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Pathways to Health: Cluster-Randomized Trial to Increase Fruit and Vegetable Consumption Among Smokers in Public Housing

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Objectives: Examine the effectiveness of an intervention to increase fruits and vegetables (FV) consumption among smokers. ***Design:*** Cluster-randomized trial of 20 public housing developments; 10 randomly assigned to an FV intervention and 10 to a smoking cessation intervention. ***Main outcome measures:*** Usual (past 7 days) and past 30 days change in daily FV intake at 8 weeks and 6 months postbaseline. ***Results:*** Greater increases were seen in the FV group. At Week 8 and Month 6, the FV group had consumed 1.58 ($p < .001$) and 0.78 ($p = .04$), respectively, more daily FV servings in the past 7 days than the cessation group. At the same time points, the FV group had consumed 3.61 ($p = .01$) and 3.93 ($p = .01$), respectively, more FV servings in the past 30 days than the cessation group. Completing more motivational interviewing sessions ($p = .02$) and trying more recipes ($p = .02$) led to significantly greater increases at Month 6 among FV participants. ***Conclusions:*** Motivational interviewing counseling and lifestyle modification through trying out healthy recipes may be effective in helping a high-risk population increase their FV intake.

Keywords: fruits, vegetables, dietary change, public housing

Together, poor dietary patterns and a sedentary lifestyle account for approximately 365,000 deaths per year, ranking second only to tobacco use as a primary cause of preventable death (Mokdad, Marks, Stroup, & Gerberding, 2005). On the basis of a convergence of evidence indicating that a diet high in fruits and vegetables (FV) is associated with lower risks for numerous chronic diseases, including several cancers, cardiovascular disease, and stroke (Hung et al., 2004), increasing Americans' intake of FV has become a national health priority (R. M. Davis, 1998). In 1991, the National Cancer Institute established the national 5 A Day for Better Health Program (Heimendinger, Van Duyn, Chapelsky, Foerster, & Stables, 1996); however, prevalence data indicated little change in the frequency of FV consumption among adults in the United States between 1994 and 2000 (Serdula et al., 2004). Furthermore, in 2000 only 24.6% of adults consumed the recommended 5–9 servings of FV a day (recommendations vary on the basis of age, gender, and activity level), with the mean frequency of consumption being 3.37 times per day (Serdula et al., 2004).

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Although many guidelines (e.g., the Food Guide Pyramid) provide recommendations for a healthy diet, limited information is available on the effectiveness of dietary interventions and the best strategies for achieving meaningful change among underserved and at risk segments of the population (Ammerman, Lindquist, Lohr, & Hersey, 2002). Individuals in such groups have the highest prevalence rates for many cancers and chronic diseases that may be linked with diet but are the least frequently reached by prevention programs (Kumanyika, 1990). Individuals living in poverty are at increased risk for poorer dietary habits and diet quality. As the majority of Americans consume less than the recommended 5 servings of FV per day, those making less than $15,000 per year or having less than a high school education are at greatest risk for inadequate consumption (Serdula et al., 2004). Smokers are also at risk. Current smokers eat less FV and are at increased risk for chronic diseases, including cardiovascular disease and cancer, thought to be linked to diet and, therefore, may derive additional health benefits from increasing their consumption of FV (Hung et al., 2004).

A cluster-randomized dual intervention trial titled *Pathways to Health* (PATH) was conducted among smokers residing in public and Section 8 housing developments (HDs). The primary purpose of the PATH study was to test the effects of nicotine gum along with motivational interviewing (MI) counseling for smoking cessation (Okuyemi, James, Mayo, Nollen, & Ahluwalia, in press). A dietary, as opposed to a placebo-controlled, intervention was used as the comparison group for the smoking cessation arm. The dietary intervention served as an attention control and was selected to fill a need for more information about dietary interventions in impoverished populations, to ensure community buy-in, and to address residents' potential distrust about being part of a "drug" study with a placebo arm. HDs were selected because of the known health disparities existing among impoverished and underserved

communities and because by intervening directly in the HD community we were able to reduce key obstacles of access and availability that often impede this population's participation in health promotion programs. The present study describes the dietary intervention used in the PATH project and its impact on FV consumption among smokers residing in public housing.

