Preventive Medicine Reports 22 (2021) 101360

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/pmedr

Community health worker-delivered weight management intervention among public housing residents: A feasibility study

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ARTICLE INFO

Keywords:
Weight management
Public housing
Diet
Physical activity
Community health workers

ABSTRACT

Community health worker-led interventions may be an optimal approach to promote behavior change among populations with low incomes due to the community health workers' unique insights into participants' social and environmental contexts and potential ability to deliver interventions widely. The objective was to determine the feasibility (implementation, acceptability, preliminary efficacy) of a weight management intervention for adults living in public housing developments. In 2016–2018, in Boston Massachusetts, we conducted a 3-month, two-group randomized trial comparing participants who received a tailored feedback report (control group) to participants who received the same report plus behavioral counseling. Community health workers provided up to 12 motivational interviewing-based counseling sessions in English or Spanish for diet and physical activity behaviors using a website designed to guide standardized content delivery. 102 participants enrolled; 8 (7.8%) were lost at 3-month follow up. Mean age was 46.5 (SD = 11.9) years; the majority were women (88%), Hispanic (67%), with ≤ high school degree (62%). For implementation, among intervention group participants (n = 50), 5 completed 0 sessions and 45 completed a mean of 4.6 (SD = 3.1) sessions. For acceptability, most indicated they would be very likely (79%) to participate again. For preliminary efficacy, adjusted linear regression models showed mean changes in weight (-0.94 kg, p = 0.31), moderate-to-vigorous physical activity (+11.7 min/day, p = 0.14), and fruit/vegetable intake (+2.30 servings/day, p < 0.0001) in the intervention vs. control group. Findings indicate a low-income public housing population was reached through a community health worker-led intervention with sufficient implementation and acceptability and promising beneficial changes in weight, nutrition, and physical activity outcomes.

1. Introduction

Cardiovascular diseases account for a substantial amount of preventable death which can be at least partially mitigated by changing modifiable behaviors and factors, including diet quality, physical activity, and weight (Benjamin et al., 2019). In the U.S., racial/ethnic minority and populations with low socio-economic status (*i.e.,* health disparity facing populations) have higher prevalence of cardiovascular diseases compared to white and higher SES populations. From 2013 to 2016, prevalence of cardiovascular diseases (including hypertension) among adults 20 years or older is 60.1% for non-Hispanic Black males, 50.6% for non-Hispanic white males, and 49.0% for Hispanic males; and among females, 57.1% for non-Hispanic Black females, 43.4% for non-Hispanic white females, and 42.6% for Hispanic females (Benjamin et al., 2019). Furthermore, health disparity facing populations have lower adherence to national guidelines for cardiovascular disease-related health behaviors and contributing factors such as obesity (Hales et al., 2018), likely owing to inequalities in economic,

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https://doi.org/10.1016/j.pmedr.2021.101360
Received 30 August 2020; Received in revised form 27 February 2021; Accepted 4 March 2021
Available online 16 March 2021

educational, environmental resources and racial/ethnic discrimination. Weight management interventions have been less effective among racial/ethnic minority compared to white individuals (West et al., 2008). Residents of public housing tend to have a higher proportion of individuals with low income, belonging to racial/ethnic minority groups, and with obesity and cardiovascular disease-related health conditions compared to other city residents (Digenis-Bury et al., 2008; Chambers and Rosenbaum, 2014).

Interventions are needed at the population-level in order to have sustained impact on weight patterns and diet and physical activity behaviors among health disparity-facing groups (Institute of Medicine Committee on Assuring the Health of the Public in the 21st Century, 2002; Naja-Riese et al., 2019). A recent synthesis of evidence demonstrated weight loss through behavioral and pharmacological trials consisting of multiple strategies, including individual, group, and technology-based formats (LeBlanc et al., 2018). Therefore, weight loss is achievable through diligent intervention delivery. However, the question remains as to how researchers and practitioners can translate effective individual-level interventions for population-level change among people in health disparity facing populations.

Training community health workers as part of an intermediate intervention delivery system holds promise for translating individual-level behavior change strategies (e.g., diet and physical activity behaviors for weight management) for scaling up to population-level change (Venditti, 2017). A community health worker is: "a frontline public health worker who is a trusted member of and/or has an unusually close understanding of the community served" (Community Health Workers, 2020). Peer support from community health workers may be a particularly useful way to promote weight management and other public health programs among residents of public housing (Rorie et al., 2011; Quintiliani et al., 2014) because the community health worker shares important characteristics and life experiences with the targeted participants and are trusted health advisors within their communities (Islam et al., 2017). Community health workers are likely to have a good understanding of social contextual factors (e.g., financial hardship, multiple family roles, access to resources) that have an impact on health behaviors and can incorporate them into intervention delivery. (Olaniran et al., 2017) A systematic review indicated the majority of community health worker-led interventions examined demonstrated a positive impact on cardiovascular disease risk reduction; (Kim et al., 2016) randomized trials of community health worker-led interventions have also demonstrated weight loss outcomes in particular (Yeary et al., 2020). However, community health workers could benefit from tools to facilitate the systematic delivery of their counseling, both to increase fidelity to intervention delivery across participants and counselors as well as transferability of the intervention, if successful, to other populations and health conditions. Digital technologies could address these goals; indeed, community health workers have used digital technologies in many global contexts to facilitate the spread of information in the communities they serve (Early et al., 2019).

