engage AA women in high amounts of PA through barrier reduction. The strategy of culturally-based PA barrier reduction has been incorporated previously, and remains relevant to address barriers that deter AA women from adopting PA behaviors (e.g. hair styling and cost, perceived neighborhood safety).[97,106,134,135] Addressing PA barriers beyond the individual level may also prove important for lasting PA change. Understanding the various behavioral influences (e.g. physical and economic environment, cultural and psychosocial processes), is key to better understanding and improving interventions for PA and other weight-related behaviors.[53] Investigators continue to cite the need for culturally-based approaches to intervention design for improved weight loss and

behavioral outcomes for AA.[9,53,58] Many of our enhancements were dependent on participant attendance. Future studies may need to include specific strategies to bolster attendance in AA women.

Conclusion

The disproportionate burden of obesity on AA women calls for solutions that maximize their weight loss in standard behavioral weight loss interventions. The similar changes observed between groups indicate that more effective strategies are needed to reach the high PA recommendations for weight loss. Similarly, strategies for dietary change and treatment adherence must also be applied for optimal weight loss. Continued investigation is warranted to discover how more African American women can achieve standard weight loss goals.

Table 5.1. Baseline Demographic Characteristics of Participants by Treatment Arm

	Total (n=85)	Standard Intervention (n=42)	Enhanced Intervention (n=43)
Age (years)	48.30(11.02)	48.12(10.61)	48.48(11.53)
Annual Income n (%)			
• < $50,000/year	34(39.44)	14(32.43)	20(47.06)
• ≥ $50,000/year	51(60.56)	28(67.57)	23(52.94)
Marital status n (%)			
• Married or living as married	48(56.96)	24(56.41)	25(57.50)
• Not married	37(43.04)	18(43.59)	18(42.50)
Weight (kg)	97.90(14.22)	95.99(11.36)	99.81(16.53)
BMI (kg/m^2)	36.46(4.50)	36.12(4.40)	36.78(4.62)

[a] Data are mean (±SD) or *n*(%) unless otherwise indicated. Bolded p-values indicate marginal significance.

Note: Categorical variables were assessed with chi-square tests. Continuous variables were assessed with t-test

Table 5.2. (cont.) Means Change in Weight, Dietary Intake, Waist Circumference, Blood Pressure, and Total Adherence at 6 months by Group

Change at 6 Months							
	Means(SD)		**Regression Results**		**Group**	**Time**	**Group*Time**
Outcome	**Standard**	**Enhanced**	**Parameter Estimate (SE)**	***p*-value**	***p*-value**		
Weight(kg)	-2.83 (3.82)	-2.08 (3.91)	-0.73 (0.92)	0.43	0.18	**<0.0001**	0.69
Objective MVPA (min/wk)	43.93 (116.10)	15.29 (132.90)	23.08 (30.44)	0.45	1.00	**0.0024**	0.56
Total fat(g/day)	-7.20 (14.24)	-10.80 (15.77)	3.41 (3.54)	0.34	0.47	**<0.0001**	0.20
Calories from fat (%)	-1.80 (3.56)	-2.70 (3.94)	0.85 (0.88)	0.34	0.99	**<0.0001**	**0.06**
Fruit/vegetable intake (servings/day)	0.47 (1.52)	0.36 (0.88)	0.18 (0.25)	0.47	0.98	**0.02**	0.75

Table 5.2. Means Change in Weight, Dietary Intake, Waist Circumference, Blood Pressure, and Total Adherence at 6 months by Group

Change at 6 Months							
	Means(SD)		Regression Results		Group	Time	Group*Time
	Standard	Enhanced	Parameter Estimate (SE)	*p*-value	*p*-value		
Session attendance	10.85(5.86)	9.83(5.37)	1.27	0.31	--	--	--
Total weeks self-monitored	6.27 (7.10)	4.31 (5.66)	0.27 (0.27)	0.32	--	--	--
Waist Circumference (in.)	-2.36 (7.85)	-1.20 (8.62)	-0.15 (0.78)	0.89	0.50	0.25	0.83
Change in systolic BP (mmHg)	0.48 (11.03)	-3.65 (11.20)	3.37 (2.48)	0.18	0.88	0.51	0.30
Change in diastolic BP (mmHg)	-3.23 (11.76)	-5.15 (11.15)	3.06 (2.41)	0.21	**0.05**	**0.004**	0.48

Total weeks self-monitored are reported in non-log transformed format for ease of interpretation. Waist circumference underwent a square root transformation. MVPA = moderate-to-vigorous physical activity (objectively measured), BP= blood pressure, Bolded p-values indicate significance at an alpha = 0.05

Table 5.3. Objective and Self-Reported Physical Activity at 3 and 6 months by Group

	Means(SD)		Regression Results	
Outcome	**Standard**	**Enhanced**	**Parameter Estimate(SE)**	**p-value**
Baseline Physical Activity				
Total MVPA, objective (min/wk)	57.83(79.00)	76.37(117.00)	--	--
Total physical activity, self-reported (kcal/wk)	312.50(476.30)	333.50(461.70)	--	--
3 Month Physical Activity				
Total MVPA, objective (min/wk)	118.10(122.20)	106.50(165.60)	--	--
Change in MVPA, objective (min/wk)	54.39(108.40)	43.09(114.00)	10.97(29.07)	0.7073
Total physical activity, self-reported (kcal/wk)	1014.40(1318.70)	849.70(838.2)	--	--
Change in PA, self-reported (kcal/wk)	709.40(1375.10)	526.00(801.30)	0.22(0.35)	0.5431
6 Month Physical Activity				
Total MVPA, objective (min/wk)	102.00(96.87)	88.59(161.50)	--	--
Change in MVPA, objective (min/wk)	43.93(116.10)	15.29(132.90)	23.08(30.44)	0.4513
Total physical activity, self-reported (kcal/wk)	705.50(761.30)	721.20(925.6)	--	--
Change in physical activity, self-reported (kcal/wk)	409.00(918.40)	391.40(947.20)	0.40(0.35)	0.2533

