Impact of Improving Home Environments on Energy Intake and Physical Activity: A Randomized Controlled Trial

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Objectives. We assessed the effectiveness of an intervention targeting home food and activity environments to reduce energy intake and increase physical activity among overweight and obese patients from 3 community health centers in rural Georgia.

Methods. We conducted a randomized controlled trial (n = 349) from 2011 to 2013, with follow-up at 6 and 12 months. Health coaches delivered the 16-week intervention by using tailored home environment profiles showing areas in need of improvement and positive aspects of the home environment, behavioral contracts for healthy actions, and mailed support materials.

Results. Participants were mostly African American women (84.8%), with a mean age of 50.2 years and a mean body mass index (weight in kilograms divided by the square of height in meters) of 38.3. Daily energy intake decreased more for the intervention than control group at 6 (–274 vs –69 kcal) and 12 months (–195 vs –76 kcal). We observed no change for either objective or self-reported physical activity. At 12 months, 82.6% of intervention participants had not gained weight compared with 71.4% of control participants.

Conclusions. The intervention was effective in changing home environments and reducing energy intake. (*Am J Public Health.* 2016;106:143–152. doi:10.2105/AJPH.2015.302942)

Adults gain about 1 pound per year, which over time can result in increased risk of diabetes and coronary heart disease, and with larger weight gain, increased risk of cancer.[1–8] Preventing weight gain requires increased energy expenditure, decreased energy consumption, and ideally both. The home environment provides physical and social cues for eating, exercise, and sedentary activity, and can be structured to encourage both healthy and unhealthy behaviors. More than two thirds of calories for US adults come from home food sources and a significant amount of time is spent at home.[9,10] Numerous aspects of the home environment affect dietary behavior, including availability and accessibility of healthy and unhealthy foods, use of nonhome food sources for family meals, and food preparation methods.[11–24] Frequency of grocery shopping and family norms around eating with the TV on are also associated with dietary behavior.[25–27] Likewise, numerous aspects of the home activity environment influence physical activity (PA) behaviors, including the availability of exercise equipment in the home and the number and location of TVs.[16,28–34] Family social support can also influence dietary and PA behaviors, in both positive and negative directions.[35–39] The home environment, while shaping behavior, is influenced, in turn, by the broader environment and may be an important mediator between community environments and behavior, especially for dietary practices.[14,40]

Despite the potential impact of changing the home environment, only a handful of studies have attempted to influence weight-related behaviors by doing so. The majority of these have focused on childhood obesity or attempted to change just 1 or 2 aspects of the home environment.[7,41–44] Recent exceptions have targeted changes in both social and physical aspects of the food and PA home environments, with mixed results.[45–47] Gorin et al. reported successful weight loss and environmental change at 6 months in an enhanced home environment intervention relative to a standard weight loss program, but no sustained weight loss difference at 18 months and no difference in PA at either time point.[45] In a weight-gain-prevention study by French et al., participants were encouraged to make both household and individual-level (e.g., limit eating fast food) behavioral goals.[46] The 1-year program led to increased PA, but no change in body mass index (BMI). Both sets of authors concluded that the home environment may be a promising target for intervention programs, but more research is needed to identify intervention strategies that support sustained change.

The purpose of the current study was to test the effectiveness of a weight-gain-

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prevention intervention delivered by health coaches and targeting the home environments of overweight and obese female patients from 3 community health centers. Health coaches help patients set goals, develop strategies for achieving goals, and anticipate and address challenges.[48] Our health coaches can be viewed as a form of community health worker, in that they were local residents not formally trained as health professionals.[49] We hypothesized that the Healthy Homes/Healthy Families intervention would reduce energy intake and increase PA at 6 and 12 months after baseline, as well as lead to improved home environments relative to usual care. No studies have rigorously tested the effectiveness of a moderate-intensity intervention delivered by health coaches and focusing on home environment change to influence weight-related behaviors of adults. Use of health coaches may provide a promising alternative to intensive and expensive weight-loss programs for resource-limited safety-net providers such as community health centers.