Interventions implemented among residents of public housing developments have targeted multiple behaviors and conditions including smoking (Brooks et al., 2018), HIV risk reduction (Jemmott et al., 2019), cancer screening (Stone et al., 2019), and oral health (Henshaw et al., 2018). Fewer have addressed weight management (Bowen et al., 2018) or used a technology solution to train and improve treatment fidelity among community health workers. Therefore, the objective of this study was to determine the feasibility (implementation, acceptability, preliminary efficacy) (Bowen et al., 2009; Orsmond and Cohn, 2015) of a community health worker-led behavioral nutrition and physical activity weight management intervention among urban public housing residents.

2. Materials and methods

2.1. Study design

In a two-group parallel randomized trial with an additive design, participants were randomized on a 1:1 basis to receive either 1) brief tailored feedback (control group) or 2) brief tailored feedback plus motivational interviewing-based counseling sessions delivered by community health workers (intervention group). Our randomization scheme was constructed by a biostatistician using SAS software (Cary, NC). We used blocked randomization to maintain balance between the two study groups. Randomization was embedded within CuesWeight, such that after a participant was consented and completed the baseline assessment, the Research Assistant clicked a button on the website which determined intervention or control group allocation. Study procedures were approved by the Institutional Review Board of Boston Medical Center/Boston University Medical Campus.

2.2. Participants and procedures

Trial recruitment occurred through mailed inserts in rent statements, posted flyers, and referrals from enrolled participants. Eligible participants were residents of Boston's public housing developments, without plans to move, 18–65 years old, BMI $\geq$ 25.0, no self-reported medical contraindications to physical activity, open to making lifestyle changes, not on a medically prescribed diet or in another weight loss program, who could speak and read in English or Spanish, owned a cell phone, were willing to receive text messages and wear an accelerometer-based physical activity device. Residents from any of Boston's 26 family public housing developments as well as participants who reported receiving a rental subsidy from the Boston Housing Authority were potentially eligible to participate. A Research Assistant conducted a screening by telephone, after which eligible participants were scheduled for an appointment to complete an in-person baseline study visit at the participant's home. During the home visit, eligibility was verified, consent obtained, and an interviewer-administered baseline survey was administered in either English or Spanish according to the participant's preferred language. The Research Assistant provided the accelerometer-based physical activity device, log, and verbally explained printed wear instructions to each participant, then returned one week later to retrieve the accelerometer. Baseline data collection occurred between September 2016 to December 2017. In-person follow-up assessments occurred 3 months post-baseline. Surveys were either inputted directly into REDCap by the Research Assistant or were completed via paper–pencil surveys and then later entered into REDCap (Harris et al., 2009). Surveys were entered in duplicate and checked for errors. Participants received $25 on a pre-paid debit card at baseline and follow-up visits.

2.3. Study groups

2.3.1. Intervention group

After baseline data collection, participants received a printed 2-page report by postal mail that listed: current levels of six behaviors (minutes of moderate physical activity, servings of fruits & vegetables, whole grains, high fat dairy foods, high fat protein foods, and sugary drinks as self-reported in the baseline survey), national guidelines for each behavior, tips to achieve these behaviors, and websites of diet and physical activity-related resources for more information.

After baseline assessment, the community health worker contacted participants to schedule the first of up to 12 weekly diet and physical activity behavioral counseling sessions (Table 1). As in other interventions (Quintiliani and Whiteley, 2016; Quintiliani et al., 2015), the Social Contextual Model (Sorensen et al., 2003) was the conceptual framework used to guide intervention delivery and evaluation, in which social contextual factors are incorporated into intervention design so that it is responsive to the needs of the target population. For example,

Table 1
Description of Intervention Group Procedures: Content of Counseling Calls, Community Health Worker Training, and Quality Assurance Activities, 2016–2018, in Boston Massachusetts.