MVPA= moderate-to-vigorous physical activity

Figure 5.1. Conceptual Model

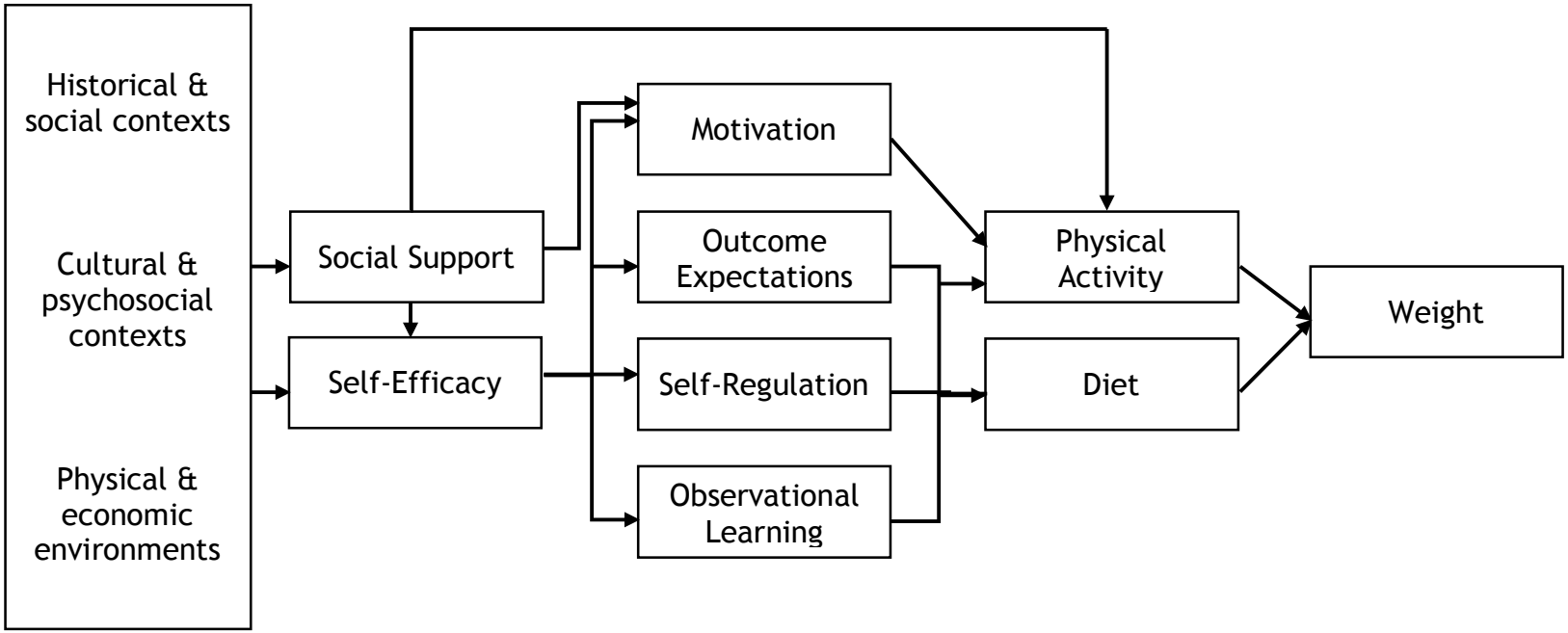


Figure 5.2. Study Flow Diagram

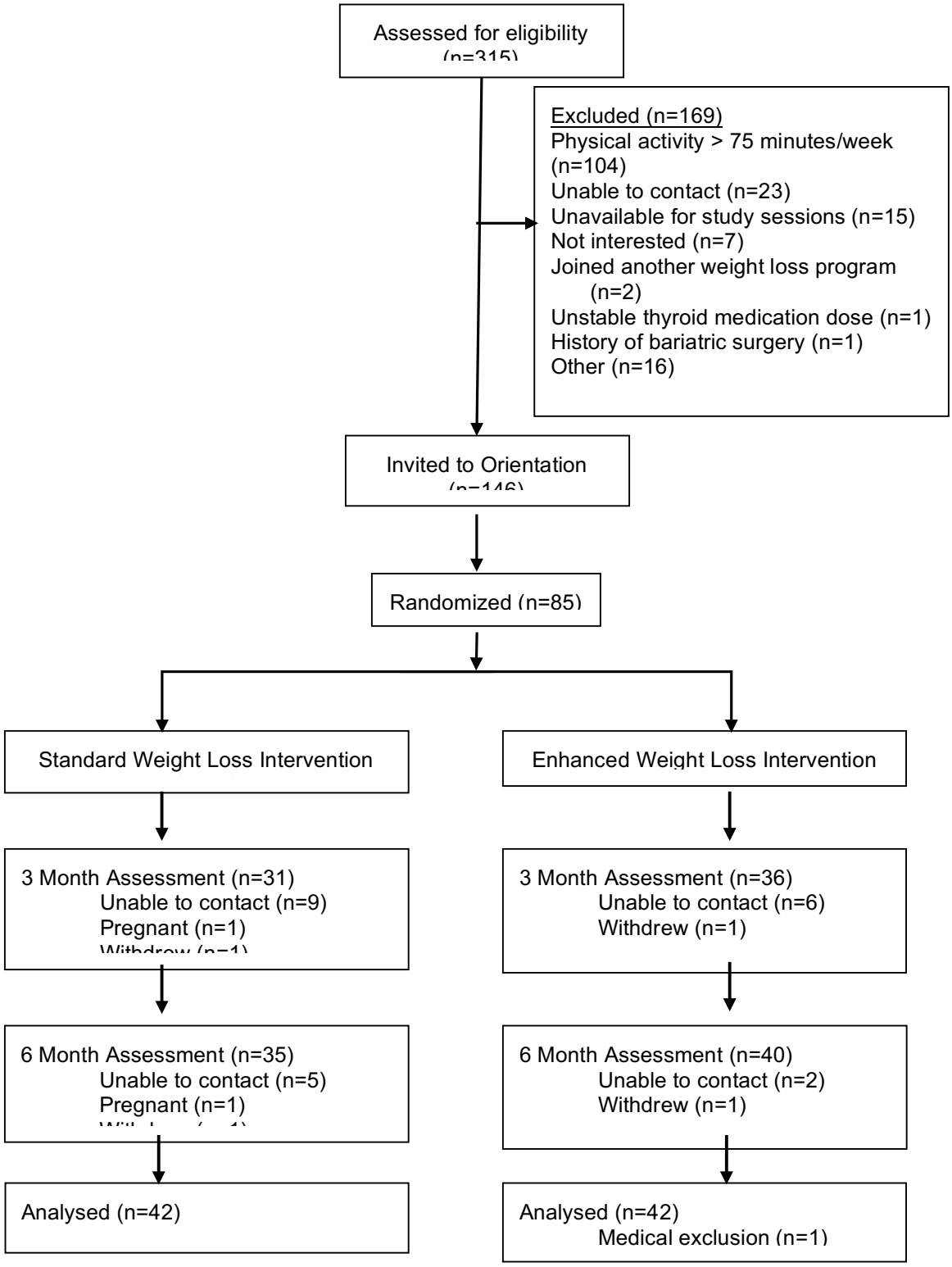


Figure 5.3. Trajectory of Weight loss by Group

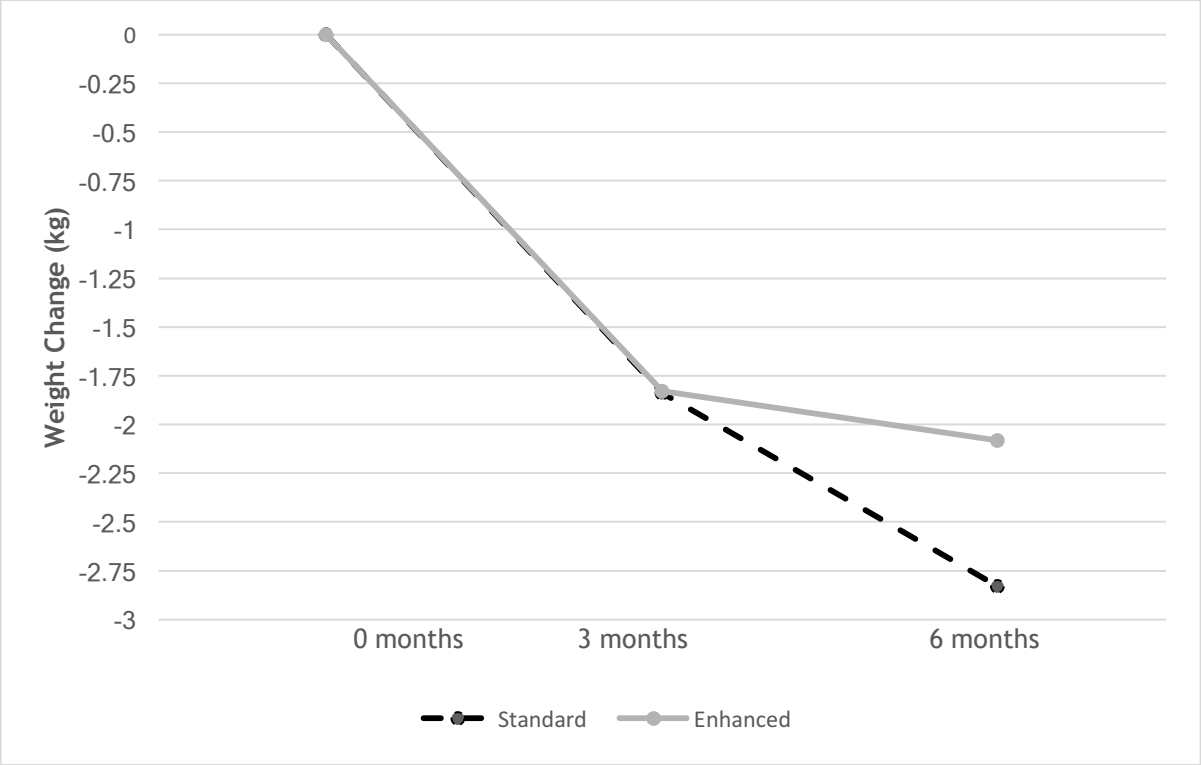
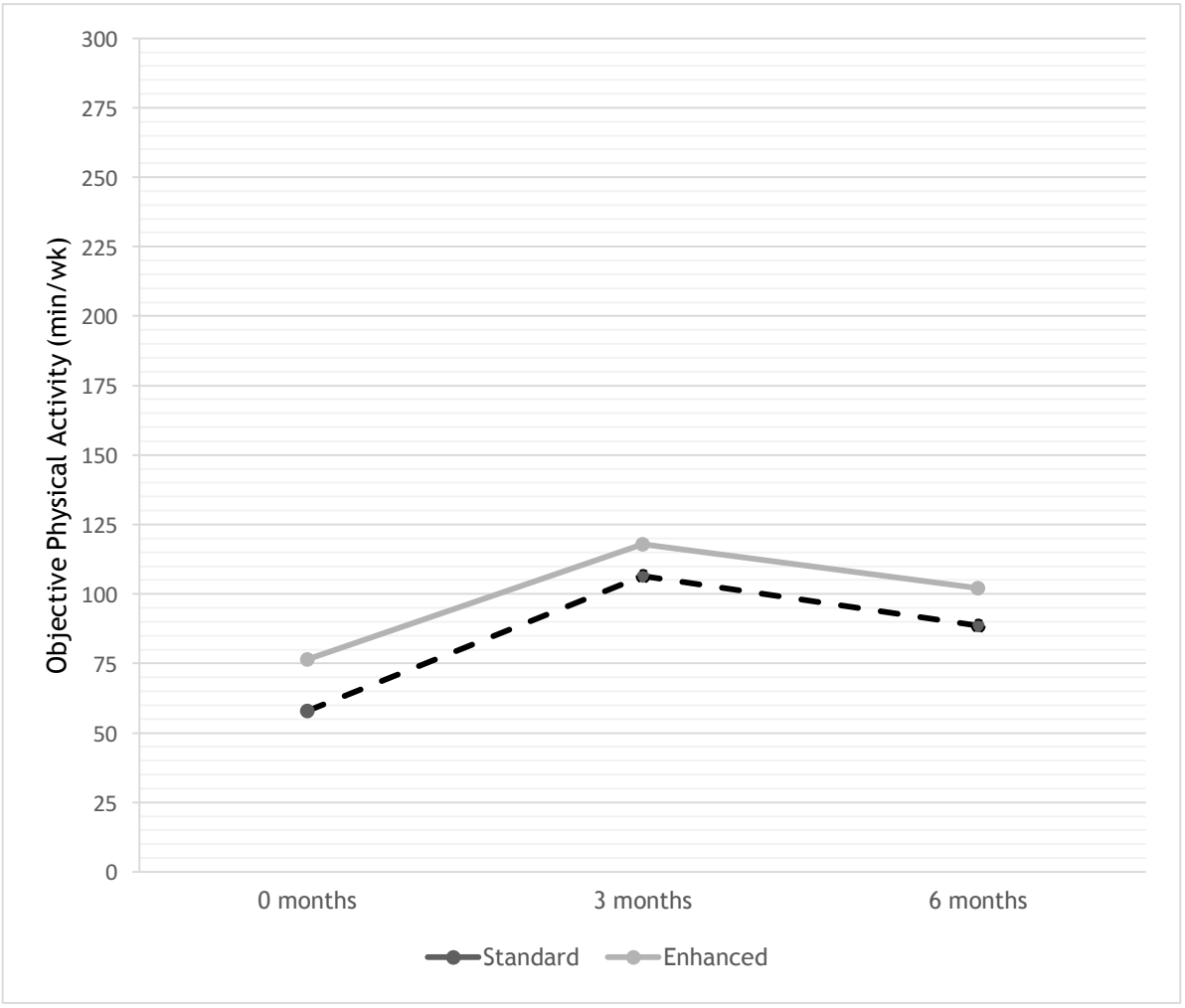


