

Fruit and Vegetable Consumption and Prevention of Cancer: The Black Churches United for Better Health Project

ABSTRACT

Objectives. This study assessed the effects of the Black Churches United for Better Health project on increasing fruit and vegetable consumption among rural African American church members in North Carolina.

Methods. Ten counties comprising 50 churches were pair matched and randomly assigned to either intervention or delayed intervention (no program until after the follow-up survey) conditions. A multicomponent intervention was conducted over approximately 20 months. A total of 2519 adults (77.3% response rate) completed both the baseline and 2-year follow-up interviews.

Results. The 2 study groups consumed similar amounts of fruits and vegetables at baseline. At the 2-year follow-up, the intervention group consumed 0.85 (SE = 0.12) servings more than the delayed intervention group ($P < .0001$). The largest increases were observed among people 66 years or older (1 serving), those with education beyond high school (0.92 servings), those widowed or divorced (0.96 servings), and those attending church frequently (1.3 servings). The least improvement occurred among those aged 18 to 37 years and those who were single.

Conclusions. The project was a successful model for achieving dietary change among rural African Americans. (*Am J Public Health.* 1999;89:1390-1396)

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Cancer is the second leading cause of death in the United States, and dietary factors have been linked to 30% or more of cancers.¹⁻⁴ Numerous studies indicate a relationship between increased consumption of fruits and vegetables and lowered risk of certain cancers.⁵ The protective effect from fruits and vegetables may be attributable to multiple factors, including fiber, antioxidants, and other anti-carcinogenic compounds.⁶ In addition, high fruit and vegetable intake is associated with lower risk of other chronic illnesses, such as cardiovascular disease and stroke.⁷ National disease prevention guidelines advise individuals to consume at least 5 servings of fruits and vegetables each day; however, surveys suggest that fewer than one third of US adults meet that target.⁸

The national 5-a-Day for Better Health Program ("5-a-Day"), established in 1991 by the National Cancer Institute (NCI) and the Produce for Better Health Foundation, encourages Americans to consume 5 or more daily servings of fruits and vegetables to promote prevention of cancer and chronic disease. In 1993, the NCI funded 9 research projects to investigate whether community intervention programs are effective in increasing fruit and vegetable consumption.⁹ The North Carolina Black Churches United for Better Health project, funded under this initiative, was the only one that specifically targeted African Americans or used churches as channels for intervention.

African Americans were selected as the target population because of their disproportionately higher rates of cancer incidence and mortality relative to other ethnic and racial groups in the United States.¹⁰ In North Carolina, age-adjusted cancer mortality rates are markedly higher for minority men than for White men (240.4 vs 164.2 per 100 000), and

this is true as well among minority women in comparison with White women (123.5 vs 103.5 per 100 000).¹¹ We chose to work with churches because of the high percentage of African Americans who attend church and the importance of this institution within the African American community.¹²

The study's primary aim was to increase fruit and vegetable consumption by at least 0.5 daily servings. In this article, we report the primary study outcomes, using data from individual preintervention and postintervention participant surveys.

Methods

Sample Recruitment and Randomization

The study population was composed of members of 50 Black churches in 10 rural counties located in eastern North Carolina.

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These counties, all of which had at least 30% minority populations, had higher rates of cancer morbidity and mortality than the state average. The units of randomization were the counties, which were pair matched on the basis of demographic and geographic characteristics. All churches (regardless of denomination) with a primarily African American membership were inventoried in each county and stratified according to membership size. Two small churches (fewer than 100 members) and 3 large churches (100 members or more) were randomly chosen in each county. Stratification was conducted because large churches tend to have a more socioeconomically advantaged membership than smaller churches (J. Hatch, North Carolina Central University, oral communication, September 1993). We did not exclude churches with racially "mixed" memberships; however, churches in these rural, southern counties typically are segregated.¹³

Random replacements from same-sized strata and counties were chosen for 12 churches that declined to participate, and all of the second-tier invitees enrolled. One small intervention church dropped out midway through the project owing to church matters unrelated to the study, leaving 49 churches in the study for follow-up. Churches in the 5 intervention counties received the planned 5-a-Day intervention program (described in the Intervention section), whereas churches in the delayed intervention counties did not receive any program activities until after completion of the 2-year follow-up survey. All intervention churches received funds to implement the program activities (approximately \$2500 per year), along with a smaller discretionary amount for general church needs (\$1000 per year). Delayed intervention churches received only the discretionary funds.