Session frequency and setting	Counseling sessions occurred once a week, for 12 weeks. First session was in-person at the participant's home and subsequent sessions were by telephone. At least three call attempts were made for any missed calls.
Behavioral topics	At the start of session 1, participants chose to work on 3 of the following behavioral topics: eating breakfast, low-fat dairy, fruits & vegetables, high calorie snacks, late night eating, lean proteins, whole grains, stress reduction, sugary beverages, walking 30 min 5 times/week, walking > 7500 steps per day, and television habits. On weeks 4 and 7, the community health worker asked participants if they would like to select 3 new topics or stay with the same topics in subsequent sessions.
Community health worker description	Two paid community health workers, each with a bachelor's degree, conducted the counseling sessions. One was English-speaking and one was English- and Spanish-speaking. Each lived in urban settings and had previous experience providing motivational interviewing counseling to patients from an urban safety-net hospital or as administering surveys to public housing residents. Both also had personal experiences with healthy eating, physical activity, and weight management. While the majority of Boston public housing residents have not graduated from college, the community health workers experience with the community allowed for an understanding of the common barriers and facilitators to weight management in this population.
Community health worker training	Four training sessions, 1–2 h in length, were held to review information on energy balance, nutrition/physical activity recommendations; motivational interviewing strategies; and study-specific protocols (e.g., how to use the CuesWeight website). Community Health Workers received a binder containing printed resources, participated in role-playing exercises, and at the end of the training, completed a call with a volunteer unknown to the community health worker trainee which was evaluated using the Motivational Interviewing Coaching Assessment (MICA) Coding Worksheet.
Content of session 1 (approximate length one hour)	The community health worker: • Reviewed confidentiality information and audio-recording procedure • Provided and reviewed a binder in either English or Spanish. The binder contained printed materials about energy balance, heart health, and a section for each of the 12 behavioral topics. Each section had information about the importance of each topic, tips to achieve the recommendations, and a goal setting worksheet. • Showed a plastic model of a Healthy Plate. Obtained participants' preferences for fruits & vegetables, grains, and proteins and typical habits on weekdays/weekends. • Provided a pedometer to track steps. Obtained participants' preferences for physical activity and typical habits on weekdays/weekends. • Assessed social contextual influences on eating and physical activity habits (e.g., family/friends, stress, work/school, neighborhood) For each behavioral topic: • Provide feedback on level of behavior from baseline survey and compare to recommended guidelines • Assessment of importance and confidence in changing the behavior • Assessment of motivation to change and goal setting (if desired), specifying the specific goal, frequency, and start date ("add salad to lunch meal five days a week, starting on Monday") and strategies to help reach goal • Summary of plan and strategies discussed
Content of subsequent sessions (approximate length 15 min)	For each behavioral topic, the community health worker: • Checked in about previously set goal (if any) • Provided feedback about text message responses from past week • Modified goal if needed • Strategized new ways to meet goal
Texting	Participants received three text messages per day to self-monitor adherence to recommendations for each of the three behavioral topics chosen (example: "Did you do brisk activity today for at least 10 min?"). Texts were in Spanish or English and were answered with a 'yes' or 'no'. No response was texted back to the participant.
Quality assurance activities/ Supervision	L.M.Q. held meetings with community health workers every other week to review scheduled participants, troubleshoot issues, answer questions, and review selected audio-recorded sessions for motivational interviewing topics (e.g., how to provide reflections, evoking information) and nutrition/physical activity topics (e.g., types of fat, fiber content of different foods)

intervention messages focused on inexpensive foods that are locally available. This approach has been shown to be effective in promoting beneficial behavior changes among health disparity-facing groups (Emmons et al., 2003; Sorensen et al., 2005). Counseling session content was informed by our qualitative formative research in which participants discussed multi-level influences on their eating and physical activity behaviors using PhotoVoice, reported elsewhere (Wells et al., 2019). The community health workers used a website, CuesWeight, developed for this study and pre-tested with three health advocates from public housing (Bowen et al., 2019). The site was designed to systematically lead community health workers through sections of our motivational interviewing counseling guide, and be flexible enough to allow them to use their own wording and expand on topics for natural conversation and rapport building. The site displayed information from the baseline survey for provision of feedback, produced dynamically tailored text depending on participant responses, included reminders to provide reflections and suggested sentence stems to phrase those reflections, and included text boxes for community health workers to record notes. The website was only accessed by community health workers and was not used by participants.

2.3.2. Control group

Participants received the same tailored feedback report and no other intervention activities.

2.4. Feasibility measures

All measures were selected to work within the context of the home visit and assessed at baseline and 3-month follow up.

2.4.1. Demographics

We assessed age, race/ethnicity, gender, and other demographic variables using standardized questions.

2.4.2. Intervention implementation

We counted the frequency of completed intervention components, such as counseling sessions and text messages occurring in our tracking database.

2.4.3. Acceptability

Intervention group participants answered questions about the acceptability of program components, including program helpfulness in setting goals, preferred numbers of calls and texts, and likelihood of enrolling again.

