Comparative effectiveness of a standard behavioral and physical activity enhanced behavioral weight loss intervention in Black women

Loneke T. Blackman Carr^{a,b}, Carmen D. Samuel-Hodge^b, Dianne S. Ward^b, Kelly R. Evenson^b, Shrikant I. Bangdiwala^c, and Deborah F. Tate^d

^aDepartment of Nutritional Sciences, University of Connecticut, Storrs, Connecticut, USA; ^bDepartment of Nutrition, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA; ^cDepartment of Health Research Methods, Evidence and Impact, McMaster University, Hamilton, Ontario, Canada; ^dDepartment of Health Behavior, Department of Nutrition, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA

ABSTRACT

Black women typically lose small amounts of weight in behavioral weight loss interventions, partially due to low engagement in physical activity. Culturally relevant enhancement of the physical activity component may improve weight loss. This study compared the effectiveness of a culturally-relevant, physical activity-enhanced behavioral weight loss intervention to a standard behavioral weight loss intervention in Black women ($n = 85$) over 6 months. The study was conducted in two cohorts from March 2016 to February 2017 at the University of North Carolina at Chapel Hill. Participants had an average age of 48.30 ± 11.02 years with an average body mass index of 36.46 ± 4.50 kg/m². Standard and enhanced groups' weight change (-2.83 kg and -2.08 kg, respectively) and change in physical activity (43.93 min/ week and 15.29 min/week, respectively) did not differ between groups. Significantly more standard group participants lost 5% of baseline weight compared to enhanced group participants. This study produced typical weight loss results in Black women. Behavioral weight loss treatment remains moderately effective for Black women. Strategies to increase attendance and self-monitoring, and the inclusion of cultural contexts to weight-related behaviors are needed to improve outcomes.

ARTICLE HISTORY

Received 15 January 2019
Revised 22 November 2019
Accepted 26 November 2019

KEYWORDS

African American; health disparities; obesity; physical activity; weight loss

Introduction

A disproportionate majority (57.2%) of African American (Black) women are obese, compared to non-Hispanic White (White) women (38.2%) (Flegal et al. 2016). Obesity increases individual risk of developing diseases, such as type 2 diabetes, hypertension, cardiovascular disease, and some cancers (American Diabetes Association 2007; Calle and Kaaks 2004; Calle et al. 2003; Schmitz et al. 2000). Behavioral weight loss interventions (BWI) can reduce weight-related disease risk through clinically significant weight loss of 5–10% (American Diabetes Association 2007; Hamman et al. 2006; Jakicic et al. 2012; Krishnan et al. 2007; The Diabetes Prevention Program Research Group 2002; Wadden

and Bray 2018; Wadden et al. 2009). Unfortunately, BWI are typically less effective for Black women, who often lose small amounts of weight (2–3%) that are significantly less (2–3 kg less) than White women (Blackman Carr et al. 2018; Davis et al. 2015; Fitzgibbon et al. 2012; Goode et al. 2017; Samuel-Hodge et al. 2014; West et al. 2008; Wingo, Carson, and Ard 2014). While small reductions in weight are beneficial (Hamman et al. 2006; Knowler et al. 2003; Svetkey et al. 2005), the weight loss disparity indicates a need for more effective BWI for Black women.

Several factors may influence the racial disparity in BWI outcomes. Differential adherence to dietary and physical activity (PA) recommendations in BWI between Black and White women may play a role in the weight loss disparity. A 16-week randomized trial of diet and exercise found that race predicted adherence to dietary recommendations, with Blacks being less adherent than Whites (Epstein and Roemmich 2001). However, Davis et al. found that Blacks and Whites enrolled in a BWI did not differ in self-reported calorie intake (Davis et al. 2015). Additionally, compared to Black women, White women have exhibited significantly higher change in objectively measured PA and cardiorespiratory fitness levels (Davis et al. 2015; Walsh et al. 2004). Self-reported PA has been reported as higher in White vs. Black women, and PA adherence was strongly related to weight loss in a multicenter trial (Wadden et al. 2009). Taken together, this suggests that greater engagement in PA may improve weight loss.