METHODS

Providers from 3 community health centers (9 clinical sites) in southwest Georgia referred overweight and obese female patients to the study. Only women were recruited because of their potential role as gatekeepers of the home environment. Eligible participants were aged 35 to 65 years at baseline, lived with at least 1 other person, and lived no farther than 30 miles from the referring clinic, the latter to reduce intervention delivery costs. Providers were asked not to refer patients with conditions that could have an impact on their ability to be physically active. Pregnant women were also excluded from the study. From February 2011 to December 2012, a total of 948 women were referred (Figure 1). Of these, 751 were reached by telephone and screened for eligibility, with 81 not meeting inclusion criteria, 203 declining to participate, 118 not completing baseline data collection, and 349 completing baseline data collection and randomized. Verbal consent was obtained before data collection. Our statistician randomized participants into intervention and control in blocks of 4 by clinic, with the RAND function in Excel 2010 (Microsoft Corp, Redmond, WA).

Intervention and Control Conditions

We developed the intervention with a community-based participatory approach. In addition to input on study design, members of the Emory Prevention Research Center's Community Advisory Board recommended use of a health coach model, decided on the number and types of contacts, and advised on intervention strategies. The intervention was based on social–cognitive theory in that we attempted to leverage the reciprocal nature of social support, physical environments, and individual behavior.[50] It consisted of 3 home visits and 4 coaching calls over 16 weeks. Core elements, informed by social–cognitive theory, include a tailored home environment profile, goal setting, and behavioral contracting for 6 healthy actions. Healthy actions were supported by correlational data and experience from our pilot study, and refined by Community Advisory Board members.[47] Selected healthy actions included always having a low-calorie beverage available instead of sugar-sweetened soda or sweet tea, cutting back on how often your family eats restaurant food, and creating a place for exercise in your home or yard and committing to using it at least once a week (Table A, available as a supplement to the online version of this article at http://www.ajph.org, shows the full set).

We used baseline data related to the healthy actions to generate a tailored home environment profile showing areas in need of improvement and positive aspects of the home environment. The profile had sections that matched the healthy actions, such as food and exercise equipment inventories. Coaches, hired and supervised by a community partner, used the home environment profile to guide participants in choosing healthy actions. The chosen healthy actions were recorded on a family contract that was signed by the participant and coach. On the basis of the healthy actions chosen, participants received supportive materials via mail (e.g., portion size plate). The intervention delivery schedule is available in Table B (available as a supplement to the online version of this article at http://www.ajph.org).

Control participants received 3 mailings of educational booklets at 6-week intervals. These mailings were government documents encouraging adoption of US dietary and PA guidelines.[51–53]

Health coaches who resided in southwest Georgia and had at least a high-school education and experience in social or customer service delivered the intervention. Training consisted of 2 days of formal training by university staff that covered the protocol for each contact point, how to use the intervention materials for goal setting, coaching tips, and documentation, followed by practice coaching sessions with extensive feedback. Quality control consisted of recording the first 3 families coached, followed by every 10th throughout intervention delivery. Supervisors gave detailed written individualized feedback, and held monthly group meetings to ensure high-quality delivery of the intervention.