2.4.4. Preliminary efficacy

2.4.4.1. Weight and height. Weight (primary outcome) was measured in each participant's home using a portable digital scale (Omron model SC100) with shoes and heavy clothing such as coats removed. For height, participants were asked to remove their shoes and stand with their back facing the wall; research assistants then measured height using a tape measure.

2.4.4.2. Diet. Diet was measured by an 18-item food frequency questionnaire, the PrimeScreen, which has been compared for reliability and validity against a full-length food frequency questionnaire and biomarkers (Rifas-Shiman et al., 2001). Participants indicated the frequency with which they ate each food, with 5 response category options (less than once a week to twice or more per day). Foods are then grouped into categories: fruits and vegetables, 6 items; whole grains, 1 item; red and processed meats, 2 items; whole fat dairy foods, 1 item; and high calorie, 3 items. Sugary beverage intake was evaluated via the 15-item Beverage Questionnaire (BEVQ-15) (Hedrick et al., 2012), which assesses frequency of past-month consumption of common sugary drinks including sweetened juice drinks, soda, and energy drinks.

2.4.4.3. Physical activity. Physical activity was assessed using an Actigraph wGT3X-BT accelerometer-based device. Participants were asked to wear the device on their hip at all times of the day except during water activities (e.g., showering, swimming). Summary files of the wGT3X-BT accelerometer sensor data were prepared by examining the proportion that had valid data (minimum acceptable wear time for a valid measurement was 4 days), removing outliers, and computing estimates of time spent in sedentary behaviors and light, moderate, and vigorous physical activity (Crouter et al., 2010). Accelerometer-based physical activity data were normalized to an 8-hour day to account for the different intervals participants wore the accelerometers. For example, if a participant wore an accelerometer for 6 h and logged 30 min of moderate physical activity (MPA), that would be normalized to 40 min in an 8-hour day. All wGT3X-BT data were processed using R (Hibbing and van Hees, 2018; Hibbing et al., 2019).

2.4.4.4. Psychosocial variables. Self-efficacy was assessed using scales for health-related diet and exercise behaviors: separately for fruit and vegetable intake (6-items) and physical activity (12-items), asking participants to rate their confidence that they can perform these behaviors under a variety of circumstances (Sallis et al., 1988). Social support was assessed using the 8-item modified Medical Outcomes Study Social Support Survey which covers emotional and tangible social support (Moser et al., 2012). Autonomous motivation to eat a healthy diet and to do physical activity regularly to manage weight was measured via the 6-item autonomous motivation subscale of the Treatment Self-Regulation Questionnaire (Levesque et al., 2007).

2.5. Statistical analysis

First, the baseline socio-demographic variables for the two study groups were compared through analysis of variance (for continuous variables) and Chi-square analysis (for categorical variables). The analysis followed an intent-to-treat approach, including all randomized and followed participants regardless of their level of compliance with the intervention. Outcome analysis compared change in weight (primary outcome), nutrition and physical activity behaviors, and psychosocial variables from baseline to 3-month follow-up using linear regression. Analyses compared intervention and control groups on demographic factors that could potentially confound our analyses, and characteristics that significantly differed between groups at the $p < 0.1$ level were included as covariates in all regression models. Multiple linear regression models were adjusted for race, BMI, and tobacco use.

Differing sample sizes by variables at 3-month follow up reflect guidance provided to Research Assistants, namely that in the event a participant was unwilling to complete all follow up measures, the weight measure (primary outcome) should be prioritized, followed by the accelerometry measure, and then the survey (in which the Primescreen diet-related questions were prioritized over the sugary beverage intake, psychosocial, and acceptability questions). Statistical analyses were conducted using SAS.

3. Results

3.1. Study participants

Of the 259 individuals who inquired about the study and we contacted to assess interest in participating, 195 were successfully screened for eligibility of whom, 126 were eligible and 102 were randomized (enrollment rate: 81.0%): 50 to the intervention group and 52 to the control group (Fig. 1). We collected either weight, accelerometer-based physical activity device, or survey 3-month follow up data for all but 8 participants (7.8%). Those lost to follow-up ($n = 8$) were more often younger, male, single/never married, and without children compared to those with follow-up data.

Socio-demographic characteristics of participants are shown in Table 2. Mean (SD) age was 46.5 (11.9) years overall: 46.0 (12.6) years in the intervention group and 47.0 (11.2) years in the control group. Most reported belonging to a minority race/ethnicity group (88%). Three variables were statistically different between the intervention and control groups at baseline: with the intervention group having a higher frequency of white participants, higher frequency of past use of tobacco, and higher mean BMI levels. For weight, mean weight in the intervention group was higher compared to the control group (90.40 kg vs. 82.14 kg, $p = 0.02$).

