Social Network Intervention Reduces Added Sugar Intake Among Baltimore Public Housing Residents: A Feasibility Study

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ABSTRACT: Public housing residents have high intake of added sugars, which is associated with sugar-sweetened beverage (SSB) consumption in their social networks. In this feasibility study, we designed and tested a network-oriented intervention to decrease added sugar intake by encouraging reduced SSB consumption. We conducted a 6-month single-arm trial testing a small-group curriculum (9 sessions) that combined behavior change strategies to reduce added sugar intake by promoting SSB reduction with a peer outreach approach. We recruited and trained public housing residents to be "Peer Educators," who then communicated information and made changes to reduce SSB with their network members. We calculated the median number of group sessions attended and determined the percentage of individuals satisfied with the program. We estimated added sugar intake using a 5-factor dietary screener and compared baseline and 6-month median values using Wilcoxon signed rank tests. We recruited 17 residents and 17 of their network members (n = 34). Mean age was 45.7 years, 79.4% were women, and 97.1% were African American. Median number of sessions attended was 9 (interquartile range: 4-9), and 88.2% were very satisfied with the program. Overall, baseline median added sugar intake was 38.0 tsp/day, which significantly declined to 17.2 tsp/day at 6 months ($P < .001$). Residents and network members achieved similar results at 6 months (17.4 vs 16.9 tsp/day, respectively). In conclusion, our results demonstrate that a social network intervention aimed at reducing SSB consumption is feasible and can produce significant decreases in adult added sugar intake, which warrants further investigation in a randomized controlled trial.

KEYWORDS: Dietary sugars, African American, overweight, social support

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Introduction

Both African American and low-income populations typically have higher intakes of added sugars relative to white and economically advantaged groups.[1] Public housing residents are a low-income group—approximately 1.1 million US households[2]—and recent analyses have demonstrated that minorities are overrepresented in this population—45% are African American.[3] Public housing residents' diets often do not meet recommendations for limitations on added sugar.[4,5] The American Heart Association (AHA) recommends that adults limit their added sugar intake to 6 to 9 teaspoons (tsp) per day.[6] In one study, the median added sugar intake among predominantly African American public housing residents in Baltimore, Maryland, was over 21 teaspoons per day.[5] A survey of public housing residents in Montgomery County, Maryland, reported 58% drank at least 1 sugar-sweetened beverage (SSB) daily.[4]

Health disparities have been previously documented for public housing residents.[7,8] For example, obesity is pervasive among adults living in public housing, where the prevalence is over 50%[7] relative to a third of US adults during a similar period.[9] During the "Moving to Opportunities" (MTO) project, public housing residents were randomized to receive a voucher to move to a higher income neighborhood. The MTO 10-year outcomes suggested that residents randomized to receive this voucher had reduced prevalence of class II/III obesity and type 2 diabetes mellitus as compared with residents without this opportunity.[7]

These results suggest that living in low-income neighborhoods confers an increased risk of chronic disease to public housing residents. The mechanisms contributing to this risk are likely multifactorial; however, social networks—the connections among people within a community—might have a role.

An ecologic framework hypothesizes that the environment—including social networks—may influence diet and weight status.[10] An individual's social networks may modify dietary behaviors through social influence, such as social norms and behavior modeling.[11] The AHA deemed social networks to be potentially powerful interventions and has encouraged networks research focused on cardiovascular disease.[12] Prior research suggests a link between social networks and obesity.[13] Some studies have examined diet and social networks—Dietary intake is correlated among family members (Feunekes, 1998).[14,15,36] In our prior research among African American public housing residents, residents suggested that networks of family and neighbors could support behavior changes to improve diet.[15] We also found a significant relationship between residents' added sugar intake and exposure to SSB consumption within their social network.[5]

Given our prior results, we designed and tested a social network–oriented behavior change intervention to decrease added sugar intake among overweight, adult public housing residents by encouraging reduced SSB consumption in a feasibility study. We hypothesized that a social network intervention would be feasible and decrease added sugar intake. A comprehensive framing of feasibility has identified 8 areas of focus for feasibility studies.[16] Considering this framework, our feasibility outcomes included acceptability, implementation, and limited-efficacy testing on added sugar intake using a previously validated assessment. Secondarily, we also explored whether (1) participants changed their intake of specific food items high in added sugar, and (2) the intervention decreased perceived SSB intake among public housing residents' social network members broadly.

Methods

Study design

We conducted a 6-month nonrandomized trial of a network-oriented intervention to reduce SSB consumption—Sugar Champ—in 2 public housing developments in Baltimore, Maryland (NCT02138240). We considered SSBs to include both regular soda that included sugar and fruit-flavored drinks with added sugar (ie, sports drinks, Tampico, Sunny D, Kool-Aid, Hi-C, cranberry cocktail, Twister). As this was a feasibility study, we elected a single-arm design given preliminary nature of the work. The Johns Hopkins School of Medicine Institutional Review Board approved all study protocols.