Physical activity can account for as much as 20–25% of weight loss in BWI when combined with a calorie-restricted diet (Goodpaster et al. 2010; Jakicic and Davis 2011). High amounts of at least moderate-intensity PA (250–300 min/week) have been recommended for short- and long-term weight loss (Goodpaster et al. 2010; Jakicic and Davis 2011; Jakicic et al. 2014; Jeffery et al. 2003; U.S. Department of Health and Human Services 2018). Evidence from PA interventions that have included Black women identified the following elements as important to increase PA: supervised PA, prescribed PA goals, group exercise, social support, problem-solving, self-monitoring, modeling, feedback, and relevant barriers and enablers of PA (Artinian et al. 2010; Banks-Wallace and Conn 2002; Stuart-Shor et al. 2012; Whitt-Glover et al. 2009; Whitt-Glover and Kumanyika 2009).

Weight loss in Blacks may also be affected by cultural influences on the outcomes and targeted behaviors (Kumanyika, Whitt-Glover, and Haire-Joshu 2014). A reframed approach that incorporates the socio-cultural norms and perspectives of Blacks has been recommended (Kumanyika et al. 2007). Furthermore, given the role of PA in weight loss, increasing Black women's PA during BWI by applying a sociocultural, race- and gender-based lens to PA adoption, may improve weight loss. Thus, we conducted a trial in which we hypothesized that Black women randomized to a culturally relevant, PA-enhanced BWI (enhanced) would have greater weight loss and objectively-measured moderate-to-vigorous PA (MVPA) than those in a standard BWI (standard) at 6-months post-baseline.

Materials and methods

Participants

Eligible women self-identified as Black, had a body mass index of 25–45 kg/m², and were 21–65 years old. Participants were required to have low activity (≤ 75 min/week of self-reported MVPA) and willing to participate in face-to-face sessions. To self-monitor and

receive feedback, reliable Internet access with a regularly used e-mail address was required. Exclusion criteria included weight loss (5–10%) in the last 6 months, concurrent participation in another weight-related program, and taking weight loss medication. The Physical Activity Readiness Questionnaire evaluated physical limitations to PA (Physiology, 2002). Physician consent was required if an affirmative response was given to any item. 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, thyroid medication dose change in the last year, current or recent (last 5 years) cancer treatment, or relocation plans were also exclusion criteria.

Recruitment

We used passive and active recruitment strategies. Passive strategies included advertisement through university and local community listservs, flyers and Facebook ads. Active recruitment strategies included meeting with community leaders (e.g., church pastors) and participating in community events (e.g., health fairs) to distribute flyers and identify interested individuals. All recruitment methods directed individuals to a study website to complete an initial online screening form. Through the study website, 955 women made contact and completed the online screener. Those who were initially eligible through the online screener, were then contacted by study staff who completed a follow-up phone screening with 315 women (Figure 1 depicts the flow of individuals through the study). If women passed the phone screening, they were invited to an orientation session ($n = 146$) to learn more about the study. At orientation, study details were communicated, and a written informed consent document was signed by women who agreed to participate. Those interested in continuing participation scheduled their baseline assessment at that time. Once baseline assessments were completed, women ($n = 85$) were randomized to one of two study groups. A total sample size of 66 was required to detect a 3.0 kg difference in change in weight between groups, with a power of 80% and two-sided alpha of 0.05.

Study design

Computer-generated randomization to the standard or enhanced group occurred after baseline data were collected. A six-month post-baseline follow-up assessment was conducted to evaluate outcomes. Participants received \$25 for completing the 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

The six-month standard intervention was adapted from published work modeled after the Diabetes Prevention Program and Look Ahead (American Diabetes Association 2007; Jakicic et al. 2012; The Diabetes Prevention Program Research Group 2002). Standard treatment included: 18 face-to-face group sessions, self-monitoring of daily weight, diet and activity with a mobile application (MyFitnessPal), and weekly e-mail feedback.

Figure 1. Study flow.

Participants received printed lessons at each group session. Photos within lessons were selected to match participants' race, representing a surface-level adaptation to lesson materials (Resnicow et al. 1999), but did not incorporate cultural values. Participants were prescribed daily calorie intake goals according to baseline weight (1200 kcal/day for 90 kg, 1500 kcal/day for >90 kg, 1800 kcal/day for those ≥ 113 kg) and received registered dietitian-created meal plan and sample menus. Weekly PA goals were prescribed to reach 300 min/week of MVPA progressively by 6 months. Progression toward the PA goal was based on self-reported MVPA (minutes/week) during recruitment. Weekly e-mail feedback, using self-monitoring records, provided behavioral guidance based on weekly weight change, average daily calorie intake and total minutes of PA.

