
Disparities in Mammography Screening in Rural Areas: Analysis of County Differences in North Carolina

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ABSTRACT: *The extent to which targeted mammography programs have impacted women in rural areas is not well defined. We investigated mammography screening rates among 843 women age 50 and over from a population-based sample in four predominantly rural eastern North Carolina counties. We examined age, race, education level, county of residence, health insurance, and the self-reported completion of mammography in the past year using contingency tables and logistic regression. African American females aged 65 years or older had the lowest reported mammography rates (42%), while white females aged 50 to 64 had the highest rates (58%). Uninsured women and those with less education were less likely to have received a mammogram. Logistic regression demonstrated that age, education, and health insurance were significant predictors of mammography completion. A county-level analysis revealed that three counties had similar rates and one county had substantially lower rates. A higher-than-expected rate of screening-mammography completion among African American women was noted in one predominantly rural county served by a breast cancer screening program. Logistic regression analysis confirmed that county was a significant predictor for mammography completion. In separate regressions run by race, county remained a significant predictor for African American women but not for white women. Differences in mammography screening appear to persist in some predominantly rural areas and are related to age, race, education, and health insurance. Programs that target hard-to-reach women with efforts tailored specifically to their needs may be effective in reducing persistent racial differences.*

Older African American women are at higher risk for diagnosis of late-stage breast cancer than older white women (McCarthy et al., 1998; Satariano, Belle, & Swanson, 1986). Yet previous research (Burns et al., 1996; Gornick et al., 1996) has demonstrated that African American women are less likely to receive mammography than white women. A variety of federal research programs funded by the National Institutes of Health, the Department of Defense, and the Centers for Disease Control and Prevention have targeted minority women in hopes of decreasing this disparity (Note 1). However, this issue remains a perplexing problem. Substantial efforts have been under-

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taken to determine why older African American women do not complete screening mammography as often as older white women and to identify methods that would increase mammography completion in accordance with published guidelines (Burns et al., 1996; Grady, Kemkau, McVay, & Reisine, 1992; Grana, 1998; Lannin et al., 1998; Mickey, Durski, Worden, & Danielis, 1995; Satariano et al., 1998). Despite these initiatives, the extent to which racial differences in mammography screening exist in rural areas has not been adequately examined.

As part of a larger survey of health service utilization patterns and health behaviors, we surveyed a population-based sample of women from four predominantly rural counties in the same region. The purpose of this article is to explore differences in the completion of mammography screening by county among African American and white women and to identify, if possible, the potential factors that may underlie any differences identified.

Methods

The data for this study were obtained from the Rural Eastern Carolina Health (REACH) project, which has been previously described (Cummings et al., 1999).

Respondents. The REACH survey, conducted in 1997, used population-based sampling methods (sampling at census tract block group level) to identify approximately 2,500 households in four predominantly rural counties representative of the coastal plain of North Carolina (see Table 1 for county characteristics). Specifically, random geographic starting points were identified in all census tract block groups in each of four counties. Approximately 5,000 households (2,000 in the most populated county and 1,000 in each of the other three counties) were initially sampled by trained interviewers using a door-to-door enumeration interview, which collected demographic information. Subsequently, one half of these (2,500 households) were selected using a stratified random sampling technique, and a detailed health survey was conducted door-to-door, again using trained interviewers. Eighty-two percent of the originally surveyed households gave permission for this repeat interview. There were no significant differences in the demographic characteristics of those who did not give permission for a repeat interview.

Table 1. Characteristics of Study Counties.

County and Rural Status	Population ¹	Percent- age of Women 50 Years and Older in the County Who Are African American ¹	Percent- age of Women 50 Years and Older in the County Who Are White ¹	Per Capita Income (\$) ¹
1, ² rural/non-MSA	25,078	45	54	16,151
2, MSA with rural areas	107,924	33	65	19,877
3, rural/non-MSA	22,523	57	41	15,604
4, rural/non-MSA	39,995	33	65	20,224

1. Population from 1990 census; per capita income from 1995; MSA = metropolitan statistical area.
2. County was an intervention site for the North Carolina Breast Cancer Screening Program (NC-BCSP).