Intervention development

Recent meta-analyses found that interventions to reduce SSB consumption produced significant decreases among children and adolescents, but no significant effects among adults.[17] Interventions that aim to reduce adult SSB consumption may therefore need to employ additional methods beyond individual-level behavior change strategies. A meta-analysis found that social network interventions promote and sustain behavior change,[18] and network interventions may be an efficient strategy as intervening on one individual might produce behavior change among a group.[19] In addition, our prior research supported a high added sugar intake among public housing residents, as well as demonstrated significant associations between added sugar intake and consumption of high added sugar foods (ie, SSB and sweets) among social network members.[5,15] Supplemental Figure 1 displays a timeline of intervention development activities.

We created a preliminary version of a small-group curriculum by combining (1) behavior change techniques to reduce added sugar intake with (2) a theory-based peer outreach approach to engage the social network. To promote reduction in added sugars, we used behavior change techniques employed by the Diabetes Prevention Program (DPP) and adapted DPP modules for the Sugar Champ curriculum. The DPP's key features include a goal-based behavioral intervention delivered by lifestyle coaches,[20] and uses behavioral techniques including goal setting, problem-solving, self-monitoring, and social support. Sugar Champ content included self-monitoring of added sugar by tracking total intake daily, devising strategies to reduce added sugar intake, as well as understanding food cues and strategies to stay motivated to limit added sugar intake.

To promote peer outreach, we modified a theory-based network intervention to prevent HIV—Self-Help in Eliminating Life-Threatening Diseases (SHIELD).[21,22] The SHIELD intervention is based on social cognitive theory, social identity theory, cognitive dissonance theory, and social influence theory. In brief, SHIELD trained individuals at high risk for HIV to be "Peer Educators" who shared information and risk reduction strategies with other individuals in their social network also at high risk for HIV. As a Peer Educator, participants learned risk reduction information and skills. They also learned communication skills to prepare them for peer outreach. While peer outreach is often done with the community at-large or with strangers, the peer outreach in the SHIELD program was focused on people in their social network—the group of people who the Peer Educator knows well or feels very comfortable with, such as drug or sex partners, family, friends, and support group members. Peer Educators were trained in a small-group setting where structured intervention sessions focus on communication and risk reduction, and every session includes training activities such as role-play and problem-solving. The SHIELD approach is effective at increasing safe sex practices and decreasing high HIV-risk drug behaviors.[21] In Sugar Champ, we similarly trained public housing residents as Peer Educators by applying the same principles and strategies used in SHIELD. Our content included describing the health risks associated with diets high in added sugar intake, training on communication skills through education and role-play, and

problem-solving. All sessions included a focus on developing Peer Educator communication and counseling skills, which then Peer Educators used with their social network members.

Next, we conducted a series of 3 focus groups with public housing residents from 2 communities to understand demand for and acceptability of the curriculum to reduce added sugar intake. Demand determines the extent that the intervention is likely to be used, and acceptability determines to what extent the intervention is suitable to participants.[16] The first group presented the results of our cross-sectional survey and assessed demand for a program to reduce added sugars in the community. In the subsequent 2 groups, residents were tasked with implementing a specific aspect of the intervention in between groups (eg, calculating their added sugar intake each day) and returned the following week to share the acceptability of their experience and provide suggestions for improvement. In the third group, we also obtained feedback regarding information that might increase demand for the program. A detailed description of the focus group methods is in Supplemental Materials 1 and moderator guides are in Supplemental Materials 2. Based on these groups, we revised the proposed Sugar Champ intervention in several ways. First, residents had difficulty attempting to track total added sugar intake daily. They recommended focusing just on reducing SSB, which they identified as a primary source of added sugars in their community. The numeracy and mathematic skills required to track added sugars presented a particular challenge for many residents, so we developed a simplified method to track SSB intake that relied on circling pictograms (Supplemental Materials 3). Second, many residents had less knowledge about the health risks of added sugars relative to other nutrients such as sodium, and residents were unsure whether reducing added sugar intake should be a priority for the community based on information regarding health risks alone. We shared information regarding the evidence of how advertising practices have targeted their communities with unhealthy foods.[23,24] Residents felt that this information was key to share during the intervention, as it created a sense of priority and empowerment for them to reduce added sugar intake.

The final Sugar Champ curriculum included a total of 9 group sessions (60-90 minutes)—6 core sessions delivered weekly for 6 weeks, then 3 booster sessions delivered every other week for an additional 6 weeks (total intervention duration 3 months). Table 1 describes the learning objectives, and lists the module origin and behavior change techniques employed based on a previously described taxonomy.[25] Peer Educators received a $300 gift card to compensate them for their time in training. A master's-level interventionist was trained to deliver this curriculum to Peer Educators. Our Peer Educators communicated information and shared skills learned during the group sessions with their social network members. Peer Educators were encouraged to share information and skills with their network members, although 1 specific network member participated in the study with them (termed as their "Sidekick"). Peer Educators and their Sidekicks worked to reduce SSB together. Sidekicks received no information or training from the research team—Any intervention content they received was from their Peer Educator. Sidekicks only interacted with the study team during recruitment and data collection.

Recruitment, eligibility criteria, and data collection

We recruited public housing residents to become Peer Educators by mailing invitations to all residences in 2 public housing developments in Baltimore, Maryland. We followed up these mailings with door-knocking attempts. We then screened potential participants for eligibility. The study took place between March and September 2017.