Each church provided a list of all active adult members, defined as those who participated in worship services or church activities at least once per month. This definition was deemed appropriate for rural churches, especially smaller ones, where services are not always held weekly. All active members were included in the study (i.e., there was no subsampling within churches). Baseline telephone interviews were conducted after randomization but before any intervention activities had begun (September 1994–January 1995). Before each interview, participants received a mailed packet that contained 2-dimensional food portion models, survey instructions, and a small incentive (e.g., a refrigerator magnet).¹⁴ Interview methods and the characteristics of the baseline sample ($n = 3737$) have been described elsewhere.^{14–17} An interim telephone survey of a one-eighth subsample of participants ($n = 459$) was conducted after 1 year (September–

December 1995). Follow-up telephone interviews with the full sample were conducted after 2 years (September–December 1996). Both counties in each pair were initiated into the project simultaneously to avoid possible biases that could occur from assessing fruits and vegetables in different seasons (e.g., September vs December).

The final sample for this study comprised 2519 individuals who completed both the baseline and follow-up surveys; the response rate was 77.3%.¹⁸ (This rate was defined as the number of respondents divided by the estimated number of those eligible in the sample.¹⁹) Church response rates ranged from 58% to 100%. Of nonrespondents, 64 (1.7%) were medically or cognitively incapable, 3 (0.1%) had language problems, 140 (3.8%) were no longer members of the study churches, 26 (0.6%) were deceased, 54 (1.5%) refused to be surveyed, 17 (0.4%) were not available during the survey period, and the remainder could not be reached after at least 8 call attempts. In comparison with respondents, nonrespondents were more likely to be younger and male and more likely to be unmarried. The overall survey response rate did not differ between study groups ($P = .55$).

Measures

The survey was pilot tested and revised on the basis of information from 100 African Americans from 2 Black churches that were not part of the study. Survey items included demographic characteristics, fruit and vegetable consumption, stage of change, knowledge of the number of servings recommended for good health, self-efficacy for eating 5 servings a day, and perceived availability of fruits and vegetables at church functions. A 15-item food frequency questionnaire was used to measure fruit and vegetable consumption. The primary outcome measure consisted of 7 of these items, developed by the NCI to evaluate the 5-a-Day studies.²⁰ Items included were 100% orange or grapefruit juice, other 100% juices, fruit, green salad, french fries or fried potatoes, other potatoes, and other vegetables. Total consumption was computed by summing individual item scores with and without fried potatoes, an item sometimes excluded by the 5-a-Day criteria.⁸ This instrument and a similar one have been validated in a number of US populations, yielding correlations in the range of 0.47 to 0.56 with longer food frequency questionnaires and multiple 24-hour recalls.^{21,22}

We validated the 7-item instrument with 3-day food records obtained from 146 members of the same subsample that completed the 1-year interim survey. The Minnesota Nutrient Data System was used in analyses of food records in regard to frequency of fruit and veg-

etable consumption.²³ The correlation between the 7 items and the food records (corrected for random within-person error) was 0.51.²⁴ The food frequency questionnaire also included 8 fruit and vegetable items, drawn from the Block food frequency questionnaire and previous research, designed to provide more information about specific kinds of fruits and vegetables (e.g., apples, oranges, turnip and collard greens, cooked dried beans) that we learned from pilot research were commonly consumed in this population.^{25,26} Baseline rates of consumption of these items have been published elsewhere.¹⁷ Stage-of-change, self-efficacy, and knowledge measures were developed jointly by the 5-a-Day community research projects and the NCI.^{27,28} We also assessed the availability of fruits and vegetables at church functions (almost always, quite a bit, a little bit, or never). Process measures included frequency of attending church during the previous year and to what extent (a lot, some, a little, or not at all) each of the different types of intervention activities led to individuals consuming more fruits and vegetables.

Cultural Sensitivity

To identify culturally sensitive ways to make the programs and messages more relevant and appropriate for an African American church audience, we drew upon information from 6 focus groups conducted early in the project, pastor interviews, and ongoing feedback from church members.^{29,30} Strategies were used such as working within social networks, recognizing and developing expertise within the church to conduct programs, and obtaining help from pastors to incorporate spiritual themes into tailored messages, sermons, and other communications. In each church, the pastor selected a coordinator and 3 to 7 members to form the Nutrition Action Team, which was responsible for organizing and implementing many of the program activities. In addition, an African American review group composed of pastors, project staff, and community members reviewed and approved all project materials.