Method

Participants and Randomization

Study design, methods, and inclusion/exclusion criteria have been described in detail elsewhere (Jeffries, Choi, Butler, Harris, & Ahluwalia, in press; Okuyemi et al., in press). In brief, this study was a cluster-randomized trial in which 20 public and Section 8 HDs, funded by the U.S. Department of Housing and Urban Development (HUD) to provide low-income housing for families meeting federal poverty guidelines (U.S. Department of Housing and Urban Development, 2005), were randomly assigned to a fruit and vegetable (FV) or smoking cessation intervention. All HD residents were invited to attend a community health fair held at their development. Health fairs served as the vehicles to recruit smokers. Health fair attendees completed a questionnaire assessing smoking status. From this, smokers were identified for potential inclusion in the randomized trial.

All participants provided written informed consent. The trial procedures were approved by the University of Kansas Medical Center's human subjects committee. Randomization occurred at the group level, with 10 HDs being randomized to the FV arm and 10 HDs being randomized to the smoking cessation arm at the conclusion of each health fair. Because age is associated with key smoking variables, HDs were stratified by elderly versus nonelderly (i.e., "family") developments, as determined by the Kansas City Kansas and Missouri Housing Authorities, and block randomization of size four occurred within each stratum. Treatment assignment was revealed to the study coordinator and research staff only after each health fair was complete. Sequential enrollment continued until 20 HDs were randomized, of which 10 were randomized to the smoking cessation arm and 10 to the comparison arm. Recruitment occurred between October 2001 and May 2003; participants were followed for 6 months.

Intervention Components

Week 0 appointments were completed within 10 days of the health fair. Participants in the dietary arm received a bag of fresh FV, a cookbook of healthy recipes, dietary education materials, and two videos on FV. Participants in the smoking cessation arm received an 8-week supply of 4-mg nicotine gum, instructions for using the gum, and educational materials related to quitting. Participants in both arms received five sessions of MI counseling for FV consumption or smoking cessation (on the basis of group assignment), conducted onsite at the HDs at Weeks 0 and 3 and via telephone at Day 10 and Weeks 5 and 20 by trained master's level staff.

A number of theoretical models guided the selection of these intervention components. Social cognitive theory posits that self-efficacy (an individual's belief in his or her ability to make a change) and outcome expectations (belief that making a change will lead to a desired outcome) are important determinants of health behavior change (Maibach & Cotton, 1995). Studies relating these constructs to FV intake have found that individuals with low self-efficacy (i.e., not confident in their ability to increase their FV) and/or low outcome expectations (i.e., don't believe increasing their FV will lead to a desired outcome) are less likely to change their FV consumption (Steptoe, Perkins-Porras, Rink, Hilton, & Cappuccio, 2004). Similarly, improvements in self-efficacy have been found to lead to increased FV consumption. Following from these findings, the dietary educational materials, cookbook, and MI counseling were designed to enhance self-efficacy and improve outcome expectations. Specific information designed to increase self-efficacy included discussions of motivation and confidence to change, suggestions for addressing barriers to FV consumption, tips on preparing and storing FV, and suggestions regarding cooking healthfully, making low fat substitutions, and incorporating more FV into one's diet. Information designed to enhance outcome expectations included discussions related to the nutritional value and health benefits of commonly available FV.

The health belief model suggests that behavior change is most likely to occur when an individual believes he or she is at risk (perceived susceptibility), that the consequences are serious (perceived severity), and that the benefits (perceived benefits) outweigh the barriers (perceived barriers; Becker, 1977). Individuals who perceive risks related to their consumption of FV and believe the pros of change (i.e., benefits) outweigh the cons (i.e., barriers) are more likely to increase their FV consumption (Steptoe et al., 2004). Following from these findings, a portion of each MI session focused on a decisional balance activity in which the benefits and barriers to increasing FV consumption were explored. A values exploration exercise also encouraged participants to consider the reason for and risks and consequences of maintaining their current level of intake.