To be eligible, we required that potential Peer Educators live in 1 of the 2 public housing developments, be at least 18 years old, and be English-speaking, consume SSB at least twice a day. Given the excess burden of overweight/obesity among public housing residents and the health consequences of this condition, we required Peer Educators to have a body mass index (BMI) in the overweight range ($\geq$25 kg/m^2). In addition, Peer Educators had to recruit one of their social network members to participate in the study as their Sidekick; they had to have in-person contact with the Sidekick at least once during the past month. Potential Peer Educators were given an informational letter to share with potential Sidekicks, which directed the Sidekick to call the research team to determine their eligibility. Eligibility criteria for Sidekicks were age $\geq$ 18 years, English-speaking, and consume SSB at least twice a day. We did not require Sidekicks to live in public housing, as we found that residents' networks often extend outside their neighborhood in our prior studies in this population.[5] We excluded individuals who had health conditions for which dietary change or weight loss is contraindicated, such as pregnancy, recent myocardial infarction, or cancer.

We collected data from Peer Educators and Sidekicks during visits to the Peer Educators' homes at baseline and 6 months, and all participants received a $50 gift card as compensation for data collection at these time points. We used software to facilitate data collection (EgoNet, MDLogix).

Primary outcomes

Our primary outcomes included acceptability, implementation, and limited-efficacy testing of the Sugar Champ intervention based on previously defined elements of a comprehensive framing of feasibility.[16]

Acceptability determines to what extent the intervention is suitable to participants[16] and can include assessments of satisfaction and intention to refer others. We assessed these elements at 6 months. We asked all participants "Overall, how satisfied were you with the Sugar Champ program?" (very satisfied, somewhat satisfied, somewhat dissatisfied, very dissatisfied) and "How

Table 1. Overview of Sugar Champ modules, their learning objectives, and behavior change techniques employed.

SESSION	OBJECTIVES	CONTENT SOURCE AND BEHAVIOR CHANGE TECHNIQUES
Core sessions		
Let's talk about sugar	1. Explain the purpose of the Sugar Champ Program 2. Establish group cohesion and expectations 3. Define "added sugars" and identify foods/drinks high in added sugars 4. Become aware of how food science may influence their food intake and how predatory marketing has targeted their communities with unhealthy foods 5. Learn how to track their intake of sugary beverages	DPP • Provide information about behavior-health link • Model/demonstrate a behavior • Prompt practice • Prompt specific goal setting
PEER communication	1. Define the Peer Educator role. 2. Introduce PEER Communication skills. • *Pick the right place & time* • *Evaluate the situation* • *Explore better options* • *Resources* 3. Practice the PEER skills learned with role-play. 4. Apply the PEER skills to communicate information about added sugars.	SHIELD • Prompt practice • Prompt identification as role model
Sugar tracker to teacher	1. Provide support and positive reinforcement for Peer Educator role and personal change. 2. Apply PEER Communication skills to spread tracking of sugary beverages throughout their network.	SHIELD • Prompt self-monitoring of behavior • Provide feedback on performance • Prompt practice • Provide opportunities for social comparison • Prompt specific goal setting • Prompt barrier identification
Sugary drinks are going down	1. Provide support and positive reinforcement for Peer Educator role and personal change. 2. Learn methods to decrease sugary beverage consumption.	SHIELD + DPP • Prompt self-monitoring of behavior • Provide feedback on performance • Provide instruction • Prompt specific goal setting • Prompt barrier identification
Everybody get low	1. Provide support and positive reinforcement for Peer Educator role and personal change 2. Apply PEER Skills to teach others how to decrease the number of sugary beverages consumed throughout their network.	SHIELD • Prompt self-monitoring of behavior • Provide feedback on performance • Prompt specific goal setting • Prompt barrier identification
Goals & moving forward	1. Provide support and positive reinforcement for Peer Educator role and personal goal setting 2. Discuss cues—food and social cues—and how they affect behavior change	SHIELD + DPP • Prompt self-monitoring of behavior • Provide feedback on performance • Prompt specific goal setting • Plan social support/ social change
Booster sessions		
Staying motivated	1. Provide support and motivation for sustainability of Peer Educator role 2. Problem-solve barriers to sustainability for individual behavior change and Peer Educator outreach 3. Learn tips to stay motivated	SHIELD + DPP • Prompt self-monitoring of behavior • Provide feedback on performance • Prompt specific goal setting • Prompt barrier identification • Relapse prevention
The slippery slope	1. Provide support and motivation for sustainability of Peer Educator role 2. Problem-solve barriers to sustainability for individual behavior change and Peer Educator outreach 3. Learn about the slippery slope of behavior change	SHIELD + DPP • Prompt self-monitoring of behavior • Provide feedback on performance • Prompt specific goal setting • Prompt barrier identification • Relapse prevention
Graduation	1. Provide support and motivation for sustainability of Peer Educator role 2. Problem-solve barriers to sustainability for individual behavior change and Peer Educator outreach	SHIELD + DPP • Prompt self-monitoring of behavior • Provide feedback on performance • Prompt specific goal setting • Prompt barrier identification

Abbreviations: DPP, Diabetes Prevention Program; SHIELD, Self-Help in Eliminating Life-Threatening Diseases intervention.

likely would you be to recommend to a friend that they participate in the Sugar Champ program?" (very likely, somewhat likely, somewhat unlikely, very unlikely). Among Peer Educators, we asked "How satisfied were you with the training that you received as a Sugar Champ Peer Educator?" (very satisfied, somewhat satisfied, somewhat dissatisfied, very dissatisfied).