3.2. Intervention implementation

All intervention participants received the tailored feedback report and the educational binder. Out of the 12 possible counseling sessions that could have been received among the 50 participants in the intervention group, 5 participants never completed a session. The remaining 45 participants completed a mean (SD) of 4.6 (3.1) sessions. For the text messages, 54% never responded, 30% responded to 1–20, and 16% responded to 21 or more messages. At baseline and follow up respectively, 7 and 9 participants were excluded from the physical activity analysis for not meeting criteria for valid wear days. Mean (SD) number of valid wear days was 4.89 (1.80) days at baseline and 4.27 (1.65) at follow up.

3.3. Intervention acceptability

Twenty-four intervention group participants responded to questions about intervention acceptability. The majority preferred both phone and in-person contacts equally (66%) or phone contacts only (21%) with their community health worker. The majority also set goals related to nutrition, physical activity or weight (92%); felt they met all (58%) or some (29%) of their goals; and felt the program was very helpful in setting goals (83%). The majority thought the number of phone calls from their community health worker and text messages was just right (92% and 83%, respectively). None indicated there were too many calls or texts. Lastly, the majority indicated they would be very (79%) or somewhat likely (8%) to participate again and very (75%) or somewhat

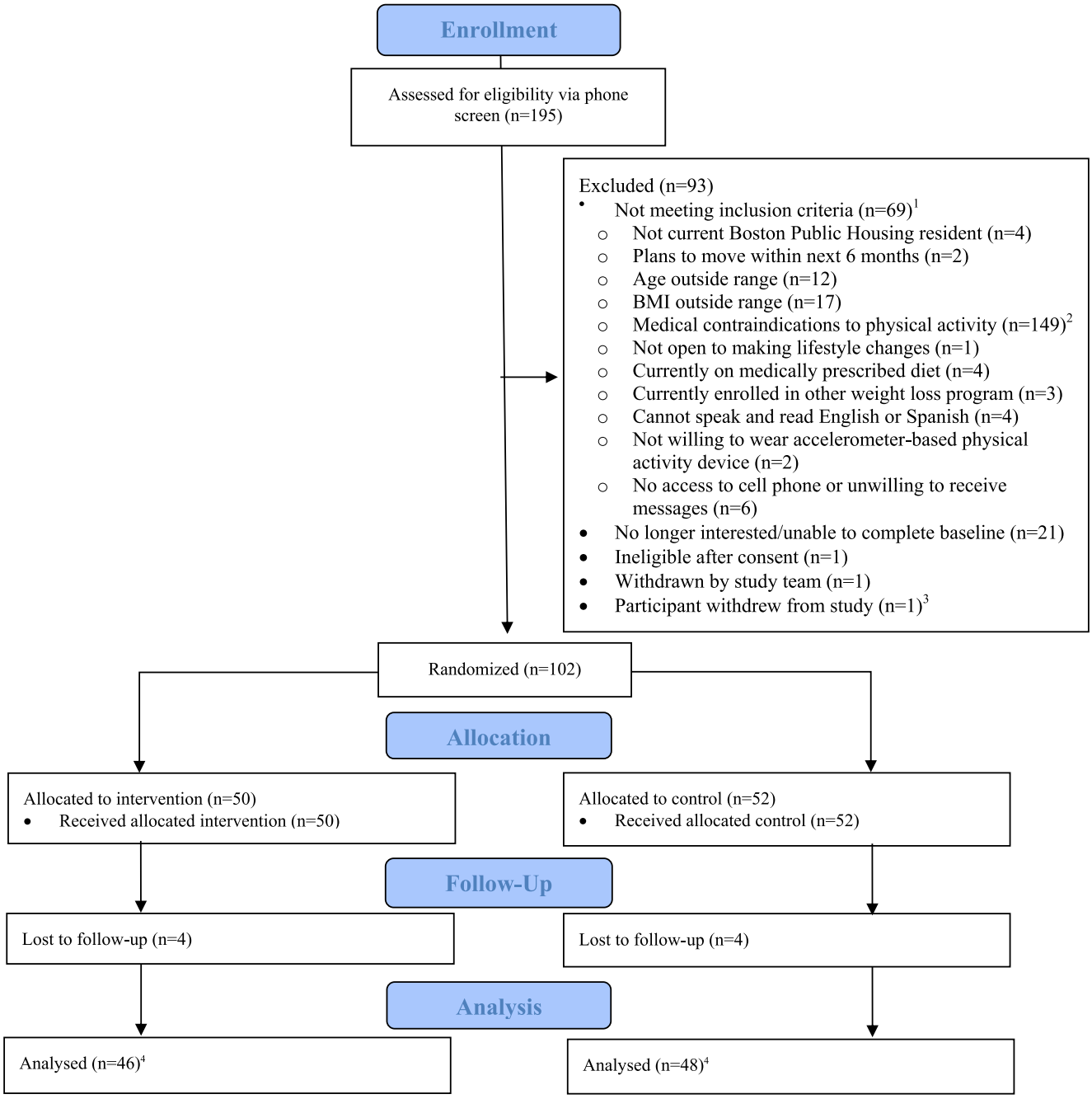

Fig. 1. Consort Diagram, Behavioral Nutrition and Physical Activity Weight Management Intervention among Urban Public Housing Residents, 2016–2018, Boston Massachusetts. [1]Assessed participants could be excluded for not meeting multiple criteria. Therefore, the cumulative frequency of all listed criteria will exceed the total number of individuals deemed ineligible after screening. [2]Number of yes responses to each medical contraindication. [3]A protocol violation occurred in which, although assigned to a randomized group, this participant was dropped from the study before any study activities were introduced to them. [4]46 Intervention group participants and 48 control group participants with either weight, accelerometer-based physical activity device, or survey follow up. Final n for analysis of outcomes varies by outcome and is indicated in Table 3.

likely (8%) to recommend the program to others.

3.4. Preliminary efficacy