Finally, our awareness of and attention to the culture of our study sample was guided by the two-dimensional model of cultural sensitivity in public health (Resnicow, Soler, Braithwaite, Ahluwalia, & Butler, 2000). *Surface structures* were incorporated through the educational materials that featured predominantly African American images and graphics and the cookbook and bag of FV, which incorporated recipes and foods common among the predominately African American sample. *Deep structures* were incorporated through the print materials and counseling that addressed unique barriers (i.e., poverty and dietary preferences) and core cultural values (i.e., religion/spiritualism, collectivism, and family) of our study sample.

Bag of fresh FV. Participants were recruited between October 2001 and May 2003. Although seasonality impacted the availability and inclusion of some fruits and vegetables at different times throughout the year, bags typically included a mix of fruits (e.g., apples, oranges, bananas, grapes) and vegetables (e.g., collard greens, carrots, bell peppers, broccoli, and cauliflower) common to our primarily African American population. In addition, bags typically contained one potentially less familiar item such as a mango, kiwi, avocado, pineapple, or eggplant. Approximately $8–$10 was spent on each bag.

FV educational materials. The FV educational materials were created by a registered dietician on the basis of existing materials from the American Cancer Society and the National Cancer Institute. The materials included information on serving size, the nutritional value and health benefits of commonly available FV, suggestions for addressing barriers to FV consumption, tips on preparing and storing FV, and suggestions regarding cooking healthy, making low fat substitutions, and incorporating more FV into one's diet.

A Pathways to Health cookbook was created on the basis of existing materials designed for ethnic minority populations (Resnicow et al., 2001). For inclusion, recipes had to include FV. Fat and calorie content was also considered. Recipes were selected to reflect foods common among our predominately African American sample.

The two videos we provided participants, *Beating the Budget Blues* and *Meal Appeal*, were modified from the *Bringing it Home* video series, a previous National Cancer Institute-funded intervention that explored the effectiveness of schoolchildren (4th graders) as change agents to increase fruit, juice, and vegetable consumption among lower income African American parents (M. Davis et al., 2000). *Beating the Budget Blues* addressed how to buy FV on a budget, whereas *Meal Appeal* provided tips for eating FV at every meal and snack. The original video series contained all African American actors and actresses. Given that the present study was not limited to African Americans, we had scenes from each video reshot with a Caucasian actor or actress to more accurately represent the ethnic makeup of our study sample. Scenes were reshot by Hall Foushee Com-

munications, Inc. (Minneapolis, MN), the production company that developed the original series. The content of each video remained unchanged.

MI. MI, described in detail elsewhere (Miller & Rollnick, 2002), is a counseling approach originally developed for addictive behaviors that has more recently been applied to other health behaviors, including smoking cessation (Butler, Rollnick, Russell, Bachmann, & Stott, 1999) and FV consumption (Resnicow et al., 2001). In the present study, MI was conducted by trained counselors following semistructured counseling scripts. Generally, participants received counseling from the same person for all five sessions. Sessions, conducted at Week 0, Day 10, and Weeks 3, 5, and 20, explored the positive and negative aspects of increasing FV consumption, the pros and cons for change, participants' ambivalence about increasing FV consumption, motivation and confidence for increasing FV consumption, and plans for change. A values clarification strategy, based on the work of Miller and Rollnick (2002), was also used. Participants were asked to identify key values and attributes and explore potential connections between their diet and their ability to live out these values. Alternatively, participants were encouraged to consider how changing their diet might be related to their core values and attributes. To maximize the fidelity and integrity of the MI session, we audiotaped all counseling sessions (telephone and in person). A subset of audiotapes was rated by doctoral level psychologists for MI adherence with a modified version of the Motivational Interviewing Skills Code (Moyers, Martin, Catley, Harris, & Ahluwalia, 2003). Counselors received ongoing supervision for the duration of the trial and met weekly with supervisors to review audiotapes and discuss current issues.

Recruitment and Retention

The recruitment strategies used to promote and encourage attendance at the health fairs are described elsewhere (Jeffries et al., in press). For the trial, reminder phone calls and postcards were used between visits to minimize attrition. All participants who missed their appointment were called up to six times to reschedule their visit. To further enhance retention, participants received incentives at every visit (e.g., movie tickets, T-shirt, water bottle, or tote bag) and were compensated in Wal-Mart vouchers during the 6-month follow-up period: $40 at the health fair, $40 at Week 8, and $40 at Month 6.