Intervention description: enhanced group

The enhanced group received the standard group treatment plus enhancements to support PA adherence. Reducing race- and gender-based PA barriers, not typically included in standard BWI, were targeted to improve participants' weight loss. Enhancements were also designed to incorporate cultural PA values and increase PA opportunities, which represented "deep structure" cultural adaptation that encompassed Black women's cultural values (Resnicow et al. 1999). The enhancements, including the cultural adaptation, were informed by qualitative and quantitative PA literature and shaped by an expanded obesity paradigm that promotes inclusion of the PA contexts and environments of Black women (Kumanyika et al. 2007). The barrier-reduction-focused enhancements included: barrier tip sheet, Facebook discussion, supervised group PA, weekly PA options, and Exercise Ambassadors (additional detail about each enhancement is detailed in Table 1).

Both the standard and enhanced interventions were delivered by the same interventionist, who was a Black woman (LBC).

Measures

All measures, except demographics, were collected at baseline and 6 months.

Demographics

Descriptive information was collected at baseline, including age, annual household income, and marital status.

Anthropometrics

Trained assessors collected anthropometric data. Assessors were not masked to participants' study group assignment. Height was measured with a wall-mounted stadiometer to the nearest 0.1 cm in duplicate. Weight was assessed in duplicate to the nearest 0.1 kg with a digital scale and participants in light clothing without shoes. After a five-minute rest period, three blood pressure readings were captured by an automated device. Waist circumference was measured in duplicate to the nearest 1.0 cm.

Dietary intake

The Block Food Frequency Questionnaires for fat and fruit/vegetable intake assessed fruit/vegetable servings (daily), total fat (g), and percent of calories from fat (Block et al. 1986).

Physical activity

The Paffenbarger Exercise Habits Questionnaire captured self-reported energy expenditure (kcal/week) (Paffenbarger et al. 1978). The SenseWear Armband Mini accelerometer (BodyMedia, Pittsburgh, PA), validated in previous studies, objectively measured MVPA (minutes/week) (Jeffery et al. 2003; Johannsen et al. 2010; St-Onge et al. 2007; Unick et al. 2017, 1–11). MVPA was defined as ≥ 3 metabolic equivalents per minute. Participants were instructed to wear the armband for 7 days during all waking hours. Adherent wear was defined as at least 4 days for at least 10 h/day.

Table 1. Enhanced group physical activity enhancements.

Enhancement	Description	Targeted Barrier or Facilitator
Barrier Tip Sheet	Participant worksheet included with every lesson that presented one physical activity barrier or facilitator identified in the literature. Participants employed problem-solving or goal-setting techniques to address barrier or facilitator in small teams. Tip sheet language incorporated sociocultural perspectives and experiences of black women.	Sample Barriers <ul style="list-style-type: none"> • Hair care & maintenance • Superwoman schema • Feared loss of desired curvy body (femininity) becoming too muscular (masculine) • Time • Sample Facilitators • Collectivism • Role modeling physical activity for community
Facebook Group	A private Facebook group moderated by the interventionist where topics coordinated with the barrier tip sheet. Two to three moderator posts were made to facilitate continued dialogue around the physical activity barrier or facilitator. (see Fig. Y)	Topics mirrored barrier tip sheet examples.
Supervised Group Physical Activity	During lessons, a black female certified group fitness instructor led 30 minutes of aerobic activity. Instruction included demonstration of proper exercise technique, assessment of exercise intensity (moderate or vigorous), and emphasized exercise bouts of at least 10 continuous minutes.	Inexperience with exercise and physical activity
Exercise Ambassador	Six ambassadors were recruited to serve as monthly role models during supervised group physical activity, and to discuss how they applied problem-solved or goal-set the barrier or facilitator presented on the tip sheet during their in-person visit and one week after in the interventionist-moderated Facebook discussion. Ambassadors were black women who maintained $\geq 5\%$ weight loss for ≥ 6 months, and maintained ≥ 150 minutes of moderate-to-vigorous PA for > 3 months.	Lack of physical activity role models
Weekly Physical Activity Options	Between sessions, participants were given 4 consistent options to engage in PA. (1) 30 min of exercise with fellow participant(s) (2) 30 min of home instructional exercise video (3) 30 min of exercise in a group fitness class (4) 30 min their choice of exercise	–