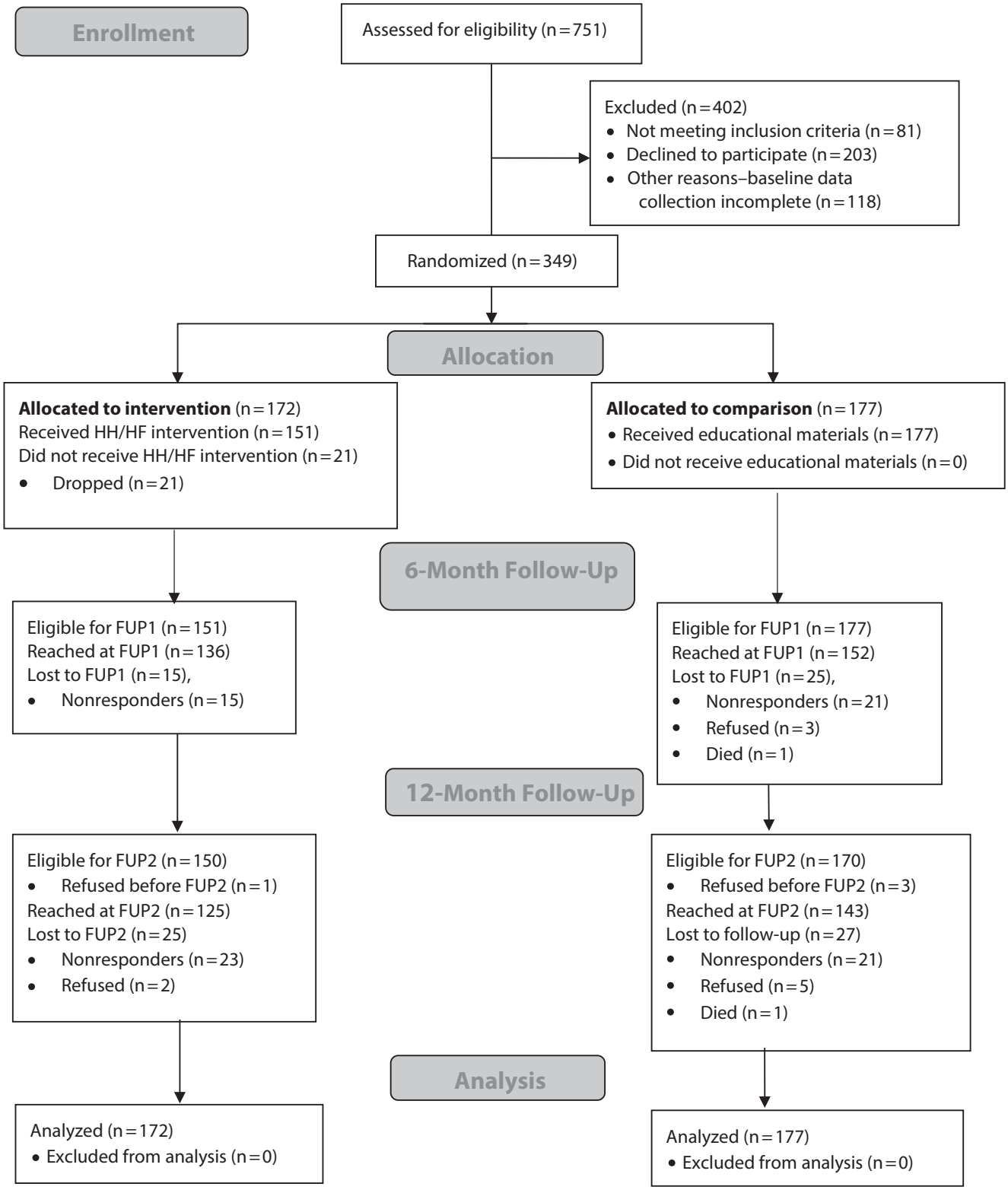
Data Collection

Study participants were asked to complete 3 baseline and two 6- and 12-month follow-up telephone interviews each, and wear an accelerometer at baseline and at 6-month follow-up. Accelerometers were mailed to participants following the first interview with a stamped return envelope at baseline and 6 months. We did not collect accelerometer data at 12 months because of budget constraints. In addition, intervention participants were mailed a process evaluation survey at 6 months. We collected data from February 2011 to July 2013, and subsequently cleaned and analyzed the data from February 2014 to July 2014.

At 6 months, 82.5% completed data collection. At 12 months, 76.8% completed data collection. All data collection staff were blind to group assignment. With the exception of objectively measured PA and process measures, all data were obtained at baseline, 6 months, and 12 months via telephone interview.

Main Outcomes

At each time point, participants completed two 24-hour dietary recalls (1 weekday and 1 weekend day). Two recalls have substantially greater validity than 1 when compared with the doubly labeled water



Note. FUP = follow-up; HF = Healthy Families; HH = Healthy Homes.

FIGURE 1—Consolidated Standards of Reporting Trials Statement Diagram Showing Study Flow: Healthy Homes/Healthy Families Study, Southwest Georgia, 2011–2013

method.[54] We calculated energy intake as the average daily kilocalories from the 2 recalls.[54] We collected and analyzed data by using Nutrition Data System for Research software version 2010, (University of Minnesota Regents, Minneapolis, MN).[55–57] Participants were mailed a copy of a Nutrition Data System for Research Foods Amount Booklet to assist with estimating portion sizes.

We measured PA as hours per week spent in moderate or vigorous PA by using the 7-day PA Recall (PAR).[58] The PAR has moderate to high criterion validity (r = 0.54–0.73) for total PA using accelerometers for comparison.[59,60] Participants also wore accelerometers for 7 days (ActiGraph 3X+, ActiGraph, Pensacola, FL) at baseline and 6 months after baseline. We used self-reported height and weight (in pounds) to calculate BMI (defined as weight in kilograms divided by the square of height in meters).