Intervention

The multicomponent intervention used an ecological framework, targeting activities at the individual, social network, and community levels. The intervention lasted approximately 20 months and was theory based, using concepts from the stages-of-change transtheoretical model, social cognitive theory, and social support models.^{31–33} We organized concepts from these models into a framework of activities using the "PRECEDE-PROCEED model," in which we identified predisposing, enabling, and reinforcing factors related to increases in

fruit and vegetable consumption and, ultimately, to cancer prevention.³⁴ Activities targeting primarily predisposing factors included the following:

1. *Tailored bulletins.* Each intervention group member received personalized, tailored messages and feedback based on survey information regarding fruit and vegetable consumption, stages of change, barriers, beliefs, and social support.³⁵

2. *Printed materials.* Monthly packets were provided to each intervention church Nutrition Action Team. These packets included brochures, posters, banners, bulletin board materials, idea sheets, and church bulletin inserts.

Activities targeting primarily enabling factors included the following:

1. *Gardening.* Churches were encouraged to plant victory gardens and fruit trees, and the Cooperative Extension Service taught a master gardener program developed by and for church members.

2. *Educational sessions.* Nutrition Action Team members attended a 5-a-Day educational session, "Up Where We Belong," and were trained to conduct at least 2 sessions in their churches. "Cooking With Pizzazz" sessions, focused on modifying cooking methods to meet 5-a-Day guidelines, and classes on canning and freezing produce were conducted by Cooperative Extension Service agents.

3. *Cookbook and recipe tasting.* A trained cookbook chairperson from each intervention church assisted members in modifying their favorite recipes to meet the 5-a-Day guidelines. The recipes were taste tested by members and included in a cookbook, *A Taste of 5-a-Day*, that was distributed to all members.

4. *Serving more fruits and vegetables at church functions.* Churches were encouraged to serve fruits and vegetables at church functions such as homecoming dinners, vacation Bible school, and after-worship services.

Activities targeting primarily reinforcing factors included the following:

1. *Lay health advisors.* Church members identified as natural helpers attended bimonthly training sessions on topics such as providing social support and helping members advance in stages of change.¹⁵

2. *Community coalitions.* Each intervention county formed a coalition that included church members, local agency representatives, grocers, and farmers. Coalitions received training and met regularly to plan community events.

3. *Pastor support.* Pastors were encouraged to promote the project "from the pulpit." They were kept informed of all project activities and received a newsletter titled *The Body*

Temple. In addition, pastors reviewed educational materials and helped write and review tailored messages.

4. *Grocer-vendor involvement.* Materials designed to promote locally grown produce, such as recipe cards, coupons, and farmer's market posters, were distributed to church members and to local grocery stores.

5. *Church-initiated activities.* In addition to the planned interventions, churches conducted their own activities, such as 5-a-Day Sundays, "gospelfests," and youth-oriented events.

Statistical Analysis

Because observations were from individual members of churches, which were sampled within each county, the responses were not statistically independent. To account for the inherent correlation between responses of members of the same church and the nesting of churches within counties, we computed the differences at follow-up between averages of responses for the 5 randomized county pairs using the SAS PROC MIXED procedure.^{36,37} County pairs, churches within counties, and study group assignment were entered as random effects. Fixed effects included demographic characteristics (sex, age, education, marital status) and, for follow-up comparisons, baseline fruit and vegetable consumption. Income was omitted from multivariate models because it was not a significant covariate of consumption when other demographic factors were included. Individual responses were weighted to account for the statistical likelihood of inclusion in the sample and participation in the study.

Regression analyses and multiple tests were used to analyze differences in consumption between study groups according to each demographic characteristic. We used χ^2 tests (for categorical variables) and F tests (for continuous variables) to assess statistical significance. For multiple comparisons, the .05 significance level was divided by the number of tests to control the overall level of significance. Logistic regression was used to model the probability of differences occurring between the study groups at follow-up regarding stages of change, knowledge, self-efficacy, and perceived availability of fruits and vegetables at church functions.

Results

Demographic Characteristics

The final sample was primarily female (73%) and was 98% African American, 1% multiracial, and 1% "other." The average age was 53.8 years; more than half (55%) of the

participants were married, 67% had at least a high school education, and the majority (59%) reported household incomes below \$20,000 per year. Whereas various demographic differences existed within some county pairs, overall demographic characteristics were similar between the 2 study groups except for income level, which was higher in the delayed intervention group (see Table 1).