Figure 5.4. Trajectory of Physical Activity by Group



CHAPTER 6

EFFECT OF A SIX-MONTH COMPARATIVE EFFECTIVENESS TRIAL OF BEHAVIORAL WEIGHT LOSS INTERVENTIONS ON PSYCHOSOCIAL VARIABLES IN AFRICAN AMERICAN WOMEN

Overview

Overweight and obesity disproportionately affect African American women. Compared to 59.5% of non-Hispanic white (NHW) women, 82.1% of African American (AA) women are overweight or obese.[1] Behavioral weight loss treatment is an effective solution for overweight and obesity.[2,6,7,27] However, evidence shows reduced effects of behavioral weight loss interventions (BWI) for AA women, who consistently lose 2-3kg less weight compared to NHW women.[9-11,27,30,136] This disparity may decrease AA women's attainment of clinically significant weight loss (5-10% of baseline weight), which is important for lowering disease risk.[2-4,23] Reasons why the racial disparity exist are still emerging, but racial differences in adherence to the high amounts of physical activity (PA) recommended for weight loss during behavioral weight loss interventions may contribute to the disparity in outcomes. Lower PA engagement has been observed in AA compared to NHW women in multicenter trials.[11,27] Understanding the psychosocial variables that may influence PA engagement in AA women may inform approaches to increase adherence to PA in AA women

The Sisters in Health study (n=85), a randomized controlled trial, was conducted to compare the change in psychosocial variables among AA women. Sisters in Health compared a standard behavioral weight loss intervention to a PA-enhanced behavioral weight loss intervention. Previous analyses found greater weight loss (-2.83kg(-2.95%) vs -2.08kg(-2.19%)) and change in objectively-measured moderate-to-vigorous PA (43.93(116.10) vs 15.29(132.90) minutes/week) in the standard vs the enhanced group. However, the between group differences were not significantly different. The main weight loss and PA findings were contrary to authors' hypotheses. The present study explored the effect of standard and enhanced group treatment on secondary outcomes from the Sisters in Health study. Between group differences were determined with an unadjusted multiple mixed linear model to determine the effect of group, time, and group*time. Within group effect size was evaluated using Cohen's *d*.

No between group differences were found in the psychosocial variables (social support, self-efficacy, or motivation for PA, perceived PA benefits or barriers). A main effect of time was observed in family social support for PA ($p=0.07$). Both groups decreased in their self-efficacy in the stick to PA subscale ($p=0.003$). No main effect of time was observed in the making time for PA subscale. Neither group had a significant main effect of time for external motivation. Relative autonomy ($p<0.0001$), introjected ($p=0.01$), identified ($p<0.0001$), and intrinsic motivation ($p<<0.0001$) increased in both groups from baseline. No main effect of group was found in motivation, various main effects of time were seen. There was no effect of group in PA barriers and benefits. Both groups decreased their perceived PA barriers

from baseline (p=0.02). No effect of time was found in perceived PA benefits. Psychologic benefits decreased over time in both groups (p=0.04). Effort barriers also decreased in both groups over time (p=0.009). Group by time interactions were not found for any variables assessed. The hypothesis of greater change in the psychosocial variables in the enhanced vs standard group was not supported in this study.

Introduction

Overweight and obesity disproportionately affect African American women. Compared to 59.5% of non-Hispanic white (NHW) women, 82.1% of African American (AA) women are overweight or obese.[1] Behavioral weight loss treatment is an effective solution for overweight and obesity.[2,6,7,27] However, evidence shows reduced effects of behavioral weight loss interventions (BWI) for AA women, who consistently lose 2-3kg less weight compared to NHW women.[9-11,27,30,136] This disparity may decrease AA women's attainment of clinically significant weight loss (5-10% of baseline weight), which is important for lowering disease risk.[2-4,23] Reasons why the racial disparity exists are still emerging.

Racial differences in adherence to physical activity (PA) recommendations in BWI may contribute to the disparity in BWI weight loss outcomes. Lower PA engagement has been observed in AA compared to NHW women in multicenter trials.[11,27] Furthermore, high amounts of physical activity (250-300 minutes/week) have been recommended for weight loss, and it is estimated that PA contributes as much as 20% of total weight lost.[15,38] Understanding factors that may influence PA engagement is necessary to improve behavioral adherence in AA women.

Psychosocial variables are elements that may influence physical activity engagement. Self-efficacy for PA has been observed as a predictor of PA, and is also a strong correlate of the behavior.[89,92] Self-efficacy for PA has also been identified as a determinant of PA in a 2012 review.[91] That same review identified social support as an additional correlate.[91] An autonomy supportive environment to increase motivation has successfully improved PA and weight loss.[76-80] Further, motivation has been

correlated to PA in AA women.[86] Perceived benefits and barriers to physical activity may be influenced by African American women's cultural values, such as the prioritization of familial obligations, or performance of multiple, valued social roles.[96] The constraint of these multiple social roles has been negatively correlated with self-efficacy for PA.[92] Evaluating the "active ingredients", theoretical underpinnings, of behavior change interventions and how they exert an effect on a desired outcome may yield better understanding of behavioral weight loss interventions in this population.[49]

Sisters in Health was a randomized controlled trial designed to evaluate the effectiveness of a behavioral weight loss intervention enhanced with culturally relevant supports for physical activity (enhanced group) compared to a standard behavioral weight loss intervention (standard group) in AA women. The study is described in detail in chapter 5. Briefly, both groups received a 6-month intervention with 18 face-to-face group sessions focused on diet, PA and behavior change. Daily calorie goals and progressive moderate-to-vigorous PA recommendations were given at study start. The PA was to achieve 300 minutes/week of moderate-to-vigorous PA by 6 months. Enhanced group treatment included culturally relevant elements to reduce race- and gender-specific barriers to PA (e.g. hair care and maintenance, multi-caregiver role). These elements, informed by the Expanded Obesity Research Paradigm, which promotes inclusion of the cultural, psychosocial, economic, and historical processes that influence AA energy balance included: 1) reduction of PA barriers specific to AA women, 2) supervised PA in each group session, 3) suggestions for weekly PA in-between sessions, and 4) AA female role models to demonstrate PA.