Secondary Outcomes

Home food environment. Measures of the home food environment corresponded to healthy actions (Table A, available as a supplement to the online version of this article at http://www.ajph.org). To assess food inventories, participants were asked about the presence of 3 unhealthy drinks (e.g., soda) and 8 unhealthy foods and snacks (e.g., regular potato chips) in the home in the past week.[12,13] Food placement was assessed by asking if participants kept fruits, vegetables, and high-calorie snack foods where they were easy to see and easy to reach.[12] Participants were also asked how often they purchased fruit and vegetables when they went grocery shopping in the past month. We assessed TV watching while eating with 3 items asking how often their family ate evening meals, other meals, and snacks in front of the TV.[61]

We assessed food preparation through 15 items that asked how often, in the past month, participants served healthier food options or prepared foods by using healthy cooking methods.[61,62] Meal serving practices focused on 3 strategies with potential to decrease portion size (e.g., use smaller plates). We assessed nonhome food sources by asking the number of days in the past week that family meals were purchased from a fast-food restaurant, full-service restaurant, take out, or delivery.[63] Participants also reported how

TABLE 1—Baseline Characteristics of Participants in the Healthy Homes/Healthy Families Study, Southwest Georgia, 2011–2013

Characteristic	Intervention (n = 172), Mean ±SD or No. (%)	Control (n = 177), Mean ±SD or No. (%)	*P*
Age, y	50.5 ±8.0	49.8 ±8.2	.41
Age group, y			
35–44	45 (26.2)	57 (32.4)	
45–54	71 (41.3)	59 (33.5)	
55–65	56 (32.6)	60 (34.1)	.27
BMI, kg/m^2	37.6 ±8.5	39.0 ±8.4	.11
Race			
White	25 (14.6)	26 (14.7)	
African American	146 (85.4)	149 (84.2)	
Other	0 (0.0)	2 (1.1)	.38
Highest education			
≤ some high school	37 (21.5)	34 (19.2)	
High school or GED	65 (38.0)	62 (35.0)	
Some college or technical school	52 (30.4)	58 (32.8)	
≥ college graduate	17 (9.9)	23 (13.0)	.49
Employment status			
Full time	61 (35.5)	58 (32.8)	
Part time	16 (9.3)	19 (10.7)	
Retired	9 (5.2)	15 (8.5)	
Not working, homemaker, student, or on disability	86 (50.0)	85 (48.0)	.62
Household income, $			
≤ 10 000	56 (33.1)	58 (33.5)	
10 001–25 000	64 (37.9)	57 (33.0)	
25 001–50 000	37 (21.9)	41 (23.7)	
≥ 50 001	12 (7.1)	17 (9.8)	.69
Marital status			
Married or living with partner	82 (47.7)	79 (44.6)	
Widowed, separated, or divorced	58 (33.7)	48 (27.1)	
Not married	32 (18.6)	50 (28.3)	.19
Neighborhood			
In town	86 (50.0)	92 (52.0)	
In rural area	86 (50.0)	85 (48.0)	.71
Other adults in the home			
None	16 (9.3)	21 (11.9)	
1	88 (51.2)	97 (55.1)	
2	49 (28.5)	35 (19.9)	
≥ 3	19 (11.1)	23 (13.1)	.43
Children aged < 18 y in the home			
None	82 (47.7)	92 (52.3)	
1	44 (25.6)	46 (26.1)	
2	33 (19.2)	19 (10.8)	.4
≥ 3	13 (7.6)	19 (10.8)	

Continued

TABLE 1—*Continued*

General health			
Poor	13 (7.6)	20 (11.3)	
Fair	72 (41.9)	58 (32.8)	
Good	64 (37.2)	80 (45.2)	
Very good	20 (11.6)	15 (8.5)	
Excellent	3 (1.7)	4 (2.3)	.23

Note. BMI = body mass index, defined as weight in kilograms divided by the square of height in meters; GED = general equivalency diploma. *P* values are from independent *t* test for continuous variables and χ^2 test for categorical variables.

often they told others in their household their weight in the past month. Family support for healthy eating was adapted from Sallis et al. (Cronbach $\alpha = 0.70$).[35]