After data collection was completed, one county (County 1 in Table 1) was found serendipitously to be an intervention site for the North Carolina Breast Cancer Screening Program (NC-BCSP). This was a long-term, comprehensive community program to increase regular breast cancer screening by African American women aged 50 and older through a natural helper lay health advisor approach (Earp, Altpeter, Mayne, Viadro, & O'Malley, 1995; Earp et al., 1997). Of the approximately 2,500 households, there were 843 households in which the respondent was a female age 50 or older; these subjects are included in the present analysis. In the repeat interview, the female respondents provided detailed health information about themselves and other household members.

Data. Demographic data, including age (studied in two categories: 50 to 64 years and 65 and older), race (African American or white), county of residence, and education (less than high school vs. high school graduate or more), were obtained for each respondent. Additional variables included the self-reported completion of screening mammography in the last year, a history of breast cancer in the respondent's parents, and the presence or absence of any health insurance.

Analysis of REACH Data. The self-reported completion of a mammogram in the last year was the outcome variable of interest. A 1-year time period was selected because the American Cancer Society (Smith, Mettlin, Davis, & Eyre, 2000) recommends yearly mammograms in women 40 years and older, while the National Cancer Institute (www.nci.nih.gov) recommends mammography every 1 to 2 years. The U.S. Preventive Services Task Force recommends mammography every 1 to 2 years in women aged 50 to 69 years (Frame, Berg, & Woolf, 1997). In addition, previous research, including one study performed in eastern North Carolina, has shown that self-reports of mammography in the last year are reliable indications of actual use (Degnan et al., 1992; McGovern, Lurie, Margolis, & Slater, 1998; Zapka et al., 1996). Because of controversy regarding the need for annual mammography in women aged 40 to 49 years and in view of the recommendations of the U.S. Preventive Services Task Force (Frame et al., 1997), a minimum age for subjects of 50 years was selected. Because of the increasing incidence of breast cancer with advancing age and because the American Cancer Society does not have an upper age limit in its screening mammography recommendations (Smith et al., 2000), no upper age limit was utilized.

The relationship between completion of mammography and the above variables (age, race, insurance, and education level) was examined initially using contingency tables and chi-square tests. We hypothesized that completion of mammography would occur less often among women who were older, African American, less well educated, and uninsured. We further hypothesized that any observed differences between counties in mammography completion would be consistent with the demographic differences in those counties (e.g., age, race, and income; see Table 1). Subsequently, we constructed a series of logistic regression models to examine the independent effects of the predictor variables on mammography completion in the last year. Regression models were constructed using mammography completion as the outcome variable and using race as well as the demographic variables age, insurance, and education level as predictor variables. Each of these predictor variables was dichotomized (African American or white; less than 65 or 65 and older; any health insurance or none; and less than a high school education or a high school education or more). These variables were selected because our review of previous literature suggested them to be important in predicting mammography completion, because they were important in characterizing potential

Table 2. Screening Mammography Rates (%) by Age, Race, and County.

County	African American		White	
	50 to 64 Years	65 Years and Older	50 to 64 Years	65 Years and Older
1 ¹ (<i>n</i> = 206)	59	59	60	46
2 (<i>n</i> = 275)	61	43	62	48
3 (<i>n</i> = 160)	38	18	62	59
4 (<i>n</i> = 183)	54	51	48	51

1. Intervention site for the North Carolina Breast Cancer Screening Program (NC-BCSP); *n* = 824; 19 cases had missing data.

differences by county, and because they were demonstrated to be significant in bivariate comparisons. The logistic regression was then fitted with interaction effects involving age, race, insurance, and education level. The interaction effects were not statistically significant; therefore, odds ratios from the main effects-only model are reported. Because substantially different mammography completion rates by county were noted in some age/race groups (see Table 2), we also constructed similar regression models to compare (1) the county served by the lay health advisor program with the other three counties and (2) the two counties with similar demographic characteristics, where one county was being served by the lay health advisor program and the other not.