Process measures

Study engagement was assessed with session attendance checklists and tracking of the number of weeks of self-monitoring. Adherent 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, analyses were unadjusted. A multiple linear model was used to compare groups using an intent-to-treat approach. Assumptions of the multiple linear model were tested to determine model fit, including visual assessment of the plots of residuals, which were adequate. Change in weight was the primary outcome, and change in objective MVPA was the secondary

outcome. Total MVPA was not compared between groups. Baseline weight (kg) and MVPA were included as control variables where appropriate. Any outcome variables that violated the assumption of normality were transformed to approximate a normal distribution of residuals. Self-reported PA 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. Post hoc exploratory analyses were conducted to examine study adherence (attendance), engagement (self-monitoring, Facebook participation) and the study outcomes (change in weight, MVPA). 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).

Results

We screened 315 individuals for eligibility. The primary reason for ineligibility was self-reported PA >75 min/week. Of the 315 women screened, 146 women were eligible and were invited to an orientation session (Figure 1). On average, participants were 48.30 (11.02) years old, weighed 97.90 (14.22) kg, with a body mass index of 36.46 (4.50) kg/m² (Table 2). Over half of participants were married or living with a partner (56.96%). No baseline between-group differences were seen in self-reported MVPA (kcal/week), daily fruit/vegetable servings, total grams or percent calories from fat.

Retention

Following orientation, when informed consent was gathered, completion of the baseline assessment was required for participation. After women completed the baseline assessment ($n = 85$), they were subsequently randomized to the standard ($n = 42$) or enhanced group ($n = 43$). No method was used to select participants from the pool of women invited to orientation. Rates of retention, defined as completion of the 6-month assessment, was not different between groups (standard vs. enhanced: 80.1% and 92.9%; $p = .31$).

Change in weight

Weight loss was not significantly different between the groups at 6-months post-baseline (standard vs. enhanced group: -2.83 kg (-2.95%) vs. -2.08 kg (-2.19%), $p = .43$). However, for

Table 2. Baseline demographic characteristics of participants by treatment arm.

	Total ($n = 85$)	Standard ($n = 42$)	Enhanced ($n = 43$)	p -Value
Age (years), mean (sd)	48.30 (11.02)	48.12 (10.61)	48.48 (11.53)	.89
Annual Household Income n (%)	34 (39.44)	14 (32.43)	20 (47.06)	.21
• $< \$50,000$ /year	51 (60.56)	28 (67.57)	23 (52.94)	
• $\geq \$50,000$ /year				
Marital status n (%)	48 (56.96)	24 (56.41)	25 (57.50)	.92
• Married or living as married	37 (43.04)	18 (43.59)	18 (42.50)	
• Not married				
Weight (kg)	97.90 (14.22)	95.99 (11.36)	99.81 (16.53)	.23
BMI (kg/m ²)	36.46 (4.50)	36.12 (4.40)	36.78 (4.62)	.52

all participants, Pearson correlation showed that change in weight over 6 months was inversely associated with the total number of sessions attended ($r = -0.39$, $p = .0006$) and the total number of weeks participants self-monitored ($r = -0.35$, $p = .0032$).

Groups differed significantly in the number of participants who achieved at least 5% weight loss. More women in the standard compared to the enhanced group lost at least 5% of baseline weight (17 (39.5%) vs. 9 (20.4%), $p = .02$). Overall, participants who lost at least 5% of baseline weight, compared to those who did not, were not significantly different in age, income or marital status, but did self-monitor for more weeks ($\beta(\text{SE}) = -4.43$ (1.70), $p = .01$).

Physical activity and diet

Over 6 months, women in the standard group increased average minutes/week of objectively-measured MVPA by 43.93 (116.10), whereas women in the enhanced group increased by 15.29 (132.90) minutes/week (Table 3). Six-month change in objectively-measured ($p = .45$) and self-reported ($p = .25$) MVPA did not differ between groups, nor did the change in daily fruit/vegetable servings ($p = .47$), total fat ($p = .34$), or total percent fat ($p = .34$; Table 4).

Anthropometric and cardiovascular outcomes

By 6 months, all participants reduced their waist circumference and diastolic blood pressure. No between group difference appeared in change in waist circumference ($p = .89$), change in systolic ($p = .18$) or diastolic blood pressure at 6 months ($p = .21$; Table 3).

