

Increasing Use of Mammography Among Older, Rural African American Women: Results From a Community Trial

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Despite their lower breast cancer incidence rates, older African American women have higher breast cancer mortality rates than do White women.^{1,2} Later stage at diagnosis accounts for a significant proportion of the mortality difference, and lower rates of screening mammography account for some of the racial disparities in stage at diagnosis.^{3–5} Although National Health Interview Survey data suggest that White and African American women report similar use of mammography, other studies have revealed racial differences.^{6–10} Breast cancer screening rates are also lower in disadvantaged populations, including women in rural areas, women of lower socioeconomic status, and women without insurance coverage.^{6,10–14}

Lay health advisors (including peer volunteers, peer educators, and lay community workers) have been proposed as an effective means of promoting breast cancer screening and other healthy behaviors.^{15–32} Lay health advisors are community members trained to act as links between the professional health care system and their communities.¹⁶ Studies conducted with disadvantaged urban populations have shown that lay health advisor interventions increase mammography use among women recruited from the community.^{25–32} Few studies have addressed communitywide changes in postintervention behaviors, and even fewer among rural populations.

The North Carolina Breast Cancer Screening Program (NC-BCSP) was a community trial designed to determine the effectiveness of a lay health advisor intervention, supplemented by a limited number of other activities, aimed at increasing self-reported mammography use among African American women 50 years and older in eastern North Carolina. In this article, we examine effective-

Objectives. A community trial was undertaken to evaluate the effectiveness of the North Carolina Breast Cancer Screening Program, a lay health advisor network intervention intended to increase screening among rural African American women 50 years and older.

Methods. A stratified random sample of 801 African American women completed baseline (1993–1994) and follow-up (1996–1997) surveys. The primary outcome was self-reported mammography use in the previous 2 years.

Results. The intervention was associated with an overall 6 percentage point increase (95% confidence interval [CI] = –1, 14) in communitywide mammography use. Low-income women in intervention counties showed an 11 percentage point increase (95% CI = 2, 21) in use above that exhibited by low-income women in comparison counties. Adjustment for potentially confounding characteristics did not change the results.

Conclusions. A lay health advisor intervention appears to be an effective public health approach to increasing use of screening mammography among low-income, rural populations. (*Am J Public Health.* 2002;92:646–654)

ness among the most disadvantaged women, presenting results, both overall and by income, after 2 years of the intervention.

METHODS

Setting

The NC-BCSP took place in eastern North Carolina in 5 intervention counties (Beaufort, Bertie, Martin, Tyrell, and Washington) and 5 comparison counties (Craven, Greene, Lenoir, Jones, and Pamlico) geographically separated by the Pamlico Sound. The 2 sets of counties (combined 1990 population: 280 659) had similar demographic, geographic, and cultural characteristics as well as similar access to health care and mammography services. Two thirds of the counties' adult residents lived in rural areas or small towns with populations below 5000; 37% were members of minority groups; and 12% lived below the poverty line.

Physician–population ratios were 1:1500 and 1:1000 in the intervention and comparison counties, respectively. Intervention coun-

ties had 5 radiology centers providing mammography services; comparison counties had 4 such centers. The Centers for Disease Control and Prevention's Breast and Cervical Cancer Control Program, which funds mammograms for eligible low-income women, became available in all 10 counties in 1994, a year after initiation of the NC-BCSP.

Intervention

On the basis of the social–ecological model of behavior emphasizing linked strategies at the individual, social network, organizational, community, and policy levels,³³ we implemented an intervention that relied primarily on a network of 170 trained, volunteer lay health advisors, supplemented by a limited number of activities targeting the communities, providers, and health care organizations. Lay health advisors were “natural helpers” in the community, women to whom other women turned for guidance and support.^{15,16} Four community outreach specialists (indigenous community leaders hired and paid by the project but located in local health depart-

ments and federally funded rural health centers) linked lay health advisors to the health care system. An in-depth description of the intervention has been published previously.³⁴

Before the intervention, we conducted 25 focus groups with older African American women (5 in each intervention county) and interviews with key community informants to guide training of lay health advisors and targeting of materials for each county. Focus groups examined local women's (1) knowledge and attitudes related to breast cancer, (2) social support, and (3) attitudes toward the health care system. The interviews and focus groups also identified characteristics of natural helpers as well as potential lay health advisors.