Implementation determines the extent that the intervention can be successfully delivered to participants[16] and can include degree of execution. We examined Peer Educator attendance at group sessions, the percentage of Peer Educators attending at least 6 of the 9 group sessions, and study retention for 6-month data collection among all participants. We also assessed self-reported participation in intervention activities outside the group sessions. At 6 months, we asked "During the 3-month Sugar Champ Program, how often did you and your Sidekick/Peer Educator discuss or work on activities from the program?" and "Since completing the 3-month Sugar Champ Program, how often did you and your Sidekick/Peer Educator discuss or work on activities you learned from the program?"

Limited efficacy determines whether the intervention shows promise of being successful,[16] for which we focused on added sugar intake. We collected information on dietary intake by having respondents complete the National Health Interview Survey (NHIS) 5-factor dietary screener[26] at baseline and 6 months. We used this information to estimate median added sugar (tsp/day) by using standard methods that combine reported intakes of regular sodas, fruit-flavored drinks, pastries, and desserts to create variance-adjusted estimates recommended by NHIS. We also used information from the NHIS 5-factor dietary screener to estimate median fruit & vegetable intake excluding fried potatoes (servings/day) as a control outcome (ie, outcome where we did not expect change). Of note, NHIS recommends that dietary estimates from their 5-factor screened be calculated as medians and interquartile ranges (IQR).

Secondary outcomes

We also examined change in intake of food items high in added sugars: (1) regular soda ("During the past month, how often did you drink regular, carbonated soda or soft-drinks that contain sugar?"); (2) fruit-flavored drinks with added sugar ("How often did you drink fruit-flavored drinks with sugar?"); (3) pastries ("During the past month, how often did you eat doughnuts, sweet rolls, Danish, muffins, or pop-tarts?"); and (4) desserts ("How often did you eat cookies, cake, pie, or brownies?"). For each of these food types, we categorized as "never" if response was never, "monthly" if 1 to 3 times last month, 'weekly' if 1 to 2 times/3 to 4 times/5 to 6 times per week, or "daily" if 1/2/3/4/5 or more times per day.

Given that Peer Educators were encouraged to share Sugar Champ information and skills with other network members beyond their Sidekick, we also examined their perceived SSB intake among their social network members broadly at baseline and 6 months using a methodology we have employed previously.[5] Participants completed an egocentric social network inventory where they generated a list of 15 people with whom they had contact with in the past year, which obtains a diverse group in terms of relationships and interactions. We then ascertained behaviors of these individuals as perceived by the participant. Participants were asked how often each person drank (1) regular soda with sugar and (2) fruit-flavored drinks, sports or energy drinks with added sugar (daily, weekly, monthly, yearly/never), which we dichotomized as "daily" versus "not daily." We then calculated the proportion of their network members whom they perceived consuming (1) soda daily and (2) fruit-flavored drinks daily.

Other baseline measures

We collected other information including demographics (age, gender, race), socioeconomic factors (educational attainment, employment status, food insecurity[27]), and health status (self-reported medical history, depressive symptoms[28]). We calculated BMI from measured height and weight. We determined other lifestyle habits including smoking status, physical activity,[29] and cognitive restraint for eating.[30]

Analyses

We conducted descriptive analyses of all variables. We compared baseline characteristics between Peer Educators and Sidekicks using t tests, χ^2 tests, or Mann–Whitney tests, as appropriate.

For our feasibility outcomes, we determined the percentage of individuals that endorsed varying levels of satisfaction with Sugar Champ, self-reported participation levels, and number retained for data collection at 6 months. Among Peer Educators, we calculated the median number of group sessions attended and percentage that attended at least 6 group sessions. Finally, we compared the median added sugar intake at baseline and 6 months using Wilcoxon signed rank sum tests. We also used Mann–Whitney tests to compare added sugar intake between Peer Educators and Sidekicks at each time point.

We examined direction and magnitude of change for the frequency of regular soda, fruit-flavored beverage, pastries, and desserts intake by each individual participant. We also compared baseline and 6-month network exposure to daily regular soda and daily fruit-flavored beverage intake using t tests.

Results

We recruited 17 public housing residents to be Peer Educators along with 17 of their network members as Sidekicks. Overall, mean age was 45.7 years (SD = 12.0), 79.4% were women, 97.1% were African American, and mean BMI was 32.1 kg/m^2 (SD = 6.7). While we do not have access to demographic

information of nonresponding households, our sample characteristics are similar for other studies of public housing residents in Baltimore City (Supplemental Table 1). There were no statistically significant differences between Peer Educators and Sidekicks at baseline (Table 2). We note that these two groups had similar demographics and health status indicators; however, food insecurity and being a current smoker was more common among Peer Educators than Sidekicks (Table 2).