It was hypothesized that the enhanced group treatment would assist AA women in performing greater PA compared to AA women in the standard intervention. Results did not support this hypothesis. Women randomized to the standard group increased their average (SD) moderate-to-vigorous PA by 43.93(116.10) minutes/week, as measured by accelerometry, compared with 15.29(132.90) minutes/week in the enhanced by 6 months post-baseline.

The intervention included specific elements (described in the methods) added to a standard behavioral weight loss intervention with the goal of supporting adoption of PA among low active AA women (<75 minutes/week self-reported moderate-to-vigorous PA). This analysis evaluated the effect of the interventions on the psychosocial constructs targeted by the RCT, which may inform the observed lack of between-group effects on objective moderate-to-vigorous PA. A priori hypothesis stated that women randomized to the PA-enhanced BWI would have higher self-efficacy, social support and motivation for PA compared to women randomized to standard BWI at 6 months post-baseline. Furthermore, we hypothesized that better change in PA beliefs and barriers would be observed in women randomized to the PA-enhanced BWI compared to the standard BWI at 6 months post-baseline.

Methods

Data source, Collection and Sample

Data for this analysis were from the Sisters in Health randomized controlled trial conducted at the University of North Carolina at Chapel Hill (NCT02631018). Women eligible for SIH were 21-65 years old, low active (<75 minutes/week of moderate-to-vigorous PA), self-identified as AA/black, and with a BMI of 25-45.

Participants were required to have Internet access, a regularly used email address, and a Facebook account or willingness to create one. If a participant had an affirmative response to the Physical Activity Readiness Questionnaire, but received physician consent, they were allowed to enter the study. Women who lost 5-10% of their weight in the last 6 months, were pregnant of planning pregnancy, took insulin to manage type 2 diabetes, taking weight loss medications, or participating in another weight-related study were also excluded. Physician consent was required for any participant with an affirmative response to the Physical Activity Readiness Questionnaire. Data collection included in-person measurement and online questionnaire completion at baseline, 3- and 6-months post-baseline. This analysis included 85 AA women.

Study Design

Sisters in Health was a comparative effectiveness study. Participants were randomized to a PA-enhanced BWI (enhanced group) or a standard BWI (standard group). Each study group received 18 in-person group sessions over 6 months led by the same interventionist. A safe rate of weight loss, 1-2 pounds/week, was produced through recommendations to adopt lower calorie dietary patterns and progressively reach 300 minutes/week of MVPA. Group sessions included behavioral skill training, goal-setting, and problem-solving. Participants were instructed to self-monitor their weight, dietary intake, and PA daily with a web-based (mobile phone compatible) tool.

The PA-enhanced group received additional culturally-based components (enhancements) to reduce PA barriers specific to AA women, to support achievement

of the PA recommendation. Enhancements included: 1) supervised PA during group sessions (30 minutes), 2) monthly appearances from AA Exercise Ambassadors (female PA role models), 3) a private PA-focused Facebook group, and 4) organization into small teams for PA support. Enhancements are fully described in chapter 5. The Institutional Review Board of the University of North Carolina at Chapel Hill approved the study.

Measures

Data were collected at baseline, 3- and 6-months post baseline. The measurement of PA-related psychosocial variables are the focus of this analysis. Change in self-efficacy, social support and motivation for PA, and PA beliefs and barriers are reported here.

Demographic variables: At baseline, a questionnaire captured age, marital status, and annual income.

Self-efficacy for physical activity: Self-efficacy for PA was measured with the 32-item Exercise Confidence survey.[137] Each item response is on a 5-point Likert scale (1= I know I cannot, 5=I know I can). This tool has been used to determine the correlation or predictive ability of self-efficacy on PA in AA women.[138,139]

Social support for physical activity: The Social Support and Exercise Survey by was used.[140] It is a 23-item measure with a Likert scale of 1 to 5 ranking the levels of social support for PA from friends and family. Items for family and friends were averaged separately to determine the score.[140]

Motivation: The degree to which exercise behavior became internally vs externally motivated (autonomous) was assessed with the Exercise Self-Regulation

Questionnaire. This measurement tool contained 16 items that were each rated on a Likert scale ranging from 1 (not at all true) to 7 (very true), and divided into 4 subscales that were individually averaged.[141]

Exercise barriers: The Outcome Expectations and Barriers to Habitual Exercise measure was used to evaluate PA benefits and barriers. The 26-item tool (12 items for outcome expectations (benefits), 14 for barriers)) rated responses on a 1 (strongly disagree) to 5 (strongly agree) Likert scale. Six subscales further define PA benefits (psychological, body image, health) and barriers (time, effort, obstacles). A summed score was derived for benefits, barriers and the other six subscales.[142]

Statistical Analysis

The original study included 86 participants. One participant was excluded from analysis due to medical reasons. Thus, the analysis included 85 participants. Data were considered missing at random since no variables of interest were associated with baseline demographic variables. No variables violated regression assumptions and therefore were not transformed. To compare the mean change in the aforementioned variables by group, a multiple linear regression model was used. A linear mixed model was applied to determine the main effects of group, time, and the group*time interaction. Effect size (small=0.2, moderate=0.5, large=0.8) within groups was evaluated with Cohen's *d*. Table 6.1 includes descriptive statistics for demographic variables and baseline values of the variables we investigated. A $p<0.05$ was the cut point for significance of results. Statistical Analysis Software (SAS) version 9.3 (Cary, North Carolina) was used to conduct a complete case analysis (n=85).

Results

Sample Characteristics

Characteristics of the study sample are found in Table 6.1. Participants (n=85) were on average 48.30(11.02) years old. Average weight was 97.90(14.22) kg, and mean body mass index at baseline was 36.46(4.50) kg/m^2.

Social Support for Physical Activity

There were no significant differences between groups in the types of social support for PA and no difference was observed in the change in family social support between groups (ß(SE) = 1.77(4.61), p=0.70; Table 6.2). However, a marginally significant increase in the change in family social support for PA from baseline was found within both groups (p=0.07). Groups did not differ in the change in social support for PA from friends (ß(SE) = -3.02(3.64), p=0.41). No main effects of group or time were observed. Within groups, the effect of the intervention on change in family social support for PA was moderate in the standard group (*d*= 0.56), and small in the enhanced group (*d*= 0.22). There was no correlation between either social support for PA subscales and objective moderate-to-vigorous PA (MVPA).

Self-Efficacy for Physical Activity

Between group differences were not observed in either self-efficacy for PA subscale: sticking to PA (ß(SE) = -0.06(0.16), p=0.72) or making time for PA (ß(SE) = -0.04(0.19), p=0.83). Both groups decreased in their self-efficacy in the stick to PA subscale (p=0.003; Table 6.2). The mean(SD) decrease in the standard group was -0.40(0.70), and the enhanced group decreased by -0.29(0.77). Within group effect sizes were moderate (standard vs enhanced: *d*= -0.67 vs -0.50). No main effect

of time was observed in the making time for PA subscale. No correlation was found between either self-efficacy for PA subscale and objective MVPA.

Motivation for Physical Activity

Change in the motivation for PA subscales did not differ by group (Table 6.2). The main effect of group approached significance for external motivation (p=0.08). Average change in the external motivation scale was (mean(SD): -0.17(0.96) vs -0.23(0.90), standard vs enhanced). Neither group had a significant main effect of time for external motivation. Relative autonomy, introjected, identified, and intrinsic motivation increased in both groups from baseline. Within groups (standard vs enhanced), the effect size of relative autonomy (*d*=0.84 vs 1.24*)*, identified (*d*=0.98 vs 1.57), and intrinsic motivation (*d*=1.10 vs 1.20) was positive and large. The effect size of introjected regulation was moderate to large in the standard group (*d*=0.68), and small to moderate in the enhanced group (*d*=0.35; Table 6.3). A significant correlation was observed between the change in introjected motivation and objective MVPA (*r*=0.27, p=0.0471).