Changes in Consumption and Psychosocial Variables

At baseline, the intervention group consumed an average of 3.84 (SE = 0.10) daily servings of fruits and vegetables, and the delayed intervention group consumed 3.65 (SE = 0.10) servings ($P = .21$). When french fries were omitted, both totals were reduced by approximately 0.15 servings. Participants in both groups consumed more fruit than vegetables. A 1-year follow-up survey of a random subsample of participants indicated greater consumption, by 1 serving, in the intervention group. Analysis of food record data obtained at the 1-year follow-up from 146 participants from the same subsample (82 intervention participants and 64 delayed intervention participants) showed higher total consumption estimates for both treatment groups (approximately 0.6–0.8 more servings) relative to the 7-item instrument but also showed a difference of 1 serving between groups.

Analyses of the 2-year follow-up, adjusted for demographic characteristics and baseline intake, showed that the intervention group's consumption increased to 4.45 (SE = 0.08) servings, as compared with 3.60 (SE = 0.08) servings in the delayed intervention group, a difference of 0.85 (SE = 0.12) servings ($P < .0001$; see Table 2). When french fries were omitted, the difference was 0.87 servings. Increased fruit consumption accounted for most of the improvement (0.66 servings). In all 5 county pairs, the intervention county increased consumption relative to the delayed intervention county, with adjusted differences at follow-up ranging from 0.55 (county pair 5) to 1.34 (county pair 1) servings.

At baseline, approximately 23% of both study groups were consuming 5 servings per day, according to the 7-item food frequency questionnaire. The proportions meeting the 5-a-Day goal increased to 33% in the intervention group, vs a decrease to 21% in the delayed group ($P < .0001$).

As shown in Table 2, the difference in fruit and vegetable consumption between the study groups at follow-up was significant for all demographic categories with the exception of 1 age group (18–37 years) and 1 marital status group (single). The largest

TABLE 1—Demographic Characteristics of Black Churches United for Better Health Participants: 1994–1996

	Overall, %		By County Pair									
	Inter- vention (n = 1198)	Delayed Inter- vention (n = 1321)	County Pair 1 ^a		County Pair 2 ^b		County Pair 3		County Pair 4		County Pair 5 ^c	
			Inter- vention (n = 151)	Delayed (n = 323)	Inter- vention (n = 279)	Delayed (n = 236)	Inter- vention (n = 135)	Delayed (n = 248)	Inter- vention (n = 335)	Delayed (n = 236)	Inter- vention (n = 297)	Delayed (n = 279)
Sex												
Male	27.2	27.1	24.4	29.1	26.9	30.4	28.6	24.1	26.0	23.4	28.4	25.5
Female	72.8	72.9	75.6	71.8	73.1	69.6	71.4	75.9	74.0	76.6	71.6	74.5
Age, y												
18–37	19.9	15.6	17.7	13.7	19.8	9.2	16.0	6.1	21.1	17.6	20.3	29.1
38–51	27.1	25.5	29.6	25.4	30.1	29.8	30.8	22.5	23.1	19.5	27.2	27.7
52–65	26.4	29.9	21.1	30.4	27.4	29.4	29.4	32.9	26.0	31.8	26.4	26.3
66+	26.8	29.0	31.6	30.6	22.7	31.6	23.9	38.5	29.7	31.1	26.2	17.0
Education												
Less than high school	36.7	29.9	38.2	23.4	26.4	34.2	34.1	33.9	40.0	38.2	39.4	25.8
High school or equivalent	34.1	32.1	39.1	32.7	38.0	29.6	22.5	29.0	32.0	30.9	34.8	36.8
More than high school	29.2	38.0	22.8	43.9	35.6	36.2	43.4	37.2	28.0	30.9	25.8	37.5
Marital status												
Single	15.2	12.2	13.8	15.8	15.8	5.1	6.7	8.4	15.2	10.1	16.9	18.4
Married	51.9	59.5	44.6	60.1	53.3	63.1	64.0	54.1	55.7	57.3	48.3	59.6
Widowed or divorced	32.8	28.3	41.7	24.1	30.9	31.7	29.4	37.5	29.1	32.6	34.8	22.1
Household income per year*												
<\$20,000	64.6	55.8	79.2	47.7	65.0	58.5	56.2	57.6	64.2	53.2	79.3	50.1
\$20,000+	35.4	44.2	20.8	52.3	35.0	41.5	43.8	42.4	35.8	46.8	20.7	49.9

Note. Comparisons between intervention and delayed intervention groups are based on χ^2 tests of independence after adjustment for the study design (randomized counties, churches sampled within counties) and probability of inclusion in the study sample. Differences were considered significant at the .05 level. Sex was not significantly different in any county pair.