Results

The characteristics of the 843 respondents in our study are shown in Table 3. We explored mammography completion as a function of demographic variables (Table 4). While there were no significant differences overall by race, modest differences existed by age, with a larger percentage of women 50 to 64 years reporting completion of a mammogram than women age 65 or older ($p < .05$). Women with a high school education or higher were more likely to complete mammography than those with less than a high school education ($p < .05$). Notable differences in mammography completion also occurred as a function

**Table 3. Characteristics of Study Respondents
(*n* = 843).**

Characteristics	Percentage of the Study Respondents
Age, 50–64 years	47
Age, ≥65 years	53
Race, African American	48
Less than high school (HS) education	34
HS graduate/GED/any college	66
Uninsured	15
Parental history of breast cancer	3

of health insurance. Uninsured women were less likely to have received a mammogram than were women with health insurance ($p < .001$). When considering both age and race, African American women 65 years or older reported the lowest mammography rates (42%), while white women aged 50 to 64 had the highest rates (58%). In a logistic regression model, age (OR = 0.6; 95% CI, 0.42 to 0.78) and health insurance (OR = 3.0; 95% CI, 1.9 to 4.7) were significant independent predictors ($p < .05$) of mammography completion, while education level (OR = 1.3; 95% CI, 0.97 to 1.8) approached significance and race (OR = 1.0; 95% CI, 0.75 to 1.4) was not significant.

Of particular interest to us were the differences among the four counties. Of the four, three had similar screening rates while one county had substantially lower rates (Table 2). When comparing counties by age and racial strata, we found greater variability in mammography completion among African American women (18 to 61%) than among white women (46 to 62%). We then compared two counties (1 and 3) directly because both had substantial minority populations as well as similar age distributions and per capita income (County 1 was also the site for the lay health advisor intervention under the North Carolina Breast Cancer Screening Program). The mammography completion rate among African Americans in County 1 was 59% compared with only 29% in County 3, while comparable rates among white women were 53% and 61%, respectively. We performed logistic regression on the data from these two counties, which confirmed that county (i.e., location) was a significant independent predictor for mammography completion after adjustment for age, race, education, and health insurance (Table 5). When we ran separate regressions by race

Table 4. Screening Mammography Rates (%) by Demographic Characteristics.

Characteristics	Variable	% Mam- mography Completion	Chi Square for Comparison
Age	50 to 64 years	55	$\chi^2 = 5.16$
	> 65 years	47	$p < .05$
Race	African American	48	$\chi^2 = 2.28$
	White	53	$p = .13$
Education	<High school	44	$\chi^2 = 9.05$
	High school or more	55	$p < .01$
Insurance	Uninsured	34	$\chi^2 = 17.19$
	Insured	54	$p < .0001$

that included all four counties, county remained a significant predictor for African American women but not for white women. When separate regressions were run for the county served by the lay health advisor program (County 1) and the other three counties combined, insurance was an independent predictor in both models, age was significant in the three combined counties but not in the county served by the lay health advisor program, and race was not significant in either model.

Table 5. Logistic Regression Model: Mammography Completion in Two Similar Rural Counties.¹

Characteristics	Variable	Odds Ratio (95% CI)
Age	<65 years	1.0
	≥65 years	0.58 (0.37 to 0.91)
Race	White	1.0
	African American	1.1 (0.70 to 1.86)
Education	<High school	1.0
	High school or more	1.47 (0.9 to 2.4)
Insurance	No insurance	1.0
	Insurance	2.66 (1.36 to 5.21)
County	County 1	1.0
	County 3	0.55 (0.35 to 0.87)

1. *n* = 353.

Discussion

This study evaluated the completion of screening mammography by rural women and sought to clarify whether patterns of racial disparity remain in such locations. Overall, only about half of the respondents reported having a mammogram in the last year. This is a slightly higher rate than the 32% reported by O'Malley and colleagues (O'Malley, Earp, & Harris, 1997) in two other eastern North Carolina counties. In the O'Malley study, 36% of white women but only 17% of African American women reported a mammogram in the last year. Similarly, a 1993 Commonwealth Fund survey found that 57% of white women aged 50 and older reported having a mammogram in the last year compared with only 43% of African American women (Commonwealth Fund, 1993). Mammography completion varied substantially as a function of several demographic characteristics including age, race, education level, and health insurance status. The declining mammography completion rates observed with increased age are a cause for concern, given that women 65 years of age and older have the greatest burden of disease (Yancik, Ries, & Yates, 1989). However, it should be noted that mammography has only been shown to significantly reduce breast cancer mortality in women age 40 to 69 (www.nci.nih.gov), and this may be the reason that women above age 69 are less likely to complete mammography. Small differences in mammography completion rates were evident by race, although race was not an independent predictor of mammography completion in the logistic regression model. Other sociodemographic characteristics including age, education level, and whether one has health insurance appeared to be more important factors. Previous authors have also identified the relationship between these sociodemographic characteristics and mammography screening (Danigelis, Worden, & Mickey, 1996; Pearlman, Rakowski, Ehrich, & Clark, 1996).