Measures

Demographic characteristics. The baseline assessment included measures of demographics, health status, and smoking behaviors.

Outcome variables. The primary FV outcomes included change from baseline in daily FV intake. Two measures of FV intake were obtained at baseline, Week 8, and Month 6 to provide a measure of usual (past 7 days) and past month consumption. One was a 2-question measure adapted from the Health Habits and History Questionnaire (Block, Thompson, Hartman, Larkin, & Guire, 1992) that asked, "Over the past 7 days, how many times per day or week did you eat fruit, not including vegetables?" and "Over the past 7 days, how many times per day or week did you eat vegetables, not including fruit?" A follow-up question asked if this was times per day or per week. Items were summed to derive an index of daily FV intake. The second was the National Cancer Institute 19-item FV food frequency questionnaire, which assesses frequency and portion size estimates of FV consumption over the last 30 days (Thompson et al., 2002). The 2 items (1 frequency and 1 portion size) assessing french fry intake were excluded from the present analyses. Additionally, the question about consumption of mixtures that included vegetables is not included in the scoring algorithm, leaving 16 items. Because of the exclusion of these 3 items, this instrument will be referred to as a 16-item measure for the remainder of the article.

Other variables of interest included change from baseline in body mass index (BMI) at Week 8 and Month 6 and the percentage of participants consuming at least five servings of FV per day in the last 7 (2-item measure) and 30 days (16-item measure). BMI was calculated from height and weight measured during the health fair. Height was measured without socks or shoes by using a portable stadiometer and rounded to the nearest 0.1 in. Weight was measured by using the Tanita bioimpedance machine (TBF-310 and TBF-300; Tanita Corporation, Arlington Heights, IL). To account for clothing, we adjusted participants' weight downward by 2 pounds and measured to the nearest 0.1 pound. Overweight was defined as BMI $\geq$ 25 kg/m^2.

Process and compliance. Process and compliance evaluations were conducted at Week 8 and Month 6. Participants in the FV arm were asked about their consumption of the bag of FV they were given at randomization; their use of the cookbook, videos, and educational materials; the perceived benefit of these materials; and overall satisfaction with the PATH program. The percentage of MI counseling completed at each visit, along with the total percentage of the sample completing 0–5 MI sessions, was also explored.

Data Management

All forms were completed by study staff and reviewed by a study coordinator. Following double data entry, comparison, logic, range, and edit checks were performed. After resolution of discrepancies and completion of all data checks, a final Access and SAS database was created and locked.

Statistical Analyses

Statistical power was based on the main outcome of the larger trial—smoking cessation—and was assessed over a range of potential intraclass correlation coefficients. Categorical baseline variables were summarized by frequencies and percentages, and quantitative variables were summarized by mean and standard deviation for each treatment group. All statistical analyses were performed on an intention-to-treat basis. Changes from baseline in daily FV intake and BMI were computed, summarized, and compared across groups for all 173 participants, imputing no change for those who were lost to follow-up. Mixed linear models, assuming a compound symmetric correlation for estimating the intraclass correlation within each housing development, were used to compare the change in FV intake between the two groups. Means, standard deviations, and p values summarized the changes from baseline in daily FV intake and BMI at Week 8 and Month 6.

Results

Sample Description

A total of 20 HDs participated, with 10 randomized to the cessation arm and 10 to the FV arm. HD size ranged from 82 to 397 adult residents. On average, 21% of adult residents attended the health fair (range = 8%–66%). Of the 813 health fair attendees, 273 smokers were identified and screened, 204 met screening criteria, and 173 smokers were randomized, 107 to the FV arm and 66 to the cessation arm (see Figure 1). Baseline characteristics at the cluster and individual level are presented in Table 1.

Of the 173 participants, 151 (87.3%) attended their Week 8 visit and 131 (75.8%) their Month 6 visit. There was no difference in the rate of missing data at Week 8 ($p = .22$) or Month 6 ($p = .28$) between groups. No differences were found in baseline FV consumption between those lost to follow-up (2-item: $M = 1.83$, $SD = 1.36$; 16-item: $M = 8.04$, $SD = 7.50$) and those who returned at Month 6 (2-item: $M = 2.19$, $SD = 1.77$, $p = .17$; 16-item: $M = 7.85$, $SD = 6.76$, $p = .97$).