Primary outcomes—acceptability, implementation, and limited efficacy to reduce added sugar intake

Table 3 displays the 6-month feasibility outcomes of acceptability and implementation. Regarding acceptability, most participants were "very satisfied" with the program (88.2%) and were "very likely" to recommend the program to a friend (91.2%). The majority of Peer Educators were "very satisfied" with the training that they received. In regard to implementation, attendance at the group sessions was high among Peer Educators (9 total sessions in Sugar Champ), and the majority of Peer Educators met our participation threshold of attending 6 or more group sessions. All participants were retained for follow-up data collection. Individuals reported participating in Sugar Champ activities outside the group sessions both during and after the program ended.

Figure 1 displays the change in dietary intakes. Overall, baseline median added sugar intake was 38.0 tsp/day (IQR: 28.3-47.5) and median added sugar intake declined to 17.2 tsp/day at 6 months (IQR: 11.2-27.8) ($P < 0.001$). Baseline median added sugar intake was higher among Peer Educators than Sidekicks, 42.4 versus 37.0 tsp/day, respectively ($P = 0.62$). There were no significant differences between groups in median added sugar intake at 6 months, Peer Educator 17.4 versus Sidekick 16.9 tsp/day ($P = 0.84$). As expected, there was no significant change in fruit & vegetable intake (Figure 1).

Secondary outcomes

Overall, 64.7% reported drinking daily regular soda and 50.0% fruit-flavored drinks (Table 2). Daily intake of other foods high in added sugar was also common—35.3% consumed pastries daily and 38.2% consumed desserts daily. Sidekicks had a relatively lower intake of fruit-flavored drinks than Peer Educators at baseline, and relatively higher intakes of pastries and deserts (Table 2). Table 4 presents the changes in regular soda, fruit-flavored drinks, pastries, and desserts by each individual participant. Over half of all participants had a reduction in their regular soda intake, and interestingly, 12 out of 17 Sidekicks decreased soda intake at 6 months. Fewer participants reduced fruit-flavored drinks. The Sugar Champ intervention did not specifically focus on limiting other foods high in added sugars, and fewer participants reduced intake of these foods (ie, pastries and desserts) (Table 4).

On average, daily intake of regular soda was perceived to be common among participants' social network members (44.9%, SD = 30.9%), which was not significantly different between Peer Educators and Sidekicks (Table 2). The mean proportion of network members perceived to drink regular soda daily significantly decreased to 27.3% (SD = 29.1%) at 6 months ($P = 0.02$). The mean proportion of network members perceived to drink fruit-flavored beverages daily was 23.4% as baseline (SD = 22.2%), which remained unchanged at 6 months (22.0%, SD = 23.1%) ($P = 0.80$).

Discussion

In this feasibility study, we found that the Sugar Champ social network intervention was feasible with respect to acceptability, implementation, and produced a clinically meaningful and statistically significant decrease in added sugar intake at 6 months among adult public housing residents and their social network members. Most participants appear to have achieved this reduction by decreasing their regular soda intake, although some participants also reduced their intakes of fruit-flavored drinks, pastries, and desserts. While we could only directly estimate added sugar intake for Peer Educators and 1 of their social network members, participants perceived a significant decrease in the proportion of their other social network members who drank regular soda daily during the study period. These results may imply that the strategy employed by Sugar Champ intervention promoted reduction in SSB consumption throughout participants' networks. These preliminary results demonstrate promising acceptability, implementation, and efficacy.

Prior research has proposed a link between social networks and diet, although much of this evidence has been cross-sectional. For example, family members' dietary intakes are highly correlated (Feunekes, 1998).[14,15,36] In our own prior cross-sectional research among African American public housing residents in Baltimore, Maryland, we found a significant association between residents' added sugar intake and higher network exposure to daily SSB consumption.[5] These prior findings prompted the design of the Sugar Champ intervention. While prior network interventions have been developed to address behaviors such as HIV risk reduction and smoking cessation,[21,31] Sugar Champ is the first social network intervention to target dietary change—reduced SSB consumption.

In examining results by beverage type—regular soda or fruit-flavored drinks—participants reduced regular soda more often than fruit-flavored drinks. Prior research has found that fruit-flavored drinks have similar amounts of sugar as regular soda.[32] These findings prompted us to reexamine the Sugar Champ curriculum and all materials to determine whether we may have emphasized reduction in regular soda more than fruit-flavored drinks. In this review, we found that the beverages displayed in program images and described during role-play scenarios were more often soda than fruit-flavored drinks, which may have inadvertently emphasized soda. This

Table 2. Baseline characteristics of the overall sample and by intervention role among Baltimore public housing residents.