Perceived Benefits and Barriers of Exercise

No significant between group differences were observed in the change in the perceived PA barriers or benefits (Table 6.2). While no main effect of group was found, various main effects of time were observed. Both groups decreased their perceived PA barriers from baseline (p=0.02). Psychologic benefits decreased over time in both groups (p=0.04). Effort barriers also decreased in both groups over time (p=0.009). Obstacle barriers trended towards a significant decreased over time in both groups (p=0.09). Within the standard group, the effect sizes for all perceived

benefits and barriers were small to moderate (*d*= -0.15 to -0.37). Enhanced group effect sizes were moderate to large (*d*= -0.36 to -0.69), with the exception of perceived body image benefit (*d*= -0.16), perceived health benefits (*d*= 0.01) and perceived time barriers (*d*= -0.06). A marginally significant correlation was observed between the change in effort barriers and objective MVPA (*r*=-0.24, p=0.06).

Discussion

This study sought to determine the effects of a comparative effectiveness trial that compared a standard vs a culturally-relevant, PA-enhanced behavioral weight loss intervention on psychosocial variables. Overall, findings show that all participants had a significant change from baseline in sticking to PA (self-efficacy subscale), motivation for PA (relative autonomy, introjected, identified, intrinsic), PA barriers, psychologic benefits, and effort barriers. Importantly, the finding of no significant between group differences suggests that the change PA psychosocial variables was not greater in the enhanced vs standard group treatment. The results do not support the a priori hypothesis that enhanced group treatment would produce significantly greater between group change in the targeted PA psychosocial variables. The enhanced group treatment was not more effective than the standard group treatment in changing PA psychosocial variables.

No between group difference was found in the change in self-efficacy for physical activity. This finding aligns with evidence from PA interventions including AA women. A multi-component, website-based, culturally-relevant intervention to increase moderate-to-vigorous PA in young adult AA women reported no change in self-efficacy for PA.[143] In a print vs. culturally-relevant Facebook and text message

intervention for PA, no between group difference in the change in self-efficacy for PA was seen in AA women.[127] In partial contrast to our findings, self-efficacy for PA did not change from baseline in participants who received the intervention. [127] Our findings showed a decrease in sticking to PA and making time for PA from baseline, a change that was only significant for the sticking to PA subscale. Decrease in self-efficacy for PA was previously observed in a multicenter weight loss trial.[144] Additionally, given the larger effect sizes in the sticking to PA vs making time for PA subscales, strategies to support participant prioritization of PA in daily life may be required.

Taken together, results reflect that adhering to a PA regimen in the midst of other life demands (e.g. family needs, work, time-consuming social obligations) was a challenge for study participants. This is not surprising given the existence of Superwoman Schema among AA women, characterized by an obligation to help others, assuming multiple social roles with difficulty saying no, and a resistance to dependence on others, which can lead to deprioritization of individual health.[83] The decrease from baseline in self-efficacy for making time for and sticking to PA may be due to the high PA goal prescribed (300 minutes/week of moderate-to-vigorous PA by 6 months). Possibly, achieving this goal was very challenging for participants, who began as low active (<75 minutes/week of at least moderate intensity, self-reported PA), to make time for and adhere to a new PA regimen. The decrease may also reflect participants' more practical understanding of the barriers of daily life they must overcome regularly to consistently engage in high amounts of PA. Similar to previous evidence, participants high baseline self-efficacy scores may reflect a lack of

experience with PA and initial high motivation to become active.[144] Therefore, as participants gain more experience with PA, they can better evaluate self-efficacy post-baseline. Strategies to assist AA women's adoption of high amounts of PA in daily life are needed, as well as techniques to increase self-efficacy for PA. Provision of mastery experiences, social modeling, improving physical and emotional states and verbal persuasion are methods cited to increase self-efficacy. (CITE HBHE)

The observed lack of between group findings in the change in social support for PA from family and friends partly aligns with recent evidence. Rodney et al. observed no between group differences in social support for PA from friends, but did see a significant difference in family social support for PA in their comparison of a print vs Facebook PA intervention.[127] In that study, within group change over time for family social support for PA was also significant, but friend social support for PA was not.[127] Those findings, with consideration for our findings of a marginally significant change from baseline in family, but not friend, social support for PA indicate that participants gather support from family. The moderate effect size in family social support for PA in the standard group suggests that participants may have been more successful at enlisting or receiving familial support. Kinship bonds are important culturally to AA.[102] Therefore, among AA women, promoting enlistment of familial social support may be key for future interventions. It is important to note the non-kin bonds are important to AA culture, and how participants conceptualize who is family may include non-kin individuals.[145] Furthermore, although not tested statistically, it appears that family and friend based support for PA was enlisted from both sources more evenly among enhanced vs standard group participants. A focus on family social

support for PA may be an important strategy among AA women. Perhaps findings also highlight an opportunity to improve friend-derived PA social support, especially considering the small effect size in both study groups.

This study also examined the shift towards more autonomous motivation for PA between groups. The marginal main effect of group in external motivation, aligns somewhat with the significant between group difference in a 12-month RCT that randomized participants to receive a PA plus weight control intervention or a general health education control program.[80] Between group differences in introjected, identified, and intrinsic motivation were observed in that study, which contrasts our findings.[80] Given this, the enhanced group treatment was more successful at reducing external motivations for PA. Additionally, all other forms of motivation increased over time, indicating a positive effect of both interventions on autonomous motivation for PA. The greater reduction of external motivation in the enhanced group likely results from the PA enhancements, which may have fostered more opportunities to internalize PA behaviors. However, the disagreement in motivation outcomes when compared to previous evidence may be due to our study design, a comparison of two active interventions. In sum, weight loss interventions seeking to increase PA motivation may need to develop strategies to provide an autonomy supportive environment that meets the basic psychological needs of autonomy, relatedness and competence.[81] Moreover, investigation is needed to unpack which elements of the PA enhancements led to less external motivation.

Evaluating physical activity benefits and barriers may also inform how the interventions affected physical activity behaviors. The decrease in PA barriers, but no

increase in PA benefits, from baseline among all participants is unexpected. Palmeira et al. conducted a short-term weight control study with overweight or obese women that found a significant change in PA barriers.[146] This contrast highlights that the parent study was effective at reducing PA barriers. However, another unanticipated finding is the lack of any between group change in PA benefits and barriers. The lack of a greater enhanced group treatment effect to reduce PA barriers may reflect the focus on addressing the common PA barriers (e.g. time), but also the focus on culturally-relevant barriers. Perhaps the expanded barrier focus reduced the effect of the enhanced group treatment to impact common PA barriers. Moreover, the unintended effect of decreased psychologic benefit among all participants may reflect a change during the study in why AA women value PA. It is also possible that as participants attempted to engage in more PA, doing so became increasingly burdensome. It is worth repeating that PA goals progressively increased to high amounts during the study. The low active sample may have found this too challenging. Perhaps a longer (1 year) or more intense (consistent weekly instead of weekly to biweekly sessions) would ease the participant burden.

Strengths and Limitations

Findings of this study should be considered in the context of its strengths and limitations. This study adds to our understanding of how physical activity psychosocial variables change in AA women in a behavioral weight loss intervention. The source of these data is a comparative effectiveness study for AA women, which sought to improve weight loss outcomes by greatly increasing PA. We add to the limited evidence on how to improve AA women's PA, which may be applicable to both the PA

and behavioral weight loss intervention literature. Limitations include the self-report nature of the PA measures studied. Self-report measures may be vulnerable to social desirability bias. Since this analysis included only AA women, findings may not applicable to the general population.

Our study does highlight some areas for future investigation. The larger study included a culturally-relevant PA-enhanced treatment. This analysis did not evaluate the sociocultural barriers or facilitators of PA specific to AA women that were targeted by the intervention. We focused solely on common PA barriers. While the assessment of the common PA barriers is valuable, appraisal of the sociocultural PA barriers and facilitators may enrich our understanding of how BWI, culturally adapted or not, may influence AA women's PA engagement.[147] For example, hair care has been discussed as a barrier to PA for AA women.[97,101] Previous reports found that many of the AA women sampled (40-45%) have avoided PA due to hair concerns.[97,148] African American women who engaged in PA less due to hair care were less likely to reach 150 minutes/week of activity.[97] Sweating, as a result of performing PA, creates economic and time costs to restyle hair.[97] Time is already a commodity for AA women who are cited to have overwhelming responsibilities, and may view PA as a luxury.[83,85,149] Assessment of barriers unique to racial/ethnic minorities may inform future BWI and PA intervention approaches.