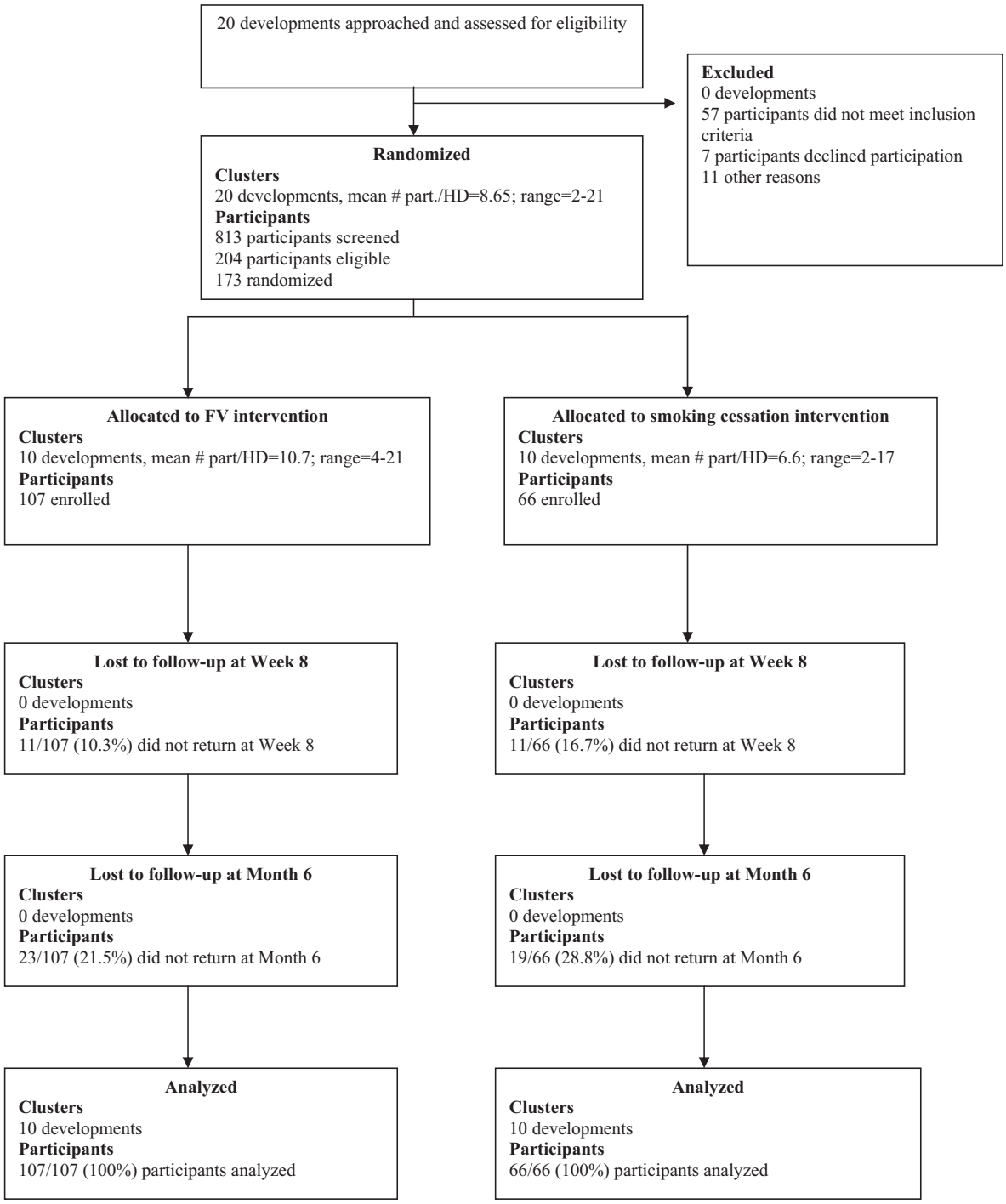

Figure 1. Flow diagram of PATH cluster-randomized trial. part = participants; HD = housing development; FV = fruits and vegetables.