	TOTAL SAMPLE (n = 34)	PEER EDUCATORS (n = 17)	SIDEKICKS (n = 17)	*P* VALUE[a]
Demographics				
Mean age in years (SD)	45.7 (12.0)	46.6 (11.7)	44.7 (12.7)	0.65
Women	79.4%	82.4%	76.5%	0.67
African American	97.1%	100%	94.1%	0.31
Socioeconomic indicators				
Less than high school education	35.3%	29.4%	41.2%	0.47
Employment status				
Employed	41.2%	47.1%	35.3%	0.71
Disabled	29.4%	29.4%	29.4%	
Unemployed	29.4%	23.5%	35.3%	
Food insecure	61.8%	76.5%	47.1%	0.08
Health status[b]				
Hypertension	26.5%	29.4%	23.5%	0.70
Elevated blood sugar	5.9%	5.9%	5.9%	1.00
High cholesterol	20.6%	23.5%	17.7%	0.67
Depressive symptoms	27.3%	29.4%	25.0%	0.78
Mean BMI in kg/m^2 (SD)	32.1 (6.7)	33.7 (6.0)	30.6 (7.25)	0.17
Lifestyle habits[c]				
Current smoker	70.6%	82.4%	58.8%	0.13
Mean score cognitive restraint for eating (SD)	25.2 (19.6)	23.3 (18.0)	27.2 (21.5)	0.57
Physical activity level				
High	9.1%	6.3%	11.8%	0.96
Moderate	12.1%	12.5%	11.8%	
Low	42.4%	43.8%	41.2%	
Very low	36.4%	37.5%	35.3%	
Dietary habits and perceived dietary habits within the social network[d]				
Median fruit & vegetable intake in servings/day (IQR)	4.5 (3.0-5.8)	4.2 (2.9-6.3)	4.9 (3.0-5.4)	0.85
Median added sugar intake in tsp/day (IQR)	38.0 (28.3-47.5)	42.4 (18.4-57.6)	37.0 (30.8-41.1)	0.62
Frequency of regular soda				
Never	0%	0%	0%	0.73
Monthly	8.8%	11.8%	5.9%	
Weekly	26.5%	29.4%	23.5%	
Daily	64.7%	58.8%	70.6%	
Frequency of fruit-flavored drinks				
Never	11.8%	0%	23.5%	0.20

(Continued)

Table 2. (Continued)

	TOTAL SAMPLE (n = 34)	PEER EDUCATORS (n = 17)	SIDEKICKS (n = 17)	*P* VALUE[a]
Monthly	5.9%	5.9%	5.9%	
Weekly	32.4%	35.3%	29.4%	
Daily	50.0%	58.8%	41.2%	
Frequency of pastries				
Never	14.7%	5.9%	23.5%	0.08
Monthly	11.8%	11.8%	11.8%	
Weekly	38.2%	58.8%	17.7%	
Daily	35.3%	23.5%	47.1%	
Frequency of desserts				
Never	8.8%	5.9%	11.8%	0.12
Monthly	8.8%	17.7%	0%	
Weekly	44.1%	52.9%	35.3%	
Daily	38.2%	23.5%	52.9%	
Mean proportion of social network with daily soda intake (SD)	44.9% (30.9%)	42.3% (29.8%)	47.5% (32.7%)	0.63
Mean proportion of social network with daily fruit-flavored drink intake (SD)	23.4% (22.2%)	25.3% (23.2%)	21.6% (21.6%)	0.63

Food frequencies were defined as "never" if respondents reported never having one of these items in the last 30 days, "monthly" if 1 to 3 items per month, "weekly" if 1 to 6 items per week, or "daily" if ⩾ item per day. Abbreviations: BMI, body mass index; tsp, teaspoon.
[a]P values calculated using t tests, χ^2 tests, and Mann–Whitney tests, as appropriate, to compare values between Peer Educators and Sidekicks.
[b]All health status variables were self-reported with the exception of BMI that was measured and depressive symptoms were captured using a validated screener.
[c]Cognitive restraint for eating was estimated using the Three-Factor Eating Questionnaire-R18. Physical activity level estimate using a validated screener.
[d]Added sugar and fruit & vegetable intakes were estimated using the National Health Interview Survey 5-factor dietary screener.

Table 3. Feasibility outcomes of acceptability and implementation for Sugar Champ at 6 months among Baltimore public housing residents.

	TOTAL SAMPLE (n = 34)	PEER EDUCATORS (n = 17)	SIDEKICKS (n = 17)
Acceptability			
Overall satisfaction with program			
Very satisfied	88.2%	88.2%	88.2%
Somewhat satisfied	11.8%	11.8%	11.8%
Somewhat dissatisfied	0	0	0
Very dissatisfied	0	0	0
Likelihood of recommending program to a friend			
Very likely	91.2%	88.2%	94.1%
Somewhat likely	8.8%	11.8%	5.9%
Somewhat unlikely	0	0	0
Very unlikely	0	0	0
Satisfaction with Peer Educator training			NA
Very satisfied		88.2%	

(Continued)

Table 3. (Continued)

	TOTAL SAMPLE (n = 34)	PEER EDUCATORS (n = 17)	SIDEKICKS (n = 17)
Somewhat satisfied	–	11.8%	
Somewhat dissatisfied		0	
Very dissatisfied		0	
Implementation			
Median number of group sessions attended (IQR)	–	9 (4-9)	NA
Attending ⩾ 6 Peer Educator groups sessions	–	70.6%	NA
Retention at 6 months	100%	100%	100%
Self-reported participation during program			
More than once a week (⩾15 times)	20.6%	17.7%	23.5%
About once a week (10-14 times)	29.4%	23.5%	35.3%
A few times a month (1-9 times)	47.1%	52.9%	41.2%
Never (0 times)	2.9%	5.9%	0
Self-reported participation after the program ended			
More than once a week (⩾15 times)	23.5%	17.7%	29.4%
About once a week (10-14 times)	23.5%	11.8%	35.3%
A few times a month (1-9 times)	44.1%	52.9%	35.3%
Never (0 times)	8.8%	17.7%	0

Abbreviations: IQR, interquartile range; NA, not applicable.