Home activity environment. We assessed screen time rules by asking about rules that limited time spent watching TV, using a computer or laptop, playing video games, and using any other hand-held device to play games, watch movies or videos, or use the Internet. In addition, we adapted an inventory of 14 items to assess availability and accessibility of exercise equipment in the home.[12,32,64]

We measured use of community facilities and spaces with 9 items that assessed frequency of using facilities and spaces for exercise in their neighborhood (e.g., public sports fields). Six items assessed family time spent in PA (e.g., playing a sport) in the past month. We also developed a set of items to assess ways in which participants might incorporate PA into their daily routines (e.g., parked far away). Participants were asked about 5 types of exercise space in their home or yards. Lastly, we measured family support for PA by using 9 items (Cronbach $\alpha = 0.79$).[35]

Intervention participants were mailed a survey that assessed satisfaction with the coach, the home visits, telephone calls, and the support materials. In addition, coaches documented each contact with the participants in a coaching log, indicating actions selected, corresponding goals, successes, and barriers.

We also assessed education, annual household income, household composition, race/ethnicity, age, general health, and neighborhood type.

TABLE 2—Baseline Values and Changes Over Time in Weight, Daily Energy Intake, and Home Food Environment Outcomes: Healthy Homes/Healthy Families Study, Southwest Georgia, 2011–2013

Variables	Baseline (n = 349), Mean ±SD or No. (%)	Change Baseline to FUP1 (6 Months; n = 288) Mean ±SD or No. (%)	*P*	Change Baseline to FUP2 (12 Months; n = 268) Mean ±SD or No. (%)	*P*	Intent to Treat, *P*
Primary outcomes						
Energy intake, kcal/d						
Intervention	1466 ±644	−274 ±583		−195 ±535		
Control	1470 ±674	−69 ±594	.003	−76 ±584	.09	.03
Weight, pounds[a]						
Intervention	219.6 ±51.0	−9.1 ±16.5		−10.7 ±17.4		
Control	232.1 ±49.7	−5.0 ±13.7	.03	−7.1 ±14.6	.08	.03
Secondary outcomes						
Unhealthy drinks in the home (of 3)						
Intervention	1.78 ±0.97	−0.65 ±1.04		−0.48 ±1.00		
Control	1.89 ±0.93	0.11 ±0.99	<.001	0.21 ±1.11	.01	<.001
Unhealthy snacks in the home (of 8)						
Intervention	4.44 ±1.74	−1.39 ±2.26		−0.92 ±2.18		
Control	4.68 ±1.78	−0.28 ±1.67	<.001	−0.08 ±1.76	<.001	<.001
Buying fruits/wk						
Intervention	1.07 ±1.27	0.18 ±1.62		0.16 ±1.80		
Control	0.93 ±0.99	0.20 ±0.98	.07	0.22 ±1.21	.22	.04
Buying vegetables/wk						
Intervention	1.02 ±1.23	0.04 ±1.48		0.13 ±1.68		
Control	0.85 ±0.78	0.20 ±0.87	.19	0.13 ±1.03	.03	.004
Family eating and TV[b]						
Intervention	2.73 ±0.92	−0.83 ±1.04		−0.83 ±1.09		
Control	2.65 ±1.05	−0.17 ±0.93	<.001	−0.20 ±0.95	<.001	<.001

Continued

Statistical Analysis

We assessed outcome variables for normality and transformed them if assumptions were not met. Assessment of missingness found no significant differences between those reached for follow-up and those who were not. We assessed statistical significance of change between baseline and each follow-up point with appropriate statistical tests (e.g., independent *t* test, Wilcoxon–Mann–Whitney test). We used growth modeling as the intent-to-treat analysis as it allows for modeling of all available data without the need for imputation.[65] The analysis produces results that can be interpreted as if all participants had provided follow-up data under the assumption of data missing at random.[66] For each outcome variable, the models included time (calculated as time elapsed between the measurement time point and baseline date) and an interaction effect between time and group