*No demographic differences between study groups except for income ($P < .01$)

^aAge, education, marital, and income differences were significant.

^bMarital and income differences were significant.

^cEducation difference was significant.

increases were seen among women, older individuals (those 66 years or older), those with education beyond high school, and those who were widowed or divorced.

Stages-of-change comparisons showed that more intervention group participants than delayed intervention group participants were in the preparation stage at baseline and that fewer were in the precontemplation stage.¹⁵ Fewer than 10% of the members of either group were in the action or maintenance stage at baseline; at follow-up, however, a higher proportion of the intervention group members (26% vs 15%) were in action or maintenance. At baseline, approximately 10% to 11% of participants knew that 5 or more daily servings of fruits and vegetables were needed for good health; at follow-up, this percentage had risen to 36% in the intervention group, as compared with 15% in the delayed intervention group. Positive changes also were found in terms of self-efficacy (confidence) for eating 5 servings per day and perceived availability of fruits and vegetables at church functions (Table 3).

Logistic regression was used to model the probability that the intervention group differed at follow-up from the delayed inter-

vention group regarding these psychosocial variables (see Table 3). Adjusted odds ratios and 95% confidence intervals were computed from models that included gender, age, and the baseline level of each psychosocial variable. Results showed that the adjusted odds for the intervention group at follow-up were significantly greater ($P < .005$) for being in the action or maintenance stage of change, having high self-efficacy, knowing that 5 or more servings were recommended, and perceiving that fruits and vegetables were available at church functions.

Process Measures

At baseline, frequency of church attendance was not significantly related to fruit and vegetable intake in either study group. In the intervention group, more frequent church attendance during the study period was a strong predictor of increased fruit and vegetable intake at follow-up. Participants who had attended church more than once per week during the previous year (25% of members) increased their consumption by 1.3 daily servings, as compared with increases of 0.6 servings for weekly attendees, 0.5 servings for twice-monthly attendees, and 0.1 servings for

those attending once per month or less. In the delayed group, more frequent church attendance was not associated with consumption.

Answers to questions regarding perceived influence of different program activities showed that the majority of participants rated having fruits and vegetables served at church functions as influencing them "a lot" (60%), along with pastor sermons (55%), the personalized tailored bulletins (53%), and other printed materials (50%). The activities least often cited as influential were educational sessions (30%) and community events (32%).

Discussion

This randomized trial of a 5-a-Day intervention in Black churches showed positive results in achieving dietary behavior change. The observed effect size (0.85 servings) was greater than the half-serving increase projected in the study design, which is impressive considering that all eligible church members were surveyed, regardless of their level of participation in project activities. This effect size was consistently estimated by mixed-model analysis (as described here), analyses using SUDAAN,³⁸ and a stratified estimation

TABLE 2—Comparison of Study Groups' Fruit and Vegetable Consumption at Baseline and 2-Year Follow-Up, Overall and by Demographic Categories: Black Churches United for Better Health Project, 1994–1996