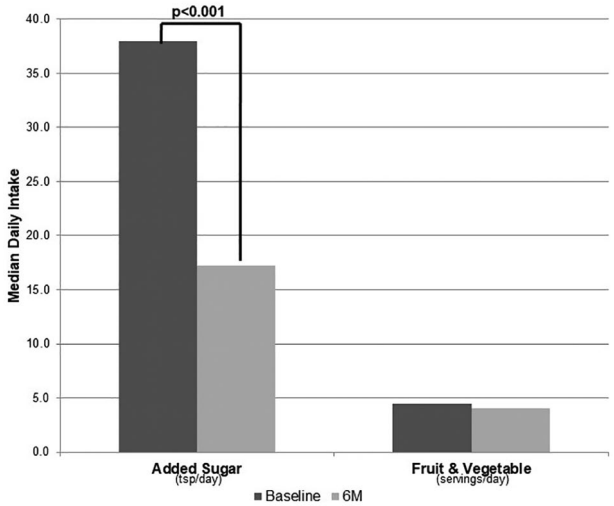

Figure 1. Median daily intake of added sugar and fruit & vegetables at baseline and 6 months among sugar champ participants (n = 34). Median intakes of added sugar (teaspoons per day) and fruit & vegetable (servings per day) estimated from the National Health Interview Survey (NHIS) 5-factor dietary screener at baseline and 6 months. We used standard methods to create variance-adjusted estimates as recommended by NHIS. We compared median intakes at these time points using Wilcoxon signed rank sum tests to calculate P values. M indicates month; tsp, teaspoon.

factor may have been critical given that prior research has demonstrated that adults do not perceive fruit drinks to be unhealthy.[33] Future studies of Sugar Champ should ensure that images and role-play scenarios are balanced between regular soda and fruit-flavored drinks to promote a reduction in both.

Our study has several limitations. This was a feasibility study with a small sample size and used a single-arm trial design where outcomes were examined post or pre-post. The small sample size may have limited power to detect statistically significant differences between Peer Educators and Sidekicks; however, reporting limited efficacy outcomes by these groups is important to ensure that the changes identified were not driven by the Peer Educators alone. Prior network studies have identified greater intervention effect among participants trained as educators.[21,22,34] We note differences in baseline characteristics between Peer Educators and Sidekicks, and further investigation is needed to understand the implications these differences. Additional trials of Sugar Champ are needed, such as an RCT within a larger sample that compares outcomes over time between an intervention and appropriate comparator group, before Sugar Champ should be disseminated. In addition, we used a brief dietary screener to estimate

Table 4. Change in Intake of Foods High in Added Sugars[a] by Individual Participant at 6 Months.

	PERSON	REGULAR SODAS			FRUIT-FLAVORED DRINKS			PASTRIES			DESSERTS		
		BASELINE	6M	CHANGE	BASELINE	6M	CHANGE	BASELINE	6M	CHANGE	BASELINE	6M	CHANGE
Peer Educators	1	Daily	Daily	No Δ	Daily	Daily	No Δ	Weekly	Never	↓↓	Monthly	Never	↓
	2	Daily	Daily	No Δ	Daily	Daily	No Δ	Never	Never	No Δ	Never	Never	No Δ
	3	Daily	Daily	No Δ	Monthly	Monthly	No Δ	Weekly	Monthly	↓	Daily	Daily	No Δ
	4	Daily	Daily	No Δ	Weekly	Daily	↑	Weekly	Monthly	↓	Weekly	Monthly	↓
	5	Daily	Weekly	↓	Daily	Daily	No Δ	Daily	Daily	No Δ	Daily	Daily	No Δ
	6	Daily	Weekly	↓	Daily	Never	↓↓↓	Daily	Monthly	↓↓	Daily	Weekly	↓
	7	Daily	Weekly	↓	Daily	Weekly	↓	Monthly	Weekly	↑	Weekly	Weekly	No Δ
	8	Daily	Weekly	↓	Daily	Weekly	↓	Daily	Monthly	↓↓	Weekly	Weekly	No Δ
	9	Daily	Monthly	↓↓	Daily	Monthly	↓↓	Weekly	Weekly	No Δ	Weekly	Never	↓↓
	10	Daily	Monthly	↓↓	Daily	Monthly	↓↓	Weekly	Never	↓↓	Weekly	Never	↓↓
	11	Weekly	Weekly	No Δ	Weekly	Never	↓↓	Weekly	Weekly	No Δ	Monthly	Weekly	↑
	12	Weekly	Weekly	No Δ	Weekly	Weekly	No Δ	Monthly	Weekly	↑	Weekly	Weekly	No Δ
	13	Weekly	Weekly	No Δ	Weekly	Weekly	No Δ	Weekly	Weekly	No Δ	Weekly	Monthly	↓
	14	Weekly	Monthly	↓	Daily	Never	↓↓↓	Daily	Monthly	↓↓	Daily	Monthly	↓↓
	15	Weekly	Never	↓↓	Weekly	Weekly	No Δ	Weekly	Weekly	No Δ	Weekly	Weekly	No Δ
	16	Monthly	Monthly	No Δ	Daily	Daily	No Δ	Weekly	Weekly	No Δ	Weekly	Monthly	↓
	17	Monthly	Monthly	No Δ	Weekly	Weekly	No Δ	Weekly	Monthly	↓	Monthly	Weekly	↑