Change in behavioral and psychosocial variables are presented in Table 3. At 3-month follow-up, adjusted linear regression models showed beneficial changes in weight (−0.94 kg), moderate-to-vigorous physical activity (+11.7 min/day), and fruits and vegetables (+2.3 servings/day) in the intervention vs. control group. Intake of sugar sweetened beverages increased in the intervention compared to the control group (+12.1 fl oz). Furthermore, there were beneficial changes in each of our psychosocial variables of self-efficacy, social support, and autonomous motivation in the intervention vs. control group.

4. Discussion

This community health worker-delivered behavioral counseling intervention for weight management among public housing residents was found to be feasible and showed preliminary efficacy for beneficial, but mostly not statistically significant, changes in weight, diet, and physical activity behaviors when compared to a control group. Acceptability of the intervention program was high, with the majority of

Table 2
Socio-Demographic Characteristics at Baseline among the Intervention and Control Groups, 2016–2018, Boston Massachusetts.

	Overall n = 102 n (%)	Intervention n = 50 n (%)	Control n = 52 n (%)	p-value
Hispanic ethnicity	68 (66.7)	29 (58.0)	39 (75.0)	0.07
Race				
Black or African American	20 (19.6)	8 (16.0)	12 (23.1)	0.37
White	18 (17.6)	13 (26.0)	5 (9.6)	0.03*
Other	65 (63.7)	30 (60.0)	35 (67.3)	0.44
Female gender	90 (88.2)	43 (86.0)	47 (90.4)	0.49
Marital status				0.79
Married/member of unmarried couple	30 (29.4)	13 (26.0)	17 (32.7)	
Divorced/widowed/separated	22 (21.6)	27 (54.0)	12 (92.4)	
Single, never been married	50 (49.0)		23 (44.2)	
Education				0.57
< high school	25 (24.7)	14 (28.6)	11 (21.2)	
High school graduate/GED	38 (37.6)	19 (38.8)	19 (36.5)	
Some college/trade or technical school	19 (18.8)	10 (20.4)	9 (17.3)	
College graduate/professional training	19 (18.8)	6 (12.2)	13 (25.0)	
Tobacco usage				0.03*
Never used tobacco products	71 (69.6)	32 (64.0)	39 (75.0)	
Have used tobacco in the past	15 (14.7)	12 (24.0)	3 (5.8)	
Currently use tobacco	16 (15.7)	6 (12.0)	10 (19.2)	
Number of children < age 18				0.22
0	20 (19.8)	13 (26.0)	7 (13.7)	
1	16 (15.8)	6 (12.0)	10 (19.6)	
2+	65 (64.3)	31 (62.0)	34 (66.6)	
Uses SNAP benefits[a]	68 (66.7)	33 (66.0)	35 (67.3)	0.89
Works for pay	35 (34.3)	15 (30.0)	20 (38.5)	0.37
BMI category				0.09*
Overweight (25.0–29.9)	39 (38.2)	15 (30.0)	24 (46.2)	
Obese (30.0 +)	63 (61.8)	35 (70.0)	28 (53.8)	

[a]SNAP = Supplemental Nutrition Assistance Program, formerly referred to as 'Food Stamps'.
*Statistically significant at the $p < 0.1$ level.

participants who responded to the acceptability questions indicating they liked the way the intervention was delivered and would recommend participating again for themselves and for others. The program also received high ratings for helping participants set health goals, indicating that the CuesWeight tool may have been effective in not only training the lay health workers but also assisting with their implementation of the intervention.