	Intervention (n = 1198), Mean (SE)		Delayed Intervention (n = 1321), Mean (SE)		Difference at Follow-Up	Difference P
	Baseline	Follow-Up	Baseline	Follow-Up		
Total fruits and vegetables	3.84 (0.10)	4.45 (0.08)	3.65 (0.10)	3.60 (0.08)	0.85 (0.12)	.0001 ^a
Fruit	2.14 (0.06)	2.64 (0.06)	2.04 (0.06)	1.98 (0.06)	0.66 (0.09)	.0001 ^a
Vegetables	1.69 (0.04)	1.82 (0.03)	1.61 (0.04)	1.63 (0.03)	0.19 (0.04)	.0003 ^a
Total by demographic group						
Sex						
Male	3.31 (0.11)	3.66 (0.13)	3.22 (0.11)	3.16 (0.14)	0.50 (0.19)	.0122 ^a
Female	3.96 (0.11)	4.70 (0.16)	3.87 (0.11)	3.84 (0.16)	0.86 (0.17)	.0001 ^a
Age, y						
18–37	3.45 (0.16)	3.55 (0.16)	3.21 (0.16)	3.08 (0.20)	0.47 (0.23)	.0409
38–51	3.66 (0.15)	4.49 (0.21)	3.51 (0.16)	3.51 (0.22)	0.98 (0.29)	.0018 ^a
52–65	3.87 (0.12)	4.44 (0.16)	3.92 (0.12)	3.85 (0.16)	0.58 (0.22)	.0128 ^a
66+	4.06 (0.11)	4.88 (0.12)	3.95 (0.11)	3.85 (0.13)	1.04 (0.17)	.0001 ^a
Education						
Less than high school	3.70 (0.12)	4.26 (0.17)	3.64 (0.13)	3.59 (0.18)	0.67 (0.19)	.0004 ^a
High school or equivalent	3.82 (0.13)	4.23 (0.15)	3.60 (0.13)	3.37 (0.16)	0.86 (0.21)	.0004 ^a
More than high school	3.80 (0.13)	4.77 (0.20)	3.99 (0.12)	3.85 (0.19)	0.92 (0.22)	.0001 ^a
Marital status						
Single	3.56 (0.17)	3.46 (0.16)	3.40 (0.20)	3.18 (0.21)	0.28 (0.26)	.2934
Married	3.72 (0.10)	4.47 (0.13)	3.74 (0.10)	3.66 (0.13)	0.81 (0.16)	.0001 ^a
Widowed, divorced, other	3.89 (0.13)	4.73 (0.22)	3.74 (0.13)	3.77 (0.23)	0.96 (0.24)	.0004 ^a
Household income per year						
<\$20 000	3.82 (0.10)	4.48 (0.14)	3.59 (0.10)	3.63 (0.15)	0.84 (0.17)	.0001 ^a
\$20 000+	3.64 (0.14)	4.23 (0.13)	3.79 (0.14)	3.64 (0.12)	0.60 (0.18)	.0014 ^a

Note. All analyses include adjustment for the study design (randomized counties, churches sampled within counties) and probability of inclusion in the study sample. Overall analyses between study groups at baseline and follow-up include adjustment for sex, age, education, and marital status. Analyses comparing follow-up consumption also include adjustment for baseline dietary intake. Individuals with missing values for demographic or dietary information are excluded. There are no significant differences in fruit and vegetable intake at baseline between study groups overall or by demographic subgroups. Analyses comparing demographic subgroups are not adjusted for other demographic covariates.

^aComparison at follow-up was statistically significant ($\alpha = 0.05$, divided by number of tests to conservatively account for multiple tests).

based on pair-matched county differences. The improvements in stages of change, self-efficacy, knowledge of the 5-a-Day recommendation, and perceived availability of fruits and vegetables at church also support the observed differences in dietary intake that were achieved at follow-up.

Strengths of the intervention included using an ecological model to target multiple levels of change and using qualitative information from the study population to design culturally sensitive programs and messages. The process data suggest that the multicomponent approach was appropriate, because participants were most influenced by activities that targeted a combination of predisposing factors (tailored bulletins and printed materials), enabling factors (having more fruits and vegetables served at church functions), and reinforcing factors (pastors' sermons). In this project, the institutional support and social networks of the church provided an effective avenue for diffusion of the 5-a-Day message. Also, partnering with churches results in the potential for long-term maintenance and institutionalization of the 5-a-Day program within the church structure.

To our knowledge, this is the largest randomized study of a dietary intervention that has been conducted in Black churches. Random selection of churches within the counties prevented the potential bias of taking a convenience sample of volunteer churches, whose members may have been of higher socioeconomic status and health orientation relative to the average church. In addition, stratification according to church size and inclusion of various denominations increase the generalizability of the study findings to other southern Black churches. The 2-year follow-up period also was longer than in many intervention studies and suggests that behavior changes observed at 1 year were maintained.

The impact on disease reduction from primary prevention studies is difficult to quantify. Epidemiological evidence has indicated that the risk of certain cancers, including lung, colorectal, and esophageal, is approximately one half for individuals in the highest quartile of fruit and vegetable intake relative to those in the lowest quartile.^{5,39} The strongest evidence for a protective effect against cancer involves vegetables, whereas the evidence for fruit consumption is inconsistent.³ Because this study increased fruit intake

more than vegetable intake, future studies may need to emphasize the importance of vegetables in addition to a combined 5-a-Day message.