Beginning in 1993, community outreach specialists and staff recruited and trained 149 lay health advisors in the 5 intervention counties over a period of 18 months. An additional 21 lay health advisors were trained in early 1997. Compared with the general population of women in the intervention counties, advisors more often reported a high school education (79% vs 32%) and an annual family income of \$12 000 or higher (43% vs 19%). Informed by focus group results, lay health advisor training included 3–5 sessions involving didactic methods, role playing, and other techniques; these sessions provided 10–12 hours of instruction about breast cancer, breast cancer screening, and eligibility for screening payment programs.

After training, lay health advisors worked individually and collaboratively with each other to promote awareness and use of breast cancer screening among African American women in their communities. Community outreach specialists supported lay health advisors through monthly meetings and assistance in organizing activities. These specialists also worked with staff and community leaders to establish local advisory committees. Community activities (approximately 2 per month) included presentations made to local community groups (at beauty parlors, nutrition sites, churches, and other places where women gathered) and community events (such as health fairs, parades, and mobile mammography van days).

At the individual level, advisors engaged in one-to-one conversations (approximately 2

per week per advisor) with women they knew and used culturally sensitive materials informed by the focus group data and behavioral change theory to reinforce their promotion of breast cancer screening.³⁵ Between 1994 and 1996, approximately 11 772 informational/motivational items were distributed, including brochures and posters with photos of local residents and mammography information tailored to each county and church fans and holiday cards (Mother's Day, Valentine's Day, and Christmas) with messages about mammography screening.

A limited number of supplemental intervention activities focused on increasing mammography quality and availability among health care providers and organizations. Project staff members expert in breast imaging met briefly with several of the local radiology practices to ensure compliance with the Mammography Quality Standards Act and to raise awareness of African American women's barriers in regard to mammography.³⁶ With assistance from the lay health advisors, community outreach specialists, and the North Carolina Breast and Cervical Cancer Control Program, staff also conducted brief training sessions with physician practices, community health centers, and health departments. These sessions were designed to promote breast cancer screening and mammography referrals, especially among women who qualified for free breast cancer screening. Finally, lay health advisors and community outreach specialists worked with providers and community organizations to increase access to mammography by providing transportation and promoting lower charges.³⁷

Evaluation Design

Adapting a framework developed by Glasgow and Vogt,³⁸ we examined intervention effectiveness, reach, and efficacy in a nonrandomized community trial. We identified and followed 2 cohorts (intervention and comparison) of African American women (approximately 500 women each at baseline). The cohort design used had greater power to detect changes in mammography use than did repeated cross-sectional sample designs.³⁹ Baseline data were collected in 1993–1994. Training of lay health advisors began in 1994, and follow-up data collection took

place in 1996–1997. A second follow-up to determine long-term intervention effects was recently completed. In addition, we identified and followed 2 supplemental cohorts (intervention and comparison) of White women to investigate changes in racial differences in mammography use (data not presented).

Sample and Data Collection

To establish the 4 cohorts, we used the 1990 census and a systematic random sample to select census blocks from each county for each race-specific cohort. Interviewers canvassed door to door in 520 selected blocks and approached 2355 households. In 235 households (10%), the potentially eligible women could not be contacted or refused to participate. The remaining 2120 households included at least one woman who was 50 years or older, did not have breast cancer, and agreed to participate; 321 households (15%) included more than one eligible woman.

We then randomly sampled households from among those identified as eligible. If a selected household contained more than one eligible woman, one was randomly selected. Counties were represented proportionally within each cohort and race stratum. Of the 2441 women potentially eligible for interview, 145 were ineligible because they were too ill, had moved, had died, or had developed breast cancer. Interviewers completed baseline interviews with 1996 of the 2296 remaining women (87% interview response rate).

At baseline, the 2 African American evaluation cohorts included 993 women (494 intervention and 499 comparison). At follow-up, we excluded 91 women because they had died ($n=70$), moved out of the study area ($n=5$), been admitted to nursing homes ($n=3$), developed breast cancer ($n=6$), or previously participated in lay health advisor training ($n=7$). Of the remaining 902 eligible women, 390 intervention participants (89%) and 411 comparison participants (88%) completed the follow-up interview.