Adherence

Standard and enhanced group participants did not differ significantly in session attendance ($p = .41$). Both groups attended approximately 50% of the 18 group sessions (standard vs. enhanced: mean (SD) = 10.85 (5.86) vs. 9.83 (5.37)). Post hoc attendance was negatively correlated with weight ($r = -0.39$, $p = <0.001$) and positively correlated with objectively-measured MVPA ($r = 0.30$, $p = .02$). Also, the mean number of weeks participants used the self-monitoring application did not differ between groups (standard vs enhanced group: 6.27 (7.10) vs. 4.31 (5.56), $p = .20$). Enhanced group participants' Facebook engagement (total likes ($r = -0.19$, $p = .26$) and comments ($r = 0.01$, $p = .94$)) was not correlated with weight loss.

Discussion

This randomized trial compared the effects of a culturally-relevant, PA-enhanced BWI versus a standard BWI among Black women. Average weight loss was not different between groups at 6 months. However, a greater proportion of participants in the standard group achieved a 5% weight loss compared to enhanced group. Though the enhanced group treatment sought to increase MVPA, change in mean objective MVPA did not differ between groups. Dietary and adherence measures also did not differ by

Table 3. Objective and self-reported physical activity at 6 months.

Outcome	Means (SD)		Regression Results	
	Standard	Enhanced	Parameter Estimate(SE)	p-Value
Baseline Physical Activity				
Total MVPA, objective (minutes/week)	57.83 (79.00)	76.37 (117.00)	–	–
Total physical activity, self-reported (kcal/week)	312.50 (476.30)	333.50 (461.70)	–	–
6-Month Physical Activity				
Total MVPA, objective (minutes/week)	102.00 (96.87)	88.59 (161.50)	–	–
Change in MVPA, objective (minutes/week)	43.93 (116.10)	15.29 (132.90)	23.08 (30.44)	.45
Total physical activity, self-reported (kcal/week)	705.50 (761.30)	721.20 (925.6)	–	–
Change in physical activity, self-reported (kcal/week)	409.00 (918.40)	391.40 (947.20)	0.40 (0.35)	.25

Table 4. Means of change in weight, dietary intake, waist circumference, blood pressure, and total adherence at 6 months by group.

Outcome	Baseline			Change at 6 Months			
	Means (SD)			Means (SD)		Regression Results	
	Standard	Enhanced	p-Value	Standard	Enhanced	Parameter Estimate(SE)	p-Value
Weight(kg)	95.99 (11.36)	99.81 (16.53)	.23	–2.83 (3.82)	–2.08 (3.91)	–0.73 (0.92)	.43
Total fat(g/day)	101.20 (30.98)	96.30 (21.54)	.42	–7.20 (14.24)	–10.80 (15.77)	3.41 (3.54)	.34
Calories from fat (%)	36.41 (7.74)	35.20 (5.38)	.42	–1.80 (3.56)	–2.70 (3.94)	0.85 (0.88)	.34
Fruit/vegetable intake (servings/day)	2.82 (1.23)	2.81 (1.04)	.94	0.47 (1.52)	0.36 (0.88)	0.18 (0.25)	.47
Session attendance	–	–	–	10.85 (5.86)	9.83 (5.37)	1.27	.31
Total weeks self-monitored	–	–	–	6.27 (7.10)	4.31 (5.66)	0.27 (0.27)	.32
Waist Circumference (in.)	82.08 (20.03)	81.39 (17.75)	.87	–2.36 (7.85)	–1.20 (8.62)	–0.15 (0.78)	.89
Change in systolic blood pressure (mmHg)	121.70 (18.26)	127.30 (17.34)	.16	0.48 (11.03)	–3.65 (11.20)	3.37 (2.48)	.18
Change in diastolic blood pressure (mmHg)	78.67 (12.76)	77.55 (11.16)	.68	–3.23 (11.76)	–5.15 (11.15)	3.06 (2.41)	.21

group. Overall, participants attended approximately half of the offered group sessions and self-monitored for approximately 25% of the study period. These findings indicate that the enhanced group treatment did not produce outcomes different from the standard group treatment.

All participants experienced small weight losses (~2%), which is typical for Black women in BWI (Fitzgibbon et al. 2008; Goode et al. 2017; Svetkey et al. 2005). While small amounts of weight loss are beneficial, the BWI target remains 5–10% weight reduction to achieve health benefits (Hamman et al. 2006). Small weight losses may also reflect subpar attendance across study groups. Though attendance at all sessions was recommended, the average of 50% attendance was not unexpected. The observed inverse correlation between weight and attendance was expected and consistent with previous trials (Davis et al. 2015; Fitzgibbon et al. 2008). Notably, proportionally more women in the standard compared to the enhanced group lost at least 5% of baseline weight. Standard

predictors of at least 5% weight loss, such as age and adherence, were not predictive in this study (Tate et al. 2017). This was unexpected. Perhaps a more equitable focus on dietary and PA behavior change was communicated in the standard group compared to enhanced group.