The strong association seen in the intervention group between frequency of church attendance and increased fruit and vegetable intake is suggestive of a dose-response relationship between intervention exposure and behavior change. Several studies have documented decreased mortality and healthier behaviors among individuals who attend church frequently.^{40,41} Although we did not observe higher fruit and vegetable intake among more frequent attendees for either study group at baseline, the final survey data clearly show that the most frequent attendees in the intervention group derived the greatest benefits from the program. Some of the demographic characteristics of those who increased consumption the most (i.e., women, older people, and widowed or divorced individuals) also are typical of people who attend church frequently.⁴⁰

Several study limitations should be noted. The findings are based on self-report information, which can be subject to response set bias.⁴² Participation in a dietary interven-

TABLE 3—Comparison of Study Groups at Baseline and Follow-Up Regarding Stages of Change and Psychosocial Factors Related to Increasing Fruits and Vegetables: Black Churches United for Better Health Project, 1994–1996

	Intervention (n = 1198), %		Delayed Intervention (n = 1321), %		Adjusted Odds Ratio (95% Confidence Interval)
	Baseline	Follow-Up	Baseline	Follow-Up	
In action—maintenance stage of change ^a	8.5	26.0	6.6	14.8	2.15 (1.80, 2.56)*
High self-efficacy for eating 5 daily servings (very sure or sure) ^a	34.7	47.3	26.4	30.7	1.80 (1.41, 2.29)*
Know that 5 or more daily servings needed for health ^a	11.4	36.4	10.0	15.2	3.48 (2.38, 5.10)*
Perceive that fruits and vegetables are available at church functions almost always—quite a bit ^a	55.8	83.5	61.8	61.8	3.42 (2.30, 5.10)*

Note. Adjusted odds ratios are calculated based on the probability of differences between study groups occurring at follow-up. Analyses are adjusted for sex, age, baseline levels of each psychosocial variable, and include adjustment for the study design (randomized counties, churches sampled within counties) and probability of inclusion in the study sample.

^aFor logistic models, n = 2350 for stages-of-change, n = 2386 for self-efficacy, n = 2289 for knowledge of servings needed, and n = 2421 for perceived availability of fruits and vegetables at church.

*Confidence intervals for odds ratios do not include 1.0; results were statistically significant at $P < .005$.

tion may improve the accuracy of reported dietary intake.⁴³ Receiving mailed survey instructions also could have differentially reinforced the program's educational messages for the intervention group. In this study, we did not assess biomarkers of fruit and vegetable intake, such as plasma carotenoid levels, which might have provided a validation of the food frequency questionnaire data.⁴⁴ Anthropometric and physiological parameters, such as weight and blood pressure, also were not monitored in the study.

Another limitation was the use of a brief food frequency questionnaire as the primary outcome measure rather than a more comprehensive dietary instrument that might have assessed additional fruits and vegetables consumed and the contribution of fruits and vegetables from mixed dishes.⁸ The randomized design, however, should have distributed these potential biases equally across both study groups. Evidence for such distribution of bias was shown in a comparison of the food records and the brief food frequency questionnaire at the 1-year follow-up. The measures provided similar intervention effect sizes, even though the more comprehensive assessment gave higher estimates of fruit and vegetable consumption for both study groups.

A final limitation is the absence of measures of cancer or other disease endpoints. Because cancer development encompasses many years, visible differences in disease incidence could not be detected in this short study.

Finally, despite the encouraging results of this study overall, the program failed to achieve significant changes in 2 subgroups: those who were single and those who were aged 18 to 37 years. This suggests a need for more research to elucidate effective approaches to reach such segments of the population, especially because lower rates of fruit and vegetable intake occur within these subgroups. □

Contributors

All authors participated in the planning and design of the study and contributed to writing the paper. M. K. Campbell was primarily responsible for the overall research design and the manuscript preparation. W. Demark-Wahnefried, J. Dodds, A. Cowan, B. Jackson, B. Motsinger, K. Hoben, and J. W. McClelland contributed to the intervention design, recruitment, implementation, and questionnaire design. M. Symons and W. D. Kalsbeek designed and supervised the sampling strategy and statistical analysis for the study. J. Lashley and S. Demissie collaborated in planning and conducting the statistical analyses for the paper.

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