Overall, there were no large differences between eligible respondents and nonrespondents. In both cohorts, nonrespondents reported less baseline mammography use and had fewer correct beliefs about mammogra-

TABLE 1—Baseline Characteristics of Black Female Respondents: North Carolina Breast Cancer Screening Program, 1993–1994 and 1996–1997

Characteristic	Intervention (n = 390), %	Comparison (n = 411), %
Personal		
Age, y		
50–64	46	44
65–74	31	32
≥75	23	24
Married	39	35
Education		
Grades 1–8	37	32
Grades 9–11	31	35
High school or more	32	33
Annual family income below \$12 000	81	63**
Health		
Personal history of breast problems	9	9
Family history of breast cancer	8	9
1 or more medications taken regularly	79	81
More than 3 chronic health problems	27	29
Access		
Regular physician		
Obstetrician/gynecologist	2	3
Other	87	86
No regular physician	11	10
Has health insurance coverage	83	84
No. of medical visits in past year		
4 or more	49	65
1–3	42	28
None	9	7**
Physician recommendation in past year	39	51**
Attitudes/knowledge barriers		
Perceived susceptibility to breast cancer	23	11**
Perceived severity of breast cancer	29	24
Breast cancer knowledge (7 items)		
High (6–7 correct)	23	28
Medium (4–5 correct)	34	41
Low (0–3 correct)	43	31**
Barriers to mammography (18 items)		
Low (0–4)	44	52
High (5–17)	56	48*
Social norms and support		
Support for breast cancer screening		
High	19	16
Medium	38	49
Low	43	35**
Spirituality (5 items)		
Low (0–2)	26	25
High (3–5)	74	75

Note. *P* values were obtained via *t* test for social network size and χ^2 tests for all other variables. Owing to item nonresponse, actual sample sizes for 16 variables ranged from 378 to 390 for intervention participants and from 407 to 411 for comparison participants. Item nonresponse was higher for annual family income and actual sample sizes were 347 (intervention) and 375 (comparison). Questions used in creating 2 of the variables (breast cancer knowledge and barriers to mammography) were asked only of women who were aware of mammography (intervention: 340; comparison: 374). Social network size means were as follows: intervention, 3.35, and comparison, 3.85.

P* < .10; *P* < .01.

phy. Intervention nonrespondents reported less perceived susceptibility to breast cancer, while comparison nonrespondents were older and had fewer comorbid conditions.

On average, baseline and initial follow-up interviews were 32 months apart (range: 20–47 months) in the intervention cohort and 30 months apart (range: 18–41 months) in the comparison cohort. At both baseline and follow-up, trained female interviewers drawn from the community administered a 45-minute questionnaire in women's homes. In most cases, the 58 interviewers were matched to the women interviewed in regard to race and age.

Outcomes, Characteristics, and Exposure Measures

The primary outcome measure was a woman's self-report of having undergone a mammogram in the previous 2 years. We defined a mammogram as "an x-ray of the breast taken by a machine that presses against the breast while the picture is being taken." Women who reported that they were not aware of mammography or of this type of x-ray were considered not to have had a mammogram.

We examined characteristics of the women (reported at baseline) that, on the basis of previous literature, could be related to mammography use (Table 1). Questions regarding attitudes toward mammography were asked only of those women who were aware of mammography. Knowledge about breast cancer and mammography, barriers to mammography use, and spirituality were summed measures comprising, respectively, 7, 18, and 5 dichotomous variables (respective Cronbach alpha coefficients: 0.69, 0.81, and 0.65). We used reduced monotonic regression analyses to categorize continuous variables. This type of analysis minimizes the information loss or overfitting associated with other methods of categorization.⁴⁰

Income was grouped into 2 categories based on the 1993 federally determined poverty level for a family of 2: less than \$12 000 per year (lower income) and \$12 000 or more per year (higher income). Of 801 women, 190 (24%) failed to report income at baseline. Because income reports at baseline and follow-up were strongly associated, we substituted

income at first follow-up when baseline information was missing. In a sensitivity analysis, we used multiple random imputation to assign incomes for 79 women missing income data at both time points.⁴¹ Multiple random imputation allowed computation of confidence intervals (CIs) that accounted for the uncertainty generated by imputation.