Studying the impact of PA barriers/facilitators specific to AA women also highlights a need to understand the processes driving behavioral engagement. As with the example of hair, overcoming PA barriers may have broader implications (e.g. economic requirements). Therefore, understanding the processes and contexts of

behaviors, like PA, is needed for behavior adoption.[50,53] More effective interventions may be designed when the social, cultural and environmental process of daily life are incorporated.[53]

Conclusions

This study suggests that the physical activity enhancements of a behavioral weight loss study to increase PA did not produce more favorable change in the PA psychosocial variables. Future studies may still aim to impact these variables because they positively influence PA as correlates, predictors and determinants of the behavior. The study of change in the psychosocial variables informs how behavior change may occur, a valuable contribution to understand how interventions exert their effect in AA women.

Table 6.1. Mean Baseline Demographic Characteristics by Group

Variable	Total (n=85)	Standard (n=42)	Enhanced (n=43)
Age (y)	48.30(11.02)	48.12(10.61)	48.48(11.53)
Annual Income (%) • < $50,000/year • ≥ $50,000/year	 39.44 60.56	 32.43 67.57	 47.06 52.94
Marital status (%) • Married or living as married • Single, divorced, separated	 56.96 43.04	 56.41 43.59	 57.50 42.50
Weight (kg)	97.90(14.22)	95.99(11.36)	99.81(16.53)
BMI (kg/m^2)	36.46(4.50)	36.12(4.40)	36.78(4.62)
Physical activity, objective (minutes/week)	67.35(100.10)	57.83(79.00)	76.37(117.00)
Social support for PA • *Family support* • *Friend support*	 26.57(15.34) 25.47(15.70)	 24.38(11.86) 24.46(16.47)	 28.82(18.14) 26.71(15.00)
Self-efficacy for PA • *Sticking to PA* • *Making time for PA*	 3.82(0.66) 3.73(0.74)	 3.88(0.63) 3.74(0.67)	 3.77(0.70) 3.73(0.81)
Motivation for PA • *Relative Autonomy* • *External motivation* • *Introjected motivation* • *Identified motivation* • *Intrinsic motivation*	 11.84(4.25) 1.69(0.79) 2.09(1.00) 3.96(2.00) 3.30(1.51)	 12.51(3.41) 1.83(0.84) 1.97(0.83) 4.17(1.80) 3.33(1.32)	 11.22(4.87) 1.56(0.73) 2.21(1.14) 3.76(2.17) 3.27(1.68)
Exercise beliefs • *Benefits* • *Barriers*	 51.12(8.05) 35.66(9.11)	 51.08(7.33) 35.14(8.69)	 51.15(8.75) 36.13(9.56)

Variable	Total (n=85)	Standard (n=42)	Enhanced (n=43)
Benefit: Psychologic	19.05(4.46)	19.03(4.31)	19.08(4.64)
Benefit: Body Image	18.20(2.73)	18.14(2.40)	18.25(3.03)
Benefit: Health	13.87(1.89)	13.92(1.54)	13.83(2.18)
Barrier: Time	10.38(3.98)	10.56(4.27)	10.23(3.74)
Barrier: Effort	17.59(4.69)	17.03(4.31)	10.10(5.00)
Barrier: Obstacles	7.68(3.66)	7.56(3.17)	7.80(4.10)

Table 6.2 Six-Month Outcome Change Values and Regression Outcomes

	Mean (SD)			Regression Results		p-values		
Outcome	**Total (n=85)**	**Standard (n=42)**	**Enhanced (n=43)**	**Parameter Estimate (SE)**	***p*-value**	Group	Time	Group*Time
Social support for PA								
• **Family support**	5.43 (20.45)	7.23 (16.32)	3.79 (23.74)	1.77 (4.61)	0.70	0.69	0.07[a]	0.55
• **Friend support**	2.38 (17.30)	0.77 (16.46)	3.85 (18.16)	-3.02 (3.64)	0.41	0.96	0.36	0.30
Self-efficacy for PA								
• **Sticking to PA**	-0.34 (0.73)	-0.40 (0.70)	-0.29 (0.77)	-0.06 (0.16)	0.72	0.29	0.003*	0.42
• **Making time for PA**	-0.15 (0.96)	-0.16 (0.92)	-0.14 (1.01)	-0.04 (0.19)	0.83	0.39	0.40	0.20
Motivation for PA								
• ***Relative Autonomy***	3.30 (4.74)	2.55 (4.33)	3.98 (5.05)	-0.36 (0.90)	0.69	0.23	<0.0001*	0.34
• ***External motivation***	-0.20 (0.92)	-0.17 (0.96)	-0.23 (0.90)	0.20 (0.22)	0.37	0.08 [a]	0.10	0.93
• ***Introjected motivation***	0.55 (1.59)	0.68 (1.25)	0.44 (1.86)	0.25 (0.36)	0.49	0.93	0.01*	0.50
• ***Identified motivation***	1.75 (2.13)	1.26 (1.72)	2.20 (2.38)	-0.45 (0.31)	0.15	0.99	<0.0001*	0.22
• ***Intrinsic motivation***	1.25 (1.69)	1.15 (1.62)	1.34 (1.77)	-0.03 (0.32)	0.92	0.56	<0.0001*	0.44
Exercise beliefs								
• **Benefits**	-1.74 (3.76)	-1.65 (6.48)	-1.83 (8.15)	0.19 (1.62)	0.91	0.63	0.11	0.69
• **Barriers**	-2.97	-2.58	-3.31	0.77	0.69	0.69	0.02*	0.76

	Mean (SD)			Regression Results		p-values		
	(8.68)	(8.44)	(9.00)	(1.88)				
Benefit: Psychologic	-1.03 (3.74)	-0.45 (3.87)	-1.54 (3.59)	1.05 (0.86)	0.23	0.86	0.04*	0.43
Benefit: Body Image	-0.56 (3.21)	-0.77 (2.54)	-0.37 (3.73)	-0.44 (0.70)	0.54	0.36	0.32	0.75
Benefit: Health	-0.15 (2.02)	-0.42 (1.43)	0.09 (2.43)	-0.37 (0.40)	0.37	0.27	0.64	0.38
Barrier: Time	-0.41 (3.60)	-0.94 (3.46)	0.06 (3.70)	-0.42 (0.73)	0.57	0.81	0.61	0.50
Barrier: Effort	-1.80 (4.59)	-1.10 (4.13)	-2.43 (4.94)	0.94 (1.06)	0.38	0.57	0.009*	0.62
Barrier: Obstacles	-0.76 (3.02)	-0.55 (3.05)	-0.94 (3.02)	0.44 (0.57)	0.44	0.94	0.09	0.66

***** Indicates a significant difference in regression parameter ($p<0.05$)

[a] Indicates marginally significant difference in regression parameter

Table 6.3. Effect size of the six-Month change in psychosocial, benefits and barriers outcomes for physical activity

	Cohen's *d*	
	Standard	**Enhanced**
SOCIAL SUPPORT FOR PA		
• Family support	0.56	0.22
• Friend support	0.18	0.21
SELF-EFFICACY FOR PA		
• Sticking to PA	-0.67	-0.50
• Making time for PA	-0.23	-0.16
MOTIVATION FOR PA		
• Relative autonomy index	0.84	1.24
• External motivation	-0.34	-0.41
• Introjected motivation	0.68	0.35
• Identified motivation	0.98	1.57
• Intrinsic motivation	1.10	1.20
EXERCISE BELIEFS		
• Benefits	-0.34	-0.36
• Barriers	-0.35	-0.56
Benefit: psychologic	-0.23	-0.63
Benefit: body image	-0.35	-0.16
Benefit: health	-0.24	0.01
Barrier: time	-0.27	-0.06
Barrier: effort	-0.37	-0.69
Barrier: obstacles	-0.15	-0.40

CHAPTER 7

SUMMARY OF FINDINGS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Summary of findings

Behavioral weight loss interventions are less effective for African American (AA) women as demonstrated by consistently lower weight loss among this subgroup compared to non-Hispanic white (NHW) women. The reasons for this disparity are unclear. Findings of the first aim of this dissertation indicate that the racial disparity in weight loss between these groups of women persists in a primarily Internet-delivered behavioral weight loss intervention. Lower website log-ins and adoption of fewer weight control behaviors partially explain the racial differences in weight loss. Aim two demonstrated that a 6-month culturally-relevant physical activity-enhanced behavioral weight loss intervention, compared to a standard intervention, did not produce greater weight loss in AA women. Additionally, aim 3 found that all participants increased their self-efficacy for adherence to PA, relative autonomy, introjected, identified, and intrinsic motivation for PA increased significantly from baseline, while effort barriers and psychologic barriers decreased from baseline. However, the change in the aim 3 variables did not differ between groups.