Differences in mammography completion rates by county are of particular interest, however, because they document the marked variation that can occur in rural areas. Some rural counties inhabited by large numbers of older women with limited education and incomes and lacking in health insurance may be beyond the reach of current efforts to increase screening mammography rates. We observed one county with notable mammography screening disparities by age and race while, in a similar county nearby, the expected impact of demographic variables appeared to be substantially blunted. The substantially lower rates in

County 3, particularly among African Americans, may be partially explained by that county's demographic profile. This county has a larger African American population (57%) than the average for the region (33% overall), and both per capita and family income are lower than the regional average. In some rural areas inadequately targeted by federal, state, and local programs attempting to increase mammography completion, age and racial disparities may continue to exist.

Based solely on age, racial distributions, and Census Bureau economic indicators, we would have estimated mammography completion rates in County 1 to be similar to those we observed in County 3. By contrast, mammography completion was greater than expected among older African American women in County 1, an intervention site for the North Carolina Breast Cancer Screening Program. Previous research suggests that there is a need to tailor breast cancer screening initiatives to specific age groups (Danigelis et al., 1996) and that culturally appropriate interventions have a significantly greater likelihood of success than nontailored ones (Erwin, Spatz, Stotts, Hollenberg, & Deloney, 1996). In particular, the use of lay health advisors as natural helpers, as occurred in County 1, has been described elsewhere (Earp et al., 1997). The use of such natural helpers is based on evidence (Eng & Smith, 1995) that suggests that older African American women are more likely to seek out such individuals when they have a female-specific concern rather than seeking help from professionals. These natural helpers provide advice, emotional support, and tangible aid. This pattern of seeking help from lay advisors may be particularly important in rural areas where fewer resources may exist to encourage preventive health behaviors. Our data suggest that this approach has substantial merit and should be more fully explored in other predominantly rural regions. Further, the cost-effectiveness of this approach should be evaluated.

The limitations of this study include those associated with the use of self-reported data. As noted above, such data on annual screening mammography completion has been demonstrated to be sufficiently accurate for population studies. Because this study was undertaken among African American and white respondents in a predominantly rural region, generalization to urban areas and ethnic groups other than African Americans and whites cannot be assumed. Likewise, generalization to other rural areas may be limited by the localized geographic focus of this study. The U.S. Preventive Services Task Force recommends screening every 1 to 2 years for women 50 to 69 years old. It is possible that some women in our

study were being routinely screened but were not screened during the study period, which was for the previous year only. Finally, no data are available about the physicians providing care for these women. The clinical competence of physicians, as measured by licensing examination scores and other indicators, may influence their recommendations for mammography and performance of other preventive health services (Tamblyn et al., 1998). Physician recommendation is of major importance in mammography completion (O'Malley et al., 2001), and specific data on physician recommendation for each county was not available to us.

In conclusion, our evidence suggests that disparities in mammography screening continue to exist in predominantly rural areas and are related to demographic variables such as the age, race, education, and health insurance status of the women in such communities. However, a comprehensive program that utilizes community-based lay health advisors to encourage breast cancer screening among older African American women appears successful in producing significant increases in mammography completion. If we wish to ameliorate disparities in mammography screening in predominantly rural communities such as those we surveyed, we may need to rely on community outreach programs that target hard-to-reach women with programs tailored specifically to their needs.

Notes

- For example, see the following announcements:
 - NIH: Understanding and Eliminating Minority Health Disparities. NIH Guide 10/20/99, RFA HS-00-003
 - CDC: Cooperative Agreement for National Breast and Cervical Cancer Early Detection Program, www.cdc.gov/od/pgo/funding/01038.htm, 2001
 - DOD: DOD Sponsors Era of Hope Breast Cancer Research Meeting, Defense Link News Memorandum 195-M, 10/31/97.

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