TABLE 2—*Continued*

Healthy food preparation[b]						
Intervention	2.27 ±0.47	0.24 ±0.46		0.22 ±0.53		
Control	2.11 ±0.46	0.19 ±0.47	.005	0.14 ±0.46	.02	< .001
Healthy food serving practices[b]						
Intervention	2.51 ±0.66	0.38 ±0.85		0.24 ±0.82		
Control	2.39 ±0.60	0.09 ±0.75	< .001	0.11 ±0.78	.06	< .001
Family meals from nonhome sources/wk						
Intervention	2.46 ±2.84	−0.82 ±2.74		−0.87 ±3.09		
Control	2.78 ±3.32	−0.67 ±3.27	.01	−0.54 ±3.46	.13	.04
Family support for healthy eating[b]						
Intervention	2.58 ±0.57	0.22 ±0.55		0.08 ±0.61		
Control	2.51 ±0.54	0.10 ±0.56	.01	0.18 ±0.59	.71	.38
Telling others your weight (yes)						
Intervention	68 (39.5)	19 (14.96)		22 (18.5)		
Control	66 (37.3)	18 (12.16)	.51	19 (13.6)	.48	.11

Note. FUP1 or 2 = follow-up 1 or 2. *P* values for cross-sectional analyses and change between 2 time points result from independent *t* test and regression analyses; *P* values for the intent-to-treat analysis are from unadjusted growth models (which included all participants) testing for intervention effect and refer to the significance of the interaction term of group and time.

[a]Significant difference at baseline ($P = .04$).

[b]1 = never or rarely; 2 = occasionally; 3 = often; 4 = very often.

assignment. Because intraclass correlations were very low for our primary outcomes (< 1% for moderate to vigorous physical activity and caloric intake), combined with the fact that our intervention was delivered at the household level, we did not adjust for clustering within clinics. We used PROC MIXED for continuous outcome variables and PROC GLIMMIX for binary variables in SAS version 9.4 (SAS Institute Inc, Cary, NC). We excluded several participants who reported unusually high (beyond 3 SDs) weight gain or weight loss from the growth model with weight as the outcome.

The study was powered to detect a difference of 31.5 minutes of moderate to vigorous activity per week between intervention and control, which is equivalent to a medium effect size of 0.35. A sample size of 258 would allow us to detect a difference of this magnitude with power of 0.80 and α of 0.05.

RESULTS

The majority of participants were African American women (84.8%), with an average age of 50.2 years (SD = 8.1) and a mean BMI of 38.3 (SD = 8.4; Table 1). Most were low-income with 68.7% reporting a yearly household income of $25 000 or less. Almost half reported fair or poor general health. About 45% were employed and almost half (49%) were living in a rural area. Most lived with 1 additional adult and half had at least 1 child younger than 18 years in the home.

Most (74.4%) intervention participants received the entire intervention (Table B, available as a supplement to the online version of this article at http://www.ajph.org). The others either dropped out (n = 21) or exceeded the 6 months allocated for intervention delivery. Only 12.2% of participants had fewer than 4 contacts with a coach. Using a 4-point scale (with 1 = strongly disagree and 4 = strongly agree), intervention participants (n = 121) found the coach easy to understand (mean = 3.72), informative (mean = 3.71), and motivating for themselves (mean = 3.64) and even others in their household (mean = 3.35). They found both the home visits and the phone calls similarly interesting (mean = 3.66 and 3.55, respectively) and relevant (mean = 3.59 and 3.61, respectively). In addition, they reported the support materials to be helpful (mean = 3.56) and motivating (mean = 3.53).

Primary Behavioral Outcomes

Daily energy consumption decreased significantly more for the intervention than control group at 6 months (–274 vs –69 kcal/day) and 12 months (–195 vs –76 kcal/day), and was significantly different in longitudinal intent-to-treat analyses based on growth models ($P = .03$; Table 2).

We did not find any meaningful change in self-reported moderate to vigorous PA as measured with the 7-day PAR (Table 3). In addition, there was no significant change in PA measured by accelerometers at 6 months compared with baseline (not shown).

Secondary Outcomes

Self-reported weight. Intervention participants had significantly higher self-reported weight loss at 6 months (mean = –9.1 pounds; SD = 16.5 pounds) than control participants (mean = –5.0 pounds; SD = 13.7 pounds; $P = .03$; Table 3). Differences were slightly less at 12 months, but longitudinal intent-to-treat analyses showed significant differences in weight loss over time ($P = .03$). In addition, at 12 months after baseline, 82.6% of intervention participants had not gained weight compared with 71.4% of control participants ($P = .03$).