We used multiple measures of women's self-reported exposure to the intervention: awareness of the intervention program (being aware of NC-BCSP or "Save Our Sisters"), 2 measures regarding receipt of mammography advice, and recognition of project materials. Regarding advice, we asked women whether anyone other than a doctor or nurse had talked to them about getting a mammogram. Women who gave the name of a lay health advisor or NC-BCSP group were considered to have received advice from a lay health advisor ("LHA advice"). Women who reported receiving advice from an unnamed friend, family member, or group member were considered to have received "any advice." We considered this second advice measure important because lay health advisor interventions seek to diffuse messages through indigenous social networks, and the lay health advisor's role was to talk to her friends and family in a natural context about mammography.¹⁶

Analysis

We adapted Glasgow and Vogt's RE-AIM framework to evaluate the following elements of the intervention: reach (exposure to the intervention), efficacy (changes in mammography use among those exposed to the intervention), and effectiveness (changes in mammography use in the community-based cohort after introduction of the intervention). Because the intervention was designed to target and benefit lower income women, we examined reach, efficacy, and effectiveness both overall and by income level.

To estimate reach, as well as contamination, we examined exposure within the intervention cohort and compared exposures between the intervention and comparison cohorts. To assess overreporting, we estimated exposures to 3 "phantom" promotional items from projects not active in the 10 counties. We assessed efficacy by comparing the unadjusted changes (baseline to follow-up) in

the primary outcome measure (mammography use in the previous 2 years) between exposed and unexposed women in the intervention cohort. Effectiveness was estimated according to a "difference of differences" technique: the increase (baseline to follow-up) in the primary outcome measure among women in the comparison cohort was subtracted from the increase among women in the intervention cohort.

In all multivariate models, 2 values (baseline and follow-up) were entered for each woman, and interaction terms involving time (baseline or follow-up) and cohort (intervention or comparison) directly estimated the difference of differences. We used both logistic regression and linear risk models with generalized estimating equations to account for correlations in repeated mammography reports.⁴² Because results were similar in the 2 models, we report results from the linear risk models, which are more easily interpreted. We obtained *P* values using Wald's χ^2 test for parameter estimates from linear risk models. As a result of model limitations, we were not able to account simultaneously for correlations from repeated measures and census block clustering.

In the multivariate models of intervention effectiveness, we included as covariates personal, health, access, attitude, and social support characteristics that were minimally associated ($P \leq .20$) with both cohort and mammography use. In addition, for each income group we used separate models with separate covariates specific to that group to examine intervention effectiveness. To assess the sensitivity of results to missing income, we repeated analyses with imputed incomes for the 79 women (10%) who had missing income data at both time points. All analyses were conducted with SAS (version 6.12).⁴³

RESULTS

Women's Characteristics

At baseline (1993–1994), a lower percentage of women in the intervention cohort than in the comparison cohort reported mammography use (41% vs 56%). Intervention cohort women significantly more often reported lower annual family incomes, fewer medical visits, and no physician recommendations for

mammography in the past year (Table 1) than did comparison cohort women. They also significantly more often reported perceived susceptibility to and less knowledge about breast cancer, a higher number of perceived barriers to mammography, and less social support for breast cancer screening.

Reach

Reach in the intervention cohort was moderate, with exposure prevalence rates of 37%, 24%, and 14% for intervention awareness, any advice, and LHA advice, respectively (Table 2). Rates of exposure to individual project promotional items ranged from 10% (Christmas cards) to 33% (posters); 60% of women reported exposure to at least one intervention informational item. Contamination from the intervention cohort to the comparison cohort was limited (Table 2). The 2 cohorts reported similar exposure to the National Cancer Institute's "Do the Right Thing" logo, which was not specific to the intervention and was used in all 10 counties. Intervention women reported more exposure to phantom materials than did comparison women.

Exposure tended to be greater among higher income women (Table 2). Exposure also varied among the 5 intervention counties (data not shown). In one county, 45% of women reported LHA advice, and 76% encountered one or more of the project promotional items. In another county, 4% reported LHA advice, and 56% encountered one or more items.