To our knowledge, among health behavior intervention trials conducted with public housing residents, one focused on weight management and a few others focused on diet or physical activity. Two of these trials emphasized multi- or environmental-level components: the Live Well, Viva Bien (Gans et al., 2018) trial which focused on fruit and vegetable consumption and the Healthy Families trial (Bowen et al., 2018) which focused on weight. Both of these 12-month trials demonstrated significant changes in their primary outcomes and the importance of changing the housing landscape to encourage healthful behaviors. A third trial, Pathway to Health (Ahluwalia et al., 2007), also demonstrated positive outcomes on fruit and vegetable intake through multiple components including the use of motivational interviewing conducted by master's level staff members. A fourth study, a one group feasibility trial, trained peer educators in public housing to deliver a social network-based intervention targeting sugary drink reduction (Gudzune et al., 2020). Taken together, these trials lend important contributions to establishing the feasibility and potential effectiveness of health behavior interventions among public housing residents, but they did not incorporate motivational interviewing behavioral counseling delivered by community health workers nor technology components. Technology components, such as the website used to encourage systematic delivery of motivational interviewing counseling or the text messages for self-monitoring, has the potential to increase the reach of individual-level interventions delivered by community health workers within public housing communities. This may serve to enhance the ability of community health workers to translate individual-level weight management strategies for population-level change. Given positive research findings regarding environmental-level change in public housing developments, multi-level interventions are also advised within these communities. By incorporating a comprehensive technology-based behavior change system guided by the Social Contextual Model, there is the potential to test our intervention with environmental strategies, which could inform future multi-level intervention research (Hall et al., 2018).

While completed intervention counseling calls fell short of our target of 12 over 3 months, we were able to achieve approximately 1 completed call per month on average. This is similar to other efficacious weight management trials among health disparity-facing populations, in which meeting counseling call goals monthly is the target (Bennett et al., 2013). Second, the text messaging component served as a self-monitoring tool, with data collected populated and displayed on CuesWeight for use by the community health worker during counseling sessions. No feedback or other types of educational or psychosocial components were incorporated into the texting program. Improvements to the texting system to transform it into a stand-alone behavioral intervention, with and without human community health workers (Azar et al., 2018), for weight management among public housing residents could be examined in future studies. This could shed light on whether the benefits of community health workers, given the added time and cost, provide a behavioral change benefit over and above a comprehensive stand-alone texting program among a public housing resident population with multiple comorbidities.

This feasibility trial had several limitations that should be considered. First, some secondary variables were not collected among the full set of participants, resulting in smaller sample sizes and potential selection bias. For example, our questions on intervention acceptability should be interpreted with caution as it is possible that the half of intervention group participants who responded were predisposed to liking the program compared to those who did not respond. Also, our findings for some variables (*i.e.,* sugar sweetened beverages and psychosocial outcomes) are based on small sample sizes at follow up and therefore these results should be interpreted with caution. Second, our 1:1 randomization scheme may have resulted in contamination if neighbors or friends were randomized to different groups and shared information. While we do not have direct evidence of this occurring, we will measure this phenomenon more carefully in future studies. Future studies may consider cluster randomization (with the public housing development as the unit of randomization) or assessing if participants speak to other development residents about the intervention to minimize this bias. We also attempted to take as many participants as possible to more closely approximate the real-world co-morbidities prevalent in public housing residents. However, to ensure the safety of our participants we did exclude a higher than expected number of

Table 3
Baseline, Follow-up and Mean Change in Primary, Secondary, and Psychosocial Outcomes among Followed Sample, 2016–2018, Boston Massachusetts.