Outcome Measures

Participants in the FV group had significantly greater increases in FV consumption than those in the cessation group (Table 2). At 8 weeks and 6 months postbaseline, respectively, the increase in FVs in the last 7 days (2-item measure) reported by the intervention group was 1.58 ($p < .001$) and 0.78 ($p = .04$) servings greater than the increase reported in the cessation group. In the past 30 days (16-item measure), the Week 8 and Month 6 increases reported by the intervention group were 3.61 ($p = .01$) and 3.93 ($p = .01$) servings greater than the increases reported in the cessation group. Significant correlations were found between the

Table 1
Baseline Characteristics by Group at the Cluster and Individual Level

Characteristic	FV				Cessation			
	n	%	*M*	*SD*	*n*	%	*M*	*SD*
Housing development								
N	10				10			
Development type								
Elderly housing development	3				3			
Family housing and Section 8 developments	7				7			
Participants								
N	107				66			
Demographic characteristics								
Age (in years)			48	13.1			43	14.3
Female	68	63.6			53	80.3		
Race/Ethnicity								
African American	93	86.9			50	75.8		
White	7	6.5			11	16.7		
Hispanic	2	1.9			3	4.6		
Other	4	3.7			2	3.0		
Married or living with a partner	10	9.4			5	7.6		
≤ High school education	46	43.0			22	33.3		
Unemployed	42	39.3			30	45.5		
Monthly income ≤ $800	78	72.9			49	74.2		
Insured	85	79.4			49	74.2		
Health-related variables								
Overweight (self-report)	60	56.1			45	68.2		
Trying to lose weight	35	32.7			34	51.5		
Diet high in fat (self-report)	32	29.9			23	34.9		
Moderate to strenuous physical activity in past 7 days	55	51.4			33	50		
Weight (in lbs)			183	56.6			183	48.5
Smoking-related variables								
Cigarettes smoked per day			16	9.2			19	13.0
Age of initiation (in years)			19	6.6			18	5.2
Cigarette in first 30 minutes of awakening	80	74.8			58	87.9		

2- and 16-item FV change scores at Week 8 ($r = .36$, $p < .0001$) and Month 6 ($r = .39$, $p < .0001$).

In both groups, fruit increased more than vegetables. On the 2-item measure, of the 1.82 and 1.05 servings-per-day increase seen among participants in the FV arm at Week 8 and Month 6, 1.12 (Week 8) and 0.70 (Month 6) servings per day were due to fruit consumption. Similarly, of the 0.24 and 0.27 servings-per-day increase seen among participants in the cessation arm at Week 8

Table 2
Change from Baseline[a] *in Daily FV Intake by Treatment Group*

Time	FV				Cessation				p[b]	Effect size estimate	ICC
	M	*SD*	Difference from baseline *M*	Difference from baseline *SD*	*M*	*SD*	Difference from baseline *M*	Difference from baseline *SD*			
2-item FV intake by group											
Baseline	2.06	1.73			2.17	1.63					
Week 8	3.88	3.02	1.82	2.68	2.41	1.94	0.24	1.73	<.0001	0.70	0.000
Month 6	3.10	2.48	1.05	2.17	2.44	2.42	0.27	1.91	.04	0.39[c]	0.015
16-item FV intake by group											
Baseline	6.74	6.36			7.16	6.48					
Week 8	11.55	8.29	4.81	7.40	8.25	8.00	1.20	8.82	.01	0.45	0.000
Month 6	9.78	7.04	3.18	7.00	6.75	5.14	−0.75	5.08	.01	0.59[c]	0.009

Note. ICC = intraclass correlation.
[a] Lost to follow-up imputed as no change. [b] Comparison of difference from baseline scores by group. [c] Adjusted for ICC.