Home food environment. Intervention participants made many changes to their home food environments relative to control participants (Table 2). They reduced the number of unhealthy drinks and snacks in the home, increased buying frequency for fruits and vegetables, and reduced the frequency of watching TV while eating meals and snacks. They also improved how they prepared and served meals in the home and reported eating family meals from nonhome sources less frequently. Telling others in the household their weight and family support for healthy eating did not improve in the intervention group relative to the control group.

Home activity environment. Having exercise equipment in a visible location changed

TABLE 3—Baseline Values and Changes Over Time in Moderate to Vigorous Physical Activity and Home Activity Environment Outcomes: Healthy Homes/Healthy Families Study, Southwest Georgia, 2011–2013

Variables	Baseline (n = 349), Mean ±SD	Change Baseline to FUP1 (6 Months; n = 288)		Change Baseline to FUP2 (12 Months; n = 268)		Intent to Treat, *P*
		Mean ±SD	*P*	Mean ±SD	*P*	
Primary outcomes						
MVPA, h/wk						
Intervention	3.9 ±5.9	0.1 ±6.3	.46	−1.3 ±4.5	.26	.38
Control	3.5 ±5.8	−0.8 ±6.3		−0.9 ±4.2		
Secondary outcomes						
Screen rules (of 4)						
Intervention	1.74 ±1.60	0.14 ±1.63		0.26 ±1.78		
Control	1.51 ±1.67	0.16 ±1.46	.57	0.18 ±1.53	.07	.053
Visible physical activity equipment (of 12)						
Intervention	2.79 ±1.78	1.23 ±1.71		1.38 ±2.04		
Control	2.95 ±1.87	5.77 ±1.61	.006	0.72 ±1.82	.005	.01
Use of community facilities or space, frequency/wk						
Intervention	1.56 ±2.49	0.54 ±3.16		0.96 ±3.48		
Control	1.70 ±3.05	0.39 ±3.17	.49	0.49 ±4.32	.21	.12
Family physical activity, frequency/wk						
Intervention	2.19 ±2.98	0.66 ±4.05		1.17 ±4.61		
Control	1.71 ±3.06	0.61 ±2.99	.46	0.83 ±4.24	.07	.01
Incorporate physical activity into daily life, frequency/wk						
Intervention	4.24 ±5.67	3.12 ±10.84		1.64 ±11.11		
Control	4.00 ±6.34	0.16 ±6.05	.45	0.99 ±8.68	.08	.03
Exercise space (of 5)						
Intervention	1.38 ±1.20	0.49 ±1.35		0.54 ±1.25		
Control	1.44 ±1.16	1.12 ±1.24	.03	0.06 ±1.29	.002	.003
Family support for physical activity[a]						
Intervention	2.14 ±0.56	0.20 ±0.66		0.08 ±0.61		
Control	2.07 ±0.49	0.10 ±0.57	.055	0.10 ±0.59	.36	.17

Note. FUP1 or 2 = follow-up 1 or 2; MVPA = moderate to vigorous physical activity. *P* values for cross-sectional analyses and change between 2 time points result from independent *t* test and regression analyses; *P* values for the intention-to-treat analysis are from unadjusted growth models (which include all participants) testing for intervention effect and refer to the significance of the interaction term of group and time. *P* values for MVPA are based on log-transformed values.

[a]1 = never or rarely; 2 = occasionally; 3 = often; 4 = very often.

significantly more in the intervention group relative to the control group (Table 3). Intervention participants also incorporated PA more often into their daily lives than those in the control group, and created more exercise space in their homes and yards. Differences between groups in screen rules, use of community facilities and spaces, and family social support for PA were not significant over time.

DISCUSSION

We tested a moderate-intensity, coach-delivered, weight-gain-prevention intervention with an explicit focus on the home environment of adults. Our primary finding was a significant and sustained difference in daily energy intake. In addition, self-reported weight loss was greater among intervention relative to control participants and percentage of participants with no weight gain was higher among intervention participants at 12 months. A recent review of weight-gain-prevention interventions used a difference of 0.5 kilograms (1.1 pounds) to designate meaningful differences by group at 12 months.[43] These results, in combination with the large number of home food environment changes, suggest that the nutrition component of the Healthy Homes/Healthy Families intervention was effective.