Efficacy

Within the intervention cohort, women who reported awareness, any advice, or LHA advice also reported greater increases in mammography use than women reporting no exposure, although linear risk models showed that these increases were not statistically significant (Table 3). Women who reported exposure to at least one of the project promotional items exhibited slightly (but not statistically significant) increased mammography use. Exposure to the "Do the Right Thing" logo was associated with a statistically significant 12% greater gain in mammography use; in the comparison cohort, this exposure was associated with an 8% gain in use. Exposure to phantom materials was not associated with an effect (data not shown).

TABLE 2—Self-Reported Intervention Exposures, by Cohort: North Carolina Breast Cancer Screening Program Follow-Up (1996–1997)

Exposure Indicator	Intervention (n = 390), %	Comparison (n = 411), %	Intervention, by Income	
			Income <\$12 000 (n = 281), ^a %	Income ≥\$12 000 (n = 66), ^a %
Awareness	37	14**	34	53**
Any advice	24	7**	23	29
Advice from lay health advisor	14	<1**	12	23*
Program materials reported				
Brochure	22	3**	20	32*
Mother's Day card	17	4**	17	26*
Valentine's Day card	11	5**	11	17
Christmas card	10	2**	10	14
Church fan	16	3**	14	27**
Poster	33	4**	32	44*
"Do the Right Thing" logo	29	26	30	26
1 or more materials	60	32**	61	65
More than 4 materials	12	2**	9	24**
Phantom materials reported				
Church fan	11	3**	10	14
Health brochure	14	7**	14	18
Logo	5	5	5	6
Any phantom material	23	11**	24	26

Note. Chi-square tests were used in obtaining *P* values. See text for complete descriptions of indicators.

^aDoes not include women with missing income data.

P* < .10; *P* < .01.

Effectiveness

Mammography use increased between baseline and the initial follow-up in both the intervention and comparison cohorts but increased 6 percentage points more (unadjusted difference of differences) in the intervention cohort (95% CI = -1, 14; Table 4). In a multivariate model adjusting for age, number of medical care visits, report of physician recommendation for mammography, and perceived susceptibility to breast cancer, the difference of differences was 7 percentage points (95% CI = 0, 14). At the first follow-up, use rates in the intervention cohort still lagged behind those in the comparison cohort, but the gap had narrowed from 15 to 9 percentage points.

Effectiveness by Income Group

Effectiveness was estimated by the "difference of differences," defined as the change (baseline to follow-up) in mammography use among women in the intervention cohort over and above the change in use among

women in the comparison cohort. Lower income women from the intervention cohort exhibited a 12 percentage point (unadjusted) greater gain in use than did lower income women from the comparison cohort (95% CI = 2, 21; Table 4). In multivariate models adjusting for characteristics related to mammography use and cohort among low-income women only, the difference of differences was 11 percentage points (95% CI = 2, 21). The difference between lower and higher income women in recent mammography use at baseline (12 percentage points) had virtually disappeared by follow-up (1 percentage point).

In contrast, higher income women in the intervention cohort exhibited a gain in use that was 6 percentage points lower than that in the comparison cohort (95% CI = -18, 7; Table 4). Multivariate models showed that the difference of differences was 1 percentage point (95% CI = -10, 11). Among these women, the 17 percentage point gap at baseline had grown to 23 percentage points at the

first follow-up. A sensitivity analysis including the 79 women with imputed income values did not substantially change the estimated difference of differences for lower and higher income women (data not shown).

DISCUSSION

Despite national trends toward increasing use,⁴⁴ mammography remains underused by disadvantaged populations, including low-income, rural, and African American women.^{14,45} This study evaluated the reach, efficacy, and effectiveness of a lay health advisor intervention designed to increase mammography use among older, low-income, rural African American women. After approximately 2 years of activities, the intervention had reached more than half of the women from the intervention cohort with project materials and a quarter with advice from a friend, family member, or lay health advisor to undergo a mammogram.

Although not statistically significant and limited by small numbers, the results suggest that the intervention was efficacious among women who reported that they had received advice. In terms of effectiveness, mammography use in the intervention cohort increased by 7 percentage points (*P* = .05) above that in the comparison group. The intervention appeared to be more effective among lower income women, who exhibited a gain 11 percentage points (*P* = .02) higher than the gain among comparable women in the comparison cohort.