Table 3
Month 6 FV Consumption by Level of Participation in FV Intervention

Intervention component	*n*	Servings per day *M*	Servings per day *SD*
MI session attendance (out of 5 total)[a]			
4 or fewer	46	0.67	2.01
5	38	2.13	2.56
Bag of FV			
Ate most or all the fruit in bag			
Yes	63	1.62	2.55
No	21	0.47	1.49
Ate most or all the vegetables in bag			
Yes	58	1.51	2.62
No	26	0.86	1.64
Educational materials			
Read at least some of the educational materials in program folder			
Yes	52	1.57	2.62
No	32	0.94	1.87
Read at least some of the educational materials in cookbook			
Yes	74	1.40	2.45
No	10	0.86	1.78
Video			
Watched some portion of *Meal Appeal*			
Yes	31	1.87	2.90
No	53	1.02	1.97
Watched some portion of *Beating the Budget Blues*			
Yes	45	1.57	2.51
No	39	1.05	2.21
No. of recipes tried from cookbook			
0	31	0.56	1.60
1–3	38	1.45	2.50
4–6	10	2.63	2.57
7 or greater	5	2.63	3.75

Note. Analyses include only participants in the FV arm. MI = motivational interview.
[a] Categories were collapsed because of the small number of participants ($n = 14$) attending ≤ 3 MI sessions.

and Month 6, 0.19 (Week 8) and 0.16 (Month 6) servings per day were due to fruit consumption. A similar trend was found on the 16-item measure in the FV group. Fruit increased by 2.48 (Week 8) and 1.68 (Month 6) servings, whereas vegetables increased by 1.84 (Week 8) and 0.81 (Month 6). In the cessation group, vegetables increased more than fruit at Week 8 (0.76 for vegetables vs. 0.24 for fruits), whereas a decrease was seen in both fruit (−0.31) and vegetables (−0.22) at Month 6.

At baseline, 10.3% in the FV group and 9.1% in the cessation group ($p = .69$) were consuming at least five servings of FV per day for the prior 7 days (2-item measure). This percentage increased to 34.6% versus 19.7% ($p = .06$) at Week 8 and 20.6% versus 16.7% ($p = .53$) at Month 6. In the past 30 days (16-item measure), 49.5% in the FV group and 56.1% in the cessation group ($p = .43$) were consuming at least five servings of FV per day at baseline. This percentage increased to 71.7% versus 57.6% ($p = .06$) at Week 8 and 68.2% versus 47.0% ($p < .01$) at Month 6. No group differences in BMI were observed.

Process Evaluation

Use of program materials. At Day 10, 72% reported eating most or all of the fruit given to them at Week 0, whereas 66% reported eating most or all of the vegetables. At Month 6, 69.2% of participants reported reading at least some of the educational materials found in the cookbook and trying a mean of 2.07 (2.42) recipes. Over half (65.3%) watched some portion of the videos, whereas the majority (72.0%) read some to all of the educational materials in the program folder.

Overall in the FV group, all participants received at least one MI session, with the majority (71.0%) receiving four or five sessions. In the cessation group, all participants received at least one MI session and the majority (60.6%) received four or five sessions.

Among participants in the FV arm, those who completed more MI sessions ($p = .02$) and tried more recipes ($p = .02$) exhibited significantly greater changes in FV intake at Month 6. No other program components were found to be significant for FV consumption at Month 6. The extent of dietary change according to level of participation in each of the FV intervention components is presented in Table 3.

Program satisfaction. The majority (72.0%) reported being very satisfied with the FV intervention and believed that the program had a lot of influence in getting them to eat more FV (68.2%). With regard to the perceived benefit of specific program components, 43.0%, 40.2%, and 37.4% of participants thought the cookbook, videos, and educational materials, respectively, were very helpful in getting them to eat more FV. Participants were very satisfied with their MI counselor

(75.7%) and believed the MI counseling was very useful in helping them eat more FV (63.6%).

Discussion

This randomized trial indicates that a multicomponent intervention, and in particular MI counseling and lifestyle modification through a cookbook of healthy recipes, may be an important facilitator of dietary change among public housing residents. According to the 2-item measure, the intervention produced a 1.05 servings-per-day increase at Month 6 among those in the FV arm, which was significantly greater then the 0.27 servings-per-day increase at Month 6 among participants in the cessation arm. The net difference of 0.78 servings per day at Month 6 is consistent with previous studies conducted in low-income and/or African American communities, in which dietary interventions have resulted in FV increases ranging from 0.40 to 1.2 servings per day (Campbell et al., 1999; Resnicow et al., 2004). Our sample is different from previous trials in that we focused exclusively on smokers residing in public housing. Compared with past or never smokers, current smokers have been found to eat less FV and are at increased risk for chronic diseases, including cardiovascular disease and cancer thought to be linked to diet (Hung et al., 2004). Smokers may, therefore, derive additional health benefits from increasing their consumption of FV.