The goals of this research were to better understand the racial disparity in weight loss outcomes, and to investigate how weight loss in AA women can be maximized through a behavioral weight loss intervention (BWI). To achieve the goals

the research (1) examined differences in weight loss and related behaviors between AA and NHW women who completed a BWI, (2) conducted a 6-month comparative effectiveness study of a standard vs culturally-relevant, physical activity-enhanced BWI in AA women, and (3) evaluated the change in the PA psychosocial variables, perceived PA benefits and barriers between groups.

Many insights were gained from this dissertation research. First, this research found significantly lower (2.64% lower) weight loss in AA compared to NHW women who completed a mostly Internet-delivered BWI. This difference was mediated by lower engagement with study components and adoption of fewer self-regulatory weight control strategies. The magnitude of the weight loss difference reiterates a well-established disparity among women observed in previous BWI.[9-11,30] Next, this research found no difference between AA women that received a standard or PA-enhanced culturally relevant BWI in weight loss (-2.83kg(-2.95%) vs -2.08kg(-2.19%)) or change in objectively-measured moderate-to-vigorous PA (15.29 and 43.93 minutes/week). This amount of weight loss is commonly achieved in AA women[6,56], however the enhancements were designed to improve weight loss via improvements in PA. Unfortunately, the 6-month PA change and total achieved is lower than a comparable study that included AA who received standard behavioral treatment, and achieved 150-200 minutes of total objectively-assessed moderate-to-vigorous PA at 6 months.[11] Although the enhanced intervention was hypothesized to produce greater weight loss and PA than standard intervention, all participants decreased weight and increased in moderate-to-vigorous PA, significantly. Finally, the enhanced treatment did not shift targeted psychosocial variables (self-efficacy for PA, social support for

PA, motivation for PA, PA benefits and barriers) more than the standard group, but within group change over time did occur in response to the interventions. Previous PA interventions including only AA women had similar findings in self-efficacy and social support for PA.[127,143] Additionally, PA barriers did change in a short-term weight control study, suggesting that common PA barriers can be reduced.[146]

This dissertation contributes to our understanding of the effectiveness of behavioral weight loss interventions among African American women, but also generates new questions and areas for investigation. More research is needed to fully comprehend why the weight loss disparity between AA and NHW women persists. Researchers must identify factors that cause or contribute to the reduced effectiveness of BWI in AA women, especially considering that average weight losses in this population are commonly below 5%, the standard for clinically meaningful change. Given the results of this present work, investigators may also seek to determine why AA women adopt fewer strategies measured by the EBI. Discovering why AA women engage less in BWI regardless of delivery mode (face-to-face or Internet) is important. Both quantitative and qualitative methodologies may be especially helpful to fill these knowledge gaps. Lastly, cultural adaptation remains a strategy commonly applied to BWI when engaging minority populations. However, without a standardized method for designing, defining, and applying cultural adaptations, it is difficult to compare studies, and assess their effectiveness. Central to this study is a cultural adaptation that focused primarily on individual-level adaptations. However, adaptation of participants' environment, for example physical and economic, may be necessary to enable AA women to realize maximum weight loss

through BWI. Addressing these gaps and questions are especially important to ultimately reduce the disproportionately high burden of overweight and obesity in AA women.

Dissertation Limitations and Strengths

Results of this dissertation should be considered in the context of its limitations and strengths, which also include the methods applied to answer the research questions. Limitations, in terms of the methods within this dissertation, included a secondary data analysis to evaluate the effect of an intervention on subgroups. The secondary data analysis, did not preserve the randomization present in the parent study. This limits our interpretation of the findings since a benefit of randomization, neutralizing threats to validity by evenly distributing them among the groups randomized, is not preserved. We controlled for original group assignment to partially address this issue. Considering the limitations, the approach of pooling the data, collapsing across the originally randomized intervention treatment groups, was appropriate given the study goal to compare AA and NHW women.

Furthermore, missingness was a concern for the variables of interest. Data was missing largely due to non-response on questionnaires, or participant loss to follow-up. Analyzing data from participants who completed the interventions was central to understanding their impact. Missingness was addressed by determining its type (e.g. missing at random), but also through a linear mixed model analysis. The linear mixed model analysis does not use a listwise deletion approach that removes a participant with partially missing data, but instead preserves a maximum amount of data for analysis from each participant, thus strengthening conclusions.

The measurement tools used to assess behavior change may also be a limitation. How African American women interpreted items on the measurement tools used may impact their responses, and thus the evaluation of the present studies' effect. For example, the psychosocial measures used in this dissertation may be a limitation. For example, family social support for PA may be influenced by who participants consider family. In the AA cultural context, family often includes non-kin "relatives", reflecting the normative cultural tenet of extended family networks in AA. This may explain why family social support for PA increased marginally from baseline, and friend support did not. Likewise, the unexpected decrease in psychologic benefits of PA from baseline may also reflect cultural perceptions of the purpose and value of PA. Items that measured psychologic benefits asked about perceived benefits of PA to reduce stress and relax, to help cope with life's pressures, for companionship, for fun and enjoyment, and a positive psychological effect. In AA women who may ascribe to the multicaregiver role, characterized by overwhelming roles and responsibilities that may lead to deprioritization of health behaviors like PA,[83] and the common PA barrier of time, engaging in PA may not aid in stress reduction or relaxation. Additionally, the rest ethic, an AA value of rest that prioritizes the need for rest above PA, rest which is even necessary before doing physical activity, may contradict the aforementioned items.[45,99] Lastly, the low active sample in this dissertation may have found adopting a new PA routine, including achieving the high PA goal, too challenging or burdensome. Therefore, the psychological benefit may not have been realized in this study. Altogether, the

potential for change over time may be impacted by participants culturally-based interpretation of the measures, which may differ from the tools' intended meaning.

This dissertation is not without strengths. A methodological strength included the design, implementation, and evaluation of a randomized controlled trial that compared two active treatments. This design allowed the evaluation of *a priori* hypotheses, prevented selection bias, and allows the assumption that the groups compared were the same on the dependent variable before the interventions were, and evenly distributed threats to validity between groups. Another strength is the cultural adaptation of Sisters in Health, the randomized controlled trial. Both qualitative and quantitative literature informed the adaptation design. This dissertation may be among the first to operationalize the Expanded Obesity Paradigm, developed by AACORN, as means of culturally adapting the PA component of a BWI. An important consideration is the need for a standardized method to culturally adapt interventions, including how to operationalize contextual models for energy balance such as AACORN's.[133]

Finally, electronic, yet mobile compatible, technologies are used throughout this dissertation. Whether electronic components were used to receive an intervention or engage in behavioral self-regulation (self-monitoring and feedback), electronic methods provided access to weight control strategies. Mobile compatibility of the electronic intervention components is important given that AA use a wide-variety of mobile phone functions.[150] Although overall engagement was low in AA women in this dissertation, the study design and findings are informative for future work that may include such technologies.

Implications and Recommendations for Future Research

This dissertation contributed to the evidence base aimed at reducing the burden of overweight/obesity on AA women in several ways. First, it showed that although AA women lose weight in behavioral weight loss interventions, the disparity when compared to NHW women persisted. This research also demonstrated that achieving a clinically significant amount of weight loss in AA women is still a challenge. A need for greater intervention engagement in AA women, regardless of intervention delivery mode (Internet or face-to-face), was also indicated. Relatedly, the identification of less than optimal adoption of self-regulatory weight-control behaviors was found, and underscored the need to prioritize better behavioral adoption in AA women during BWI. Together, these findings reiterate a very well-established disparity that has been understudied in a population experiencing the highest burden of unhealthy weight in the United States. The potential for broad impact through public health solutions requires that equity in outcomes from behavioral weight loss interventions is reached. This dissertation research points to areas that may identify or increase methods for the improved effectiveness of behavioral weight loss treatment in AA women.