Lay health advisor interventions have been recommended for disadvantaged women.⁴⁶ Previous studies examining intervention efficacy, primarily among minority populations in urban settings but also (in one study) among rural African American women, have shown increased rates of mammography use.^{25–32,47,48} Although the term *efficacy* is used in various ways,^{38,49} community-based efficacy trials generally measure behavior change among individuals recruited to the study and exposed to the intervention. Community-based *effectiveness* trials, in contrast, measure behavior change in the community, regardless of exposure to the intervention.

The current study has provided the first evidence that a lay health advisor intervention

TABLE 3—Self-Reported Mammography Use In Past 2 Years From Baseline (1993–1994) to Follow-Up (1997–1997): Black Women in the North Carolina Breast Cancer Screening Program Intervention Counties

Exposure	Baseline, %	Follow-Up, %	Increase, %	Difference of Differences, ^a %		
				Estimate	95% CI	P
Awareness						
Yes (n = 142)	49	72	23	9	(-2, 21)	.10
No (n = 244)	36	50	14			
Any advice						
Yes (n = 55)	49	76	27	12	(-3, 27)	.13
No (n = 332)	39	55	16			
Advice from lay health advisor						
Yes (n = 95)	46	72	26	11	(-2, 23)	.11
No (n = 292)	39	54	15			
1 or more program materials						
Yes (n = 232)	45	65	20	5	(-6, 16)	.33
No (n = 155)	34	48	14			
Do the Right Thing logo						
Yes (n = 113)	42	67	25	12	(0, 24)	.05
No (n = 274)	41	54	13			
Any phantom material						
Yes (n = 88)	49	68	19	2	(-11, 15)	.76
No (n = 299)	38	55	17			

Note. See text for complete descriptions of indicators. As a result of rounding, estimates may not sum in an exact manner.
^aUnadjusted estimates and confidence intervals (CIs) obtained from linear risk models with generalized estimating equations.

may be effective among African American women in rural areas. Furthermore, because effects were greater among women with low incomes (family earnings at or below the pov-

erty level), these findings suggest that a lay health advisor network can increase mammography use among women at the highest levels of disadvantage.

The results of this study are consistent with findings from 2 other community-based trials that evaluated the effectiveness of lay health interventions in regard to increasing mammography use. In the face of strong secular trends, these studies revealed relatively small (approximately 3%) or nonsignificant increases in screening use.^{50,51} Small changes in behavior, however, may have a large impact when they are observed in a population, and clinical standards for effect sizes may not be appropriate in the case of population-based research.⁵² In future population-based studies, detection of these small but important changes probably will require very large sample sizes.

Because we lacked process evaluation measures at the provider, organization, and community levels, we were unable to distinguish the effects of the lay health advisor network from the limited supplemental efforts to improve mammography quality and access. In practice, lay health advisor network activities constituted the majority of all intervention activities, and most supplemental activities were not distinct from the lay health advisor intervention. Lay health advisors organized and conducted many of the activities aimed at increasing access, including providing transportation to mammography centers and helping women enroll in the North Carolina Breast and Cervical Cancer Control Program

TABLE 4—Self-Reported Mammography Use in Past 2 Years From Baseline to Follow-Up: North Carolina Breast Cancer Screening Program, 1993–1994 and 1996–1997

	No.	Baseline, %	Follow-Up, %	Increase, %	Difference of differences, ^a %				P	
					Unadjusted		Adjusted			
					Estimate	95% CI	Estimate	95% CI		
Overall										
Intervention	387	41	58	17	6	(-1, 14)	7 ^b	(0, 14)	.05	
Comparison	409	56	67	11						
Low income^c										
Intervention	279	37	59	22	12	(2, 21)	11 ^b	(2, 21)	.02	
Comparison	235	49	60	11						
High income										
Intervention	66	56	59	3	-6	(-18, 7)	1 ^d	(-10, 11)	.92	
Comparison	138	73	82	9						

^aEstimates and confidence intervals (CIs) obtained from linear risk models with generalized estimating equations.
^bAdjusted for age, medical visits, physician recommendation for mammography and perceived susceptibility to breast cancer.
^cAnnual income below \$12 000. When available, income at follow-up was used when baseline income was missing.
^dAdjusted for age, physician recommendation for mammography, and perceived susceptibility to breast cancer.

so that they could obtain free or low-cost screening.