Although findings from the 16-item measure also indicate significantly greater increases in FV consumption among participants in the FV group, it is important to note the difference in estimates provided by the 2- and 16-item measures. The larger estimates provided by the 16-item measure are consistent with previous studies, which have found that food frequency questionnaires containing a greater number of items or with greater specificity (i.e., portion size) produce higher estimates of intake (Kim & Holowaty, 2003). Additionally, the 2-item instrument measured average intake in the past 7 days, whereas the 16-item instrument measured average intake in the past 30 days. These differences in recall time frame may also partially account for the disparate estimates obtained via the two measures. We are unable to draw any conclusions comparing the 2- versus the 16-item measure as this study was not designed to assess the validity of these instruments against more detailed dietary assessments (i.e., diet diaries, 24-hr dietary recalls) or biological markers (i.e., serum carotenoids). The consistent findings across the measures do, however, provide evidence of the intervention's effect on usual (i.e., 7 day) and past month (i.e., 30 day) FV consumption.

The potential public health impact of our findings is difficult to quantify. It has been estimated that a 0.5 serving-size increase in daily FV consumption would translate into an 8% lower incidence of cancer (Potter, 1997), whereas a one serving-per-day increase in FV would lower cardiovascular disease risk by 6%–11% (Hung et al., 2004). These findings are more pronounced among smokers, for whom greater FV consumption is associated with a 20% lower risk of cardiovascular disease among current smokers, and a one serving-per-day increase in cruciferous vegetables is associated with a 45% lower risk of cancer among male current smokers. Drawing from these findings, it can be reasonably concluded that maintaining the approximately one serving-per-day increase seen at Month 6 among participants in the FV arm may positively impact long-term health outcomes of this population. Considered within the context of the disproportionately higher rates of cardiovascular disease and cancer found among low-income and minority populations (Kumanyika, 1990), the public health impact of this finding should not be overlooked. It is important to note, however, that the strongest evidence for a protective effect against chronic disease involves vegetables (Hung et al., 2004). Consistent with others (Campbell et al., 1999; Resnicow et al., 2004), this study was more successful in increasing fruit intake than vegetable intake. Future studies are needed to determine strategies to effectively increase the consumption of vegetables. Not surprisingly, increasing FV had no impact on BMI over 6 months, suggesting that modifying FV alone is not enough to alter weight status and that interventions addressing both diet and activity are warranted.

Our findings provide insight into the design of dietary interventions among public housing residents. Partnering with housing authorities and implementing the intervention at the HDs minimized attrition (76% completed their Month 6 visit). Although the intervention involved multiple components, participants who completed more MI sessions and tried more recipes exhibited significantly greater changes in FV consumption, whereas the video, educational materials and bag of FV had no impact. These findings suggest that MI counseling and lifestyle modification through a cookbook of healthy recipes may be important facilitators of dietary change among public housing residents. More research is needed to determine other individual (e.g., age, gender) and psychosocial (e.g., motivation, confidence, self-efficacy) factors predictive of compliance with dietary interventions and protocols.

Several limitations should be noted. Our findings are based on a comparison group of smokers receiving a dietary intervention as an attention control in a smoking cessation trial who were recruited from health fairs at their HD. Our results, therefore, may reflect self-selection bias, and the external validity of our findings is limited by the fact that participants were not representative of the entire HD community. The assessment of FV consumption is based on self-report and is, therefore, subject to response and recall bias; however, our randomized design should have distributed these potential biases equally across both study groups. Additionally, two brief screeners were used to assess FV intake as opposed to a more comprehensive food frequency questionnaire or 24-hr dietary recall. However, validity data on these two measures indicate small to moderate correlations with 24-hr dietary recalls and serum total carotenoids (Resnicow et al., 2002).

Despite these limitations, our findings suggest that MI counseling and trying out recipes may be effective in helping a high-risk population increase its FV intake. Results also suggest that intervening directly within the HD community reduces many of the key obstacles of access and availability that often impede this underserved population's participation in health promotion programs.

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