Study engagement, regardless of the mode of intervention delivery, is important for AA women's weight loss. For behavior change to occur, participants must receive the intervention. The discovery of lower website log-ins that mediated the race-weight loss relationship from the secondary data analysis, and approximately 50% session attendance in Sisters in Health, indicate a need to increase AA women's engagement. Although the secondary data analysis was limited because original group

randomization was not preserved, it was a suitable approach to investigate racial subgroup differences among women. Mediation analyses allowed the identification of important factors that impacted the study's effect, and should be used in future studies to better understand intervention and behavioral mechanisms behind AA women's weight loss in BWI. Future research should also determine the factors that influence AA women's ability to use web-based intervention delivery components, or attend face-to-face intervention sessions. Whether face-to-face or web-based, BWI Perhaps the multi-caregiver role, characterized by overwhelming multiple roles and responsibilities to others that many AA women feel they cannot leave unfulfilled,[83] decreased their ability to engage. Strategies to aid AA women's navigation of this role may be important in future work.

The most effective behavioral weight loss interventions among AA women include behavior modification techniques, diet and physical activity components.[10] Participant adoption of behavioral modification techniques such as monitoring PA and diet, reducing caloric intake and dietary fat are important for weight loss.[10] This dissertation observed low engagement in monitoring (~25% of study weeks), which highlights a need to improve the component of behavior modification for better weight outcomes in AA women. Future approaches to self-regulation, particularly self-monitoring, should consider how it can be made less burdensome for participants. Tools capable of objectively monitoring behaviors (e.g. dietary intake, physical activity, daily weight) and providing feedback may be especially helpful by reducing or eliminating manual monitoring. Simplified, less time-consuming methods, that avoid the process of recording all foods, beverages and physical activities, may ease

the monitoring process for participants. Future research should also identify the specific self-regulatory weight control behaviors that may be adopted less by AA women through a comparison of EBI items between AA and NHW women. Examination of individual EBI items has been done previously.[151] Once known, intervention strategies to support AA women's adoption of self-regulatory weight control behaviors can then be applied. In addition, monitoring change in the items can identify key points when participants need more support to adopt the behavioral modification techniques.

The dietary component of the present study cannot be overlooked. Favorable changes in dietary intake among AA women were observed in this dissertation. However, when compared to dietary change in NHW, the evidence is mixed regarding AA. No racial difference in dietary change was observed in a recent BWI,[11] a result also found in the present study, but lower adherence has also been observed in AA compared to NHW participants.[32] Therefore, given that dietary intervention alone can yield significant weight loss,[16] and the importance of the dietary component to the success of previous multicenter weight loss trials in AA women,[10] improved dietary change in BWI may still be important to AA women's weight loss. The aforementioned direction of improving behavioral modification techniques, which includes monitoring of food intake, may result in improved dietary adherence during BWI. An important area for investigation is cultural adaptation of the dietary component. The BWI enhancement in this dissertation focused solely on adapting the PA component. It is possible that cultural adaptation of the dietary component that included traditional foods from across the African diaspora (e.g. African American, Afro-Caribbean, etc.)

may have improved participants' weight loss. Future studies should explore how to effectively adapt the dietary component. Successful methods of cultural adaptation include involving members of the target population in the design phase of a BWI.[133] This can be accomplished through qualitative methods such as focus groups or key informant interviews, which can inform study content.[133] Importantly, future work should adapt BWI above the individual level, including the environmental factors that may influence behavior adoption.[133] This approach would align with AACORN's expanded obesity research paradigm that cites the necessity of understanding the context of where and how health behavior occur in AA.[53]

The physical activity component is another key part of behavioral weight loss interventions. Objective moderate-to-vigorous PA showed a small to modest increase. High amounts of PA were not achieved in this dissertation. Therefore, the question central to this dissertation, regarding the ability of high amounts of PA to bolster weight loss in AA women remains unanswered. Future research should explore how to increase objectively-measured physical activity to the high amount recommended for weight loss (250-300 minutes/week). To this end, there are many routes future investigations can follow:

1) Provide sufficient opportunities for physical activity. In the present study, in comparison to the 6-month PA goal, minimal supervised PA was given. Participants were largely responsible for performing PA independently. Future studies should provide enough supervised PA opportunities to match weekly PA goals throughout BWI may support achievement of the recommended high amounts of PA. Organizational partnerships (e.g. YMCA) may be one way to provide PA

opportunities that are geographically and economically feasible for AA women. A community-based participatory research approach may prove useful to determine the best approach to increasing PA opportunities that can also be maintained long-term.

2) Intervention above the individual level (e.g. interpersonal, community, policy, structural) may be especially impactful. This dissertation included some interpersonal elements, considering the collectivist perspective of AA culture, including the family unit within BWI as a means to increase PA may be important for behavior change. Furthermore, higher levels of the socio ecological model may be valuable to intervene on. The organizational, community and policy levels represent an opportunity for multi-level and interdisciplinary intervention approaches. Future research should incorporate these levels given that environmental contexts (e.g. physical and economic) can affect behavior. For example, the physical context may include a lack of sidewalks or safe neighborhoods.[50] Economic context may include a lack of access to gyms available locally.[50] Both examples require change at the higher levels of the socio ecological model.
3) Study results indicate that physical activity was highest when intervention contact was more frequent. The decision to reduce the frequency of intervention group sessions was made to reduce participant burden of visiting the study site for 6 months. Perhaps, the reduction in dose delivered and the subsequent PA decrease reflects the need for continued high frequency dose to support PA increase. Therefore, future studies should deliver a dose frequency consistent with a high-

intensity intervention. In the context of the present study's results, dose may be administered weekly throughout the entirety of an intervention. Dose may be conceptualized in the frequency of group sessions, but other applications of intervention dose should be investigated and weighed against participant burden.

Moreover, this dissertation shows that, on average, low active AA women did not become active (150 minutes/week of at least moderate PA), and were far from the recommended high amount of PA. Future research should consider what is needed for a low active sample to become active. Higher intervention dose, as previously discussed may be one solution, and a longer-term intervention (e.g. 12 months) may also be necessary to observe such a high amount of PA in AA women.

4) Determine standardized methods to operationalize cultural adaptation of interventions. While Sisters in Health included cultural adaption achieved through a review of the evidence, mainly qualitative with AA women, and informal formative work, the adaptation centered on only one aspect of the expanded knowledge domain of the Expanded Obesity Research Paradigm.[53] Focus on only the cultural and psychosocial process involved in energy balance may be a limitation, but did address the study hypothesis. The cultural adaptation could have been strengthened by applying a more formal, pre-intervention formative phase, using the qualitative methods mentioned for the dietary component to inform study design and content.

Future work should include adaptation that addresses all aspects of the expanded knowledge domain. This relates to the recommendation 2 above, multilevel adaptations that address environmental influences on behavior, which

aligns with evidence of the most effective BWI in AA that employed cultural adaptation.[133] However, current evidence cites a need for better conceptualization and operationalization for improved assessment of their effect.[50,133] The Expanded Obesity Research Paradigm is a model that communicates contextual influences on weight-related behaviors. Future work requires standardized methods to culturally adapt interventions, and definitions for the adaptations. How to implement the adaptations, once-defined, is also necessary. Once accomplished, the development of appropriate measures may lead to a greater understanding of the impact of cultural adaptations on intervention outcomes and targeted behaviors.

Conclusions

In summary, while overweight and obesity are national problems of public health significance, an alarming number of African American women are affected. This issue is compounded by the lower effectiveness of behavioral weight loss interventions, the best treatment for overweight/obesity, for AA compared to NHW women. Consistently, AA women lose less weight. The research in this dissertation made strides toward addressing this treatment disparity by identifying intervention factors that drive the racial weight loss difference. Additionally, this research tested an intervention approach to increase weight loss in AA women that indicated what future interventions may need to accomplish to achieve equity in weight loss outcomes between AA and NHW women. To advance the science, investigators may: 1) determine how to increase intervention engagement in African American women, 2) increase intervention supports for adoption of self-regulatory weight control

behaviors, 3) determine how to engage AA women in high amounts of PA within BWI, while supporting dietary behavior change, and 4) develop standardized definitions and methods for cultural adaptation of behavioral weight loss interventions including and above the individual level.

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