For practical reasons related to implementation, we assigned the intervention to one set of adjacent counties rather than randomly assigning counties to intervention and comparison conditions. This strategy limited contamination but produced intervention and comparison cohorts with different baseline rates of mammography use. We attempted to account for different secular changes in mammography use between the cohorts by using a “difference of differences” approach. Nevertheless, initial differences in use, along with a strong secular trend of increasing mammography use, may have limited our ability to estimate the intervention’s effectiveness.

Missing income data could have introduced bias; however, a sensitivity analysis demonstrated that the results of effectiveness by income calculations were robust. Also, face-to-face interviews may have prompted socially desirable reports of mammography use.⁵³ Although self-reports generally overestimate actual mammography use, they are reasonably accurate and are feasible for population-based studies.^{54–59} Also, any such bias would have been limited in the present study, because the 2 cohorts were interviewed in the same manner and both interviewers and participants were generally unaware of the evaluation design.

Moderate exposure rates and the resulting small numbers hindered our ability to assess intervention efficacy, especially by income level. Also, reports of exposure to phantom materials suggested that women may have overreported intervention exposures. Because increases in mammography use were not associated with phantom reporting, overreporting may have reduced our estimates of intervention efficacy as well. Despite these issues, results showed measurable, but not statistically significant, efficacy in the case of one project-specific area of exposure: mammography advice.

Higher income women reported more exposure to the intervention, but the intervention was more effective among lower income women. Although lay health advisors were carefully recruited for their “natural helper” qualities and their similarity to the target

group (all were older African American women living in the intervention counties), they tended to have higher levels of education and income compared with the general population of women in the community. Because the lay health advisors’ role was to discuss mammography with friends, family, and acquaintances, it is likely that they primarily advised and encouraged their higher income peers and family. Reports of the lay health advisors summarizing their activities during a 3-month period indicated that their one-on-one contacts primarily involved friends and family.^{35,60}

At the same time, lower income women may have been more receptive to the intervention. According to process evaluation data, barriers to screening that were common among low-income women were also the barriers that lay health advisors more frequently addressed (data not shown). Also, the North Carolina Breast and Cervical Cancer Control Program, which was funded by the Centers for Disease Control and Prevention, undoubtedly had a greater effect on the ability of low-income women to obtain screening mammography.

As this intervention appears to have been more effective among lower income women, future social network interventions should recruit natural helpers from this group and should more specifically target these women. Because advice appeared to be more efficacious than materials, future interventions should continue to emphasize the lay health advisor network rather than the development and dissemination of educational materials. The one exception was the National Cancer Institute’s “Do the Right Thing” logo. Although not unique to this intervention, the logo was printed on pins and T-shirts frequently worn by advisors. Qualitative interviews with advisors indicated that women often asked about these eye-catching pins and shirts, giving advisors an opportunity to talk about mammography.

While health care system factors such as physician recommendation and access to mammography are important in the case of low-income and African American women, these factors alone do not fully account for the patterns of underuse observed.^{61–66} Although intensive, a lay health advisor net-

work intervention, supplemented by efforts to increase access and quality, appears effective and may be the best community-based approach for increasing mammography use among lower income, rural African American women. Such interventions should be carefully targeted to this group to achieve a maximum effect. ■

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Contributors

All of the authors contributed to the writing, revision, and review of the paper. J.A. Earp designed and directed all aspects of the study, including interpreting results, and led in writing, editing, and revising the manuscript. E. Eng designed and helped implement the lay health advisor intervention and oversaw the training of the lay health advisors. M.S. O’Malley helped design the study, directed the analysis, and interpreted results. M. Altpeter helped design the study and oversaw implementation of the intervention and evaluation. G. Rauscher conducted all data analyses and contributed to interpretation of results. L. Mayne was responsible for coordinating, carrying out, and sustaining the lay health advisor program in the field. H.F. Mathews helped design the study, assisted with questionnaire design, and directed data collection. K.S. Lynch contributed to interpretation of results. B. Qaqish contributed to study design and data analysis.

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