	Baseline[a] Mean (SD)		3- Month Follow-Up[a] Mean (SD)		Treatment Effect	
	Intervention	Control	Intervention	Control	Adjusted Beta Estimate[b]	p-value
Primary & Secondary Outcomes						
Weight, kilograms	91.11 (21.42) n = 44	80.63 (13.69) n = 46	90.68 (21.37) n = 44	80.54 (13.56) n = 46	−0.94	0.31
Fruit & vegetable, servings/day[c]	1.30 (1.05) n = 24	2.28 (1.28) n = 28	3.36 (2.26) n = 24	2.18 (1.51) n = 28	2.30	<0.0001*
Primescreen composite score[d]	54.25 (9.06) n = 24	56.96 (13.57) n = 28	67.27 (9.82) n = 24	61.65 (11.53) n = 28	8.32	0.03*
Sugar sweetened beverages, fl oz/day	11.33 (11.48) n = 15	22.41 (22.53) n = 16	14.59 (19.53) n = 15	15.39 (16.92) n = 16	12.13	0.13
Sedentary physical activity, min/day[e]	265.2 (60.8) n = 40	253.8 (52.5) n = 39	271.7 (66.1) n = 40	266.2 (62.9) n = 39	−16.3	0.19
Light physical activity, min/day[e]	131.5 (31.5) n = 40	132.6 (35.6) n = 39	129.9 (34.6) n = 40	132.6 (35.6) n = 39	4.6	0.52
Moderate physical activity, min/day[e]	81.8 (40.5) n = 40	90.0 (37.0) n = 39	77.0 (39.9) n = 40	80.0 (36.9) n = 39	10.9	0.17
Vigorous physical activity, min/day[e]	1.6 (1.9) n = 40	1.5 (1.5) n = 39	1.9 (3.2) n = 40	1.1 (1.2) n = 39	0.9	0.09
Moderate-to-vigorous physical activity, min/day[e]	83.4 (41.7) n = 40	91.4 (37.4) n = 39	79.4 (40.9) n = 40	81.2 (37.5) n = 39	11.7	0.14
# of moderate-to-vigorous physical activity bouts per day[e]	4 (2) n = 35	4 (2) n = 38	3 (2) n = 35	3 (2) n = 38	0.4	0.37
Psychosocial Outcomes						
Physical activity self-efficacy[f]	3.61 (1.22) n = 14	4.21 (0.88) n = 15	4.06 (1.05) n = 14	3.18 (1.36) n = 15	1.70	0.002*
Fruit & vegetable self-efficacy[f]	2.12 (0.75) n = 24	2.71 (0.72) n = 28	3.15 (0.67) n = 24	2.50 (0.76) n = 28	1.39	<0.0001*
Social support[g]	3.28 (1.35) n = 14	3.55 (1.32) n = 15	3.96 (1.27) n = 14	2.94 (1.18) n = 15	1.36	0.01*
Autonomous motivation[h]	6.76 (0.36) n = 14	6.66 (0.83) n = 15	6.77 (0.55) n = 14	5.97 (1.04) n = 15	0.68	0.03*

[a]Baseline and follow-up means are direct means of baseline and follow-up timepoints, by randomization.
[b]Beta Estimates are from multiple linear regression, adjusted for race, BMI, and tobacco use. Beta estimates describe the mean change in outcome, from baseline to 3 months, in the treatment group beyond any change in the control group.
[c]Due to an error, one question (*i.e.,* other vegetables) that comprises the fruit and vegetable servings estimate was not administered. Therefore, analyses represent the mean of 5 (instead of 6) questions.
[d]A composite diet score was calculated, with a score from 0 (worst) to 100 (best) assigned for intake from each of 5 food categories and then averaged (Delichatsios et al., 2001); the 5 food categories were: fruits and vegetables, whole grains, red and processed meats, whole fat dairy foods, and high calorie foods.
[e]Accelerometer-based physical activity data are normalized to an 8 h day; bouts of ≥ 10 min.
[f]Self-efficacy was measured on a scale of 1 (low self-efficacy) to 5 (high self-efficacy).
[g]Social support was measured on a scale of 1 (low social support) to 5 (high social support).
[h]Autonomous motivation was measured on a scale of 1 (low motivation) to 7 (high motivation).
*Statistically significant at the $p < 0.05$ level.

participants due to their contraindications for physical activity, which may limit some of the generalizability of our findings. Our feasibility study design does benefit from an intervention informed by formative qualitative research (Wells et al., 2019), a randomized design with a control group, a three-month longitudinal design, and objective assessment of weight and physical activity.

In conclusion, our findings demonstrated a behavioral counseling intervention for weight management delivered by trained community health workers conducted among public housing residents was feasible and resulted in beneficial, although primarily not statistically significant, changes in weight, diet, and physical activity. Future work should replicate and extend these findings to a larger sample with a longer follow up time period and less frequent telephone counseling sessions (e.g., monthly vs. weekly) while examining the utility of more comprehensive technology-based programs and consider multi-level approaches to behavior change.

CRediT authorship contribution statement

Lisa M. Quintiliani: Conceptualization, Methodology, Writing - original draft, Supervision, Funding acquisition. **Jessica A. Whiteley:** Conceptualization, Methodology, Writing - review & editing, Supervision. **Jennifer Murillo:** Investigation, Writing - review & editing. **Ramona Lara:** Investigation, Writing - review & editing. **Cheryl Jean::** Investigation, Writing - review & editing. **Emily K. Quinn::** Formal analysis, Writing - review & editing. **John Kane::** Methodology, Writing - review & editing. **Scott E. Crouter:** Methodology, Formal analysis, Writing - review & editing. **Timothy C. Heeren:** Formal analysis, Writing - review & editing. **Deborah J. Bowen:** Conceptualization, Methodology, Writing - review & editing.

Acknowledgement

Funding Sources: This study was funded by the American Heart Association [grant number 14SDG20050015].

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