We observed changes in almost all of the measures that corresponded to the food-related healthy actions, including household food inventories, frequency of purchasing fruits and vegetables, patterns of family eating with the TV on, food preparation, and family meals from nonhome sources. These results suggest that women can be effective change agents in establishing healthier home food environments. Other studies have similarly documented changes in the home food environment, but have not sustained daily caloric differences between groups as documented in our study.[45]

Despite the encouraging changes in nutrition-related outcomes, our intervention was not effective in changing PA levels. One reason may be the surprisingly low levels of PA at baseline among our primarily obese participants. Although self-reported levels of PA were relatively high, none of the participants met recommended guidelines for PA when we used objective measures and the average level of moderate to vigorous activity at baseline was less than 1 minute per day.[67] Poor health status, combined with morbid obesity, was a significant barrier to moderate and vigorous activity as documented in our coaching logs and supported by almost half of our participants indicating poor or fair general health. It is also possible that targeting the home environment is not sufficiently powerful to induce increased PA. Gorin et al. gave participants an exercise machine, asked them to restrict TV viewing, provided cues to exercise (e.g., videos), and observed no change in PA.[45] In addition,

participants in our study were very poor and half lived in rural areas outside town, thus suggesting limited access to safe, walkable neighborhoods or affordable recreational facilities.

This study has several limitations. With the exception of the accelerometers, all measures were self-reported, with acceptable but modest validity reported in the literature.[12,68–70] The 24-hour dietary recall is considered one of the better ways to measure dietary intake[54]; however, of some concern was the suspected underreporting of daily food intake. Our population of low-income, obese, and African American women is one of the most challenging for accurate dietary intake.[71,72] We also collected self-reported height and weight. Fortunately, because of randomization, the potential underreporting of food intake and weight was distributed across groups and does not invalidate our outcomes. It is possible, however, that intervention participants reported more favorable home environment outcomes. A second substantive limitation is related to generalizability of the findings. Because of the extensive baseline data collection (i.e., 3 interviews and wearing an accelerometer), a significant number of those initially enrolled in the study did not complete baseline data collection and were not randomized.

The US Preventive Services Task Force recommends screening all adults for obesity and encourages clinicians to refer obese patients to intensive, multicomponent behavioral interventions.[73,74] This recommendation, however, is difficult to implement in safety-net clinics such as community health centers in resource-poor communities.[75] Alternative approaches are needed, both in terms of intervention targets and intervention delivery methods. Our intervention integrates public health principles that focus on environmental influences with current health reform attempts to transform the "doctor's office" into the patient-centered medical home.[76–78] Instead of traditional moderate-intensity behavioral counseling, our intervention trains local residents to function as health coaches who help the patient construct a healthier home environment, thus linking the medical home with the patient's home. This model capitalizes on the ability of residents who essentially work as community health workers to create a bridge between the community and formal health services.[49]

This approach proved successful in changing one of the most challenging behaviors—excessive food consumption—in a very-high-priority population for obesity prevention. Future research could complement our intervention with mobile messaging and home monitoring of PA, weight, blood pressure, and blood sugars. Future research could also focus on the long-term sustainability of changes to the home food environment and whether booster sessions would be beneficial. Our study offers one model for intervening in a potentially important setting for obesity prevention. Combining effective home-focused interventions with strategies that target individual-level factors and neighborhoods is an important next step in a more comprehensive approach to tackling the obesity epidemic. AJPH

CONTRIBUTORS

M. C. Kegler led design and implementation of the research, wrote sections of the article, interpreted results, and edited the full article. R. Haardörfer analyzed the data, wrote sections of the article, and edited the full article. I. C. Alcantara assisted in developing the intervention and study protocol, managed data collection, wrote part of the discussion, and reviewed the full article. J. A. Gazmararian assisted in designing the intervention and study protocol, wrote part of the discussion, helped interpret results, and edited the full article. J. K. Veluswamy assisted in developing the intervention, managed intervention delivery, helped interpret results, wrote part of the discussion, and reviewed the full article. T. L. Hodge helped deliver the intervention and interpret the results, wrote part of the discussion, and reviewed the full article. A. R. Addison advised on intervention and study design, wrote part of the discussion, and reviewed the full article. J. A. Hotz advised on intervention and study design, wrote part of the introduction and discussion, and reviewed the full article.

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HUMAN PARTICIPANT PROTECTION

This protocol was approved by the Emory University institutional review board.

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