Participants' objective MVPA was far below the six-month goal (300 min/week). Change in objective and self-reported MVPA was not different between groups and was small in comparison to other studies with predominantly White samples (Davis et al. 2015; Jeffery et al. 2003). However, the average objectively-measured MVPA below 150 min/week, has been previously observed among Blacks in a BWI (Davis et al. 2015). Studies that produced higher PA at 6 months maintained weekly session frequency (Davis et al. 2015; Jeffery et al. 2003). In this study, group session frequency decreased from weekly to biweekly after 3 months. Perhaps the intervention dose delivered was insufficient to support such great PA change in the initially low-active participants.

The lower than expected PA engagement in the enhanced vs. standard group may also have reflected a greater focus on addressing intra- and interpersonal PA barriers. However, institutional, community, and policy level barriers that likely affect PA behavior needed to be addressed to improve enhanced group responsiveness (Golden and Earp 2012; Kumanyika et al. 2007; Kumanyika, Whitt-Glover, and Haire-Joshu 2014; McLeroy et al. 1988). Future studies may need to expand PA barrier reduction efforts to improve engagement.

Study engagement through session attendance was necessary to gain exposure to the majority of enhancements and small team support. Across study groups, participants attended about half of the group sessions, a rate that is not unusual, nor unexpected, for this population during weight control interventions (Davis et al. 2015; Fitzgibbon et al. 2008). While one might expect the racially homogenous composition of the study sample to foster greater engagement due to similarity, this was not observed in this study. Less than ideal attendance meant some teams were small and potentially less effective at addressing PA barriers, and women had decreased opportunities for group interaction to build cohesion (Harden et al. 2014). Consequently, the intended formation of culturally relevant interpersonal non-kin and sisterhood bonds may not have occurred. Participants' attendance rate also limited contact with the Exercise Ambassadors, who attended 100% of their monthly group session appearances. Thus, participants did not receive full exposure to Ambassadors who modeled successful PA adoption, barrier management and provided social support. Importantly, monthly Exercise Ambassador visits may have been inadequate to meet Black women's need for PA role models and increased PA exposure (Harley et al. 2009; Joseph et al. 2015; Young et al. 2002).

Furthermore, the sub-optimal attendance rate-limited participation in supervised PA during enhanced group sessions. While the supervised PA was likely insufficient, the small change in objective MVPA likely reflects low adoption outside of group sessions. Taken together, improved attendance is needed, as is the provision of sufficient structured PA opportunities, a strategy that has produced significant PA change (Whitt-Glover et al. 2014). This approach may answer hypotheses about whether greater PA engagement among Black women enhances weight loss.

The enhanced group Facebook component aimed to engage participants in PA and barrier reduction further. While modest Facebook engagement has been observed previously in this population, we observed low engagement (Joseph et al. 2015). Importantly,

Facebook likes were directly correlated with objectively-measured MVPA but not weight loss. Greater Facebook engagement may have produced better PA outcomes through continued interaction with PA and barrier reduction content. Online social networking tools have been recommended for use in Internet-delivered PA interventions with Black women to provide social connections (Durant et al. 2014). Furthermore, Facebook engagement has been associated with weight loss in other studies (Hales, Davidson, and Turner-McGrievy 2014). Including a Facebook component may still be a practical tool to increase PA and ultimately weight loss, but improved engagement strategies are necessary.

In addition to PA increase, reduced calorie intake is essential for weight loss. Both groups lowered their self-reported intake, a change likely responsible for the small weight losses observed (Fitzgibbon et al. 2008). While both groups made positive changes to dietary intake, no between group differences emerged. The limited weight loss observed likely also reflects low self-monitoring (a few weeks, on average), a finding observed among Blacks in another intervention (Davis et al. 2015). Self-monitoring adherence was associated with greater weight loss in this and other BWI (Krukowski et al. 2013). While we did not expect dietary and self-monitoring group differences to emerge, it helps explain the lower weight loss.