(Continued)

Table 4. (Continued)

	PERSON	REGULAR SODAS			FRUIT-FLAVORED DRINKS			PASTRIES			DESSERTS		
		BASELINE	6M	CHANGE	BASELINE	6M	CHANGE	BASELINE	6M	CHANGE	BASELINE	6M	CHANGE
Sidekicks	1	Daily	Daily	No Δ	Never	Never	No Δ	Daily	Monthly	↓↓	Never	Never	No Δ
	2	Daily	Daily	No Δ	Weekly	Daily	↑	Daily	Daily	No Δ	Daily	Daily	No Δ
	3	Daily	Daily	No Δ	Weekly	Never	↓↓	Never	Monthly	↑	Weekly	Monthly	↓
	4	Daily	Weekly	↓	Daily	Weekly	↓	Daily	Weekly	↓	Daily	Weekly	↓
	5	Daily	Weekly	↓	Never	Never	No Δ	Daily	Monthly	↓↓	Daily	Monthly	↓↓
	6	Daily	Weekly	↓	Never	Weekly	↑↑	Never	Weekly	↑↑	Weekly	Weekly	No Δ
	7	Daily	Weekly	↓	Weekly	Monthly	↓	Daily	Weekly	↓	Daily	Weekly	↓
	8	Daily	Weekly	↓	Weekly	Weekly	No Δ	Never	Weekly	↑↑	Daily	Daily	No Δ
	9	Daily	Monthly	↓↓	Daily	Monthly	↓↓	Monthly	Weekly	↑	Weekly	Never	↓↓
	10	Daily	Monthly	↓↓	Daily	Never	↓↓↓	Weekly	Monthly	↓	Weekly	Monthly	↓
	11	Daily	Monthly	↓↓	Daily	Weekly	↓	Daily	Never	↓↓↓	Daily	Weekly	↓
	12	Daily	Monthly	↓↓	Weekly	Weekly	No Δ	Weekly	Monthly	↓	Daily	Monthly	↓↓
	13	Weekly	Weekly	No Δ	Daily	Never	↓↓↓	Never	Never	No Δ	Never	Weekly	↑↑
	14	Weekly	Monthly	↓	Daily	Monthly	↓↓	Daily	Daily	No Δ	Daily	Daily	No Δ
	15	Weekly	Never	↓↓	Monthly	Daily	↑↑	Daily	Daily	No Δ	Daily	Daily	No Δ
	16	Weekly	Never	↓↓	Never	Monthly	↑	Monthly	Never	↓	Weekly	Weekly	No Δ
	17	Monthly	Daily	↑↑	Daily	Daily	No Δ	Weekly	Daily	↑	Weekly	Daily	↑

Number of arrows indicates the magnitude of change. For example, a 1-category change (eg, daily to weekly or monthly to never) would have a single arrow, whereas a 3-category change (eg, daily to never) would have 3 arrows. Abbreviations: M, month; Δ, change; ↓, decrease; ↑, increase.

[a]We report the 4 food types that comprise the estimated of added sugar intake in the National Health Interview Survey 5-factor dietary screener—regular soda, fruit-flavored drinks with added sugar, pastries (eg, doughnuts, sweet rolls, Danish, muffins, or pop-tarts), and dessert (eg, cookies, cake, pie, or brownies).

added sugar intake, which was the preferred instrument in regard to length and comprehension when we shared options with community members prior to study start. This measure captures most SSB; however, it is important to note that energy drinks and flavored coffees were not included among the examples provided. While the measure used is a validated instrument, future studies should consider using more comprehensive and rigorous dietary assessment methods. In addition, our assessment of satisfaction was brief, and findings may be inflated. We also were not able to quantify how often Peer Educators reached out to their Sidekicks or other social network members, and therefore, cannot determine whether these network members received adequate exposure to the intervention through their Peer Educator. Future studies should consider comprehensively assessing acceptability by augmenting survey measures with semi-structured interviews. Finally, the compensation provided to study participants for data collection and for Peer Educators to take part in training may have influenced our feasibility outcomes, particularly satisfaction and implementation.

In conclusion, our results demonstrate that a social network intervention reducing SSB consumption is acceptable, can be implemented, and produces significant decreases in added sugar intake among adult public housing residents trained as Peer Educators and their social network members. Although public housing residents are a highly impoverish population with high levels of food insecurity,[35] this study demonstrates that they can make significant dietary changes. Sugar Champ may have been effective due in part to focusing on a few salient behaviors and utilizing the natural social supports in the environment. These findings warrant further investigation of social network interventions to promote dietary change in an RCT.

Author Contributions

KAG conceived the intervention and was responsible for study design, data analysis, and manuscript writing. OO, JCM, and RSD all assisted in intervention design and implementation, data collection, and critically reviewed the manuscript. DML, CAL and JMC participated in intervention and study design, and critically reviewed the manuscript.

Supplemental Material

Supplemental material for this article is available online.

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