Our study produced small weight losses typically seen among Black women in standard BWI. Therefore, ample opportunity exists to improve both PA and weight loss for this population. Physical activity barrier reduction techniques should be investigated further, with an expanded scope to target the broader context of PA barriers.

Strengths and limitations

A major strength of this study was the randomized controlled trial design to compare intervention effectiveness. By doing so, we were able to contribute to the field's understanding of what may be a more effective BWI for Black women. The unexpected null results partially fill the evidence gap concerning Black women in BWI, by indicating the intervention approaches used were not more effective for weight loss than standard BWI. The computed effect size of 3 kg may have been overly optimistic, and sample size may have not have provided adequate statistical power to detect a smaller perhaps more reasonably expected between-group change in weight. Null results are valuable, informing areas where future study is and is not required. Another strength was objective MVPA measurement, which enabled a clear evaluation of the outcome. Our study was further strengthened by the incorporation of the expanded obesity paradigm that promotes inclusion of the context of weight-related behaviors in Blacks (Kumanyika et al. 2007). The PA enhancements addressed this context by including PA barriers specific to Black women that are usually not included in BWI (Resnicow et al. 1999).

While incorporating these PA barriers was a strength, a limitation persists in the need for systematic conceptualization, operationalization, reporting and assessment of cultural adaptations to interventions (Kong et al. 2014; Kumanyika, Whitt-Glover, and Haire-Joshu 2014). Additionally, the PA barriers included mostly addressed intra- and interpersonal contexts, but not community or policy contexts. Inadvertently, this may have excluded important barriers that affect PA engagement. The strategy of PA barrier reduction has been explored previously and remains relevant to address barriers that deter PA adoption and maintenance (Hall et al. 2013; Pekmezi et al. 2016, 2013; Ray 2014). Furthermore, bringing together Black

women to a weight loss group led by a Black woman may have resulted in more cultural relevance in the standard group than we expected. However, interventionist-participant race concordance may not have affected weight loss, as demonstrated in a previous weight control trial (Batch et al. 2013). Importantly, the enhanced treatment in our study did not increase PA to the goal amount; so, despite research indicating the role of PA in maximizing weight loss (Goodpaster et al. 2010; Jakicic and Davis 2011), questions remain about ways to increase PA to higher levels in Black women. Finally, BMI is an imperfect measure, but it represents one part of the standard approach to screening and recruitment. For this study focused on Black women, we extended the traditional range of BMI eligibility from 25 to 40 to 25–45 to acknowledge the frequent finding that Black women often enter weight control interventions at a higher weight than their White female counterparts. Though imperfect, BMI remains the practical measure for assessing weight status for weight control interventions that may have broadly-applicable outcomes.

Results of this study indicate multiple areas for continued investigation. Future interventions should incorporate barrier reduction strategies. Formative work may be a necessary step to elucidate relevant barriers and develop appropriate strategies. Importantly, barriers may extend beyond the individual level to include community and policy levels, all of which can influence PA engagement. Interdisciplinary design of BWI are likely necessary to address barriers above the individual socioecological level. Relatedly, many of the PA enhancements were delivered during group sessions, where attendance was less than optimal. Different attendance strategies and BWI delivery modes, other than face-to-face, likely need to be explored. Importantly, adoption of PA was low, limiting examination of the central question, whether higher PA would yield greater weight loss in Black women. Finally, while the present study was sufficiently powered to detect a 3 kg between-group difference in weight loss, a larger sample size is required to adequately power future studies in which smaller differences may be expected and could thus be detected. Future interventions may seek to improve Black women's self-monitoring adherence and program attendance. Improving both may bolster dietary and PA change to achieve clinically significant weight loss. In sum, more investigation is warranted, especially given the persistent need for culturally informed and responsive intervention approaches to improve weight loss and behavioral outcomes in this population (Goode et al. 2017; Kumanyika et al. 2007; Whitt-Glover et al. 2014).

Conclusions

Neither weight loss nor change in objectively-measured MVPA after 6 months differed between participants randomized to the standard or enhanced behavioral weight loss intervention. Findings suggest that the enhanced BWI was not more effective than standard BWI. Improved self-monitoring adherence and attendance may offer pathways to bolster Black women's weight loss in BWI. The dual disparity of disproportionately high obesity prevalence and sub-optimal weight loss in BWI among Black women persists. Thus, further study and novel approaches to design and implement more effective BWI that consistently yield clinically meaningful weight loss among Black women is imperative.

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