FACTORS ASSOCIATED WITH ADHERENCE TO RECOMMENDATIONS FOR SCREENING MAMMOGRAPHY AMONG AMERICAN INDIAN WOMEN IN COLORADO

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Objective: To compare adherence to screening mammography recommendations of American Indian and non-Hispanic White women in the Denver, Colorado, area.

Design/Setting/Participants: This study retrospectively examined adherence patterns in 229 American Indian and 60,197 non-Hispanic White women ≥40 years and older, with at least one screening mammogram in the Colorado Mammography Project (CMAP), from January 1, 1999, to December 31, 2003. The CMAP was a prospective study of women receiving mammograms at participating clinics around Denver.

Main Outcome Measures: Using logistic mixed models, we defined two dependent variables as annual and biennial adherence from the intervals between screening mammograms for each woman.

Results: Biennial adherence was substantially higher than annual adherence for both American Indian and non-Hispanic White women in our analyses. American Indian women were less likely than non-Hispanic White women to adhere to biennial recommendations in multivariate models controlling for age, family history of breast cancer, and economic status (zip code): odds ratio (OR) .4 and 95% confidence interval (CI) .2–.6. The association between American Indian race/ethnicity and annual adherence was similar, although not as strong (OR .5, 95% CI .3–.8).

Conclusions: American Indian women in the CMAP cohort were less likely than non-Hispanic White women to adhere to recommendations for screening mammography, both annually and biennially. Additional research is needed to explore the effect of biennial screening and other barriers among American Indian women. (*Ethn Dis*. 2006;16:808–814)

Key Words: American Indians, Guideline Adherence, Mammography, Patient Compliance

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INTRODUCTION

Breast cancer is second only to lung cancer as the leading cause of cancer deaths among women of all races and ethnicities in the United States.[1] From 1998 to 2000, the age-adjusted breast cancer death rate was 28 per 100,000 women,[1] and the rates differ by race/ethnicity.[2] Nationwide, American Indian and Alaska Native women have low breast cancer incidence and death rates compared to women of other race/ethnicity groups.[2–4] American Indian women have the poorest survival prognosis after diagnosis of breast cancer compared to all other races, even controlling for stage of disease.[5–7]

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Screening mammography facilitates early diagnosis of breast cancer, increases treatment options, and may improve survival time.[8–10] A screening mammogram is a procedure performed as part of a routine checkup, not as followup on a lump or other symptom detected upon clinical breast exam or upon breast self-examination. The United States Department of Health and Human Services recommends that women ≥40 years of age be screened for breast cancer with mammography every one to two years.[11]

A review of regional and national studies in the United States indicates that participation of American Indian women in screening mammography during the 1990s was lower than that observed for non-Hispanic White women, with rates of 35%–65% vs 57%–68%, respectively.[12–18] However, these studies were based on self-reported information.

This study examines data on American Indian and non-Hispanic White women who participated in the Colorado Mammography Project (CMAP) from 1999 through 2003. As part of the National Breast Cancer Surveillance Consortium, CMAP is a National Cancer Institute-funded project studying performance of mammography in community settings.[19]

Study Objectives

American Indian women have low mammography rates nationally.[17,18] To our knowledge, no published studies have evaluated factors associated with adherence to recommendations for screening mammography among American Indian women. The aims of this study were to evaluate the patterns of screening mammography and factors associated with adherence to screening mammography recommendations during a five-year period from January 1, 1999, to December 31, 2003, and to compare adherence between the two racial/ethnic groups. We hypothesized

that patterns of adherence to screening mammography recommendations among American Indian women differ from those observed among non-Hispanic White women.

METHODS

Study Design and Setting

This study retrospectively examined screening mammograms of >60,000 women with complete records within the CMAP database who self-identified their race/ethnicity to be either American Indian or non-Hispanic White. During the study period, CMAP obtained data on mammograms from approximately half of all mammography facilities in the six-county Denver metropolitan area of Colorado. Breast cancers within the database were identified through semiannual matches with the Colorado Central Cancer Registry. To ensure confidentiality, personal identifiers were removed, and each participant was assigned a unique patient identifier. The CMAP has been reviewed and approved by the institutional review boards annually.

Definitions and Study Measures

In this study, a screening mammogram was defined as a bilateral routine view mammogram performed on a woman who was asymptomatic, according to the radiology form, at the time of the exam. Diagnostic mammograms obtained to evaluate any current breast problems were not included. Also, mammograms were not included if the woman had a personal history of breast cancer at the time of the exam or if she had ever had breast implants.

We included women ≥40 years of age, based on recommendations by leading health organizations that, beginning at age 40, all women should receive a mammogram every one or two years, and annually after age 50.[20] The National Cancer Institute included an additional condition for recommending mammography for women age 40–49 years: specifically, to screen annually if the woman has a family history of breast cancer.[21]

Dependent Variables

Incorporating the above recommendations, we defined two dependent variables for annual and biennial adherence by examining the intervals between screening mammograms. Annual and biennial adherences were defined by the age of the woman and her family history of breast cancer at the time of each mammogram. We began with the identification of all screening mammograms for each woman in the five-year time period of the study. Thus, women potentially had more than one adherence assessment during the study period.

At each screening mammogram we examined the woman's records to determine if that screening mammogram was done within the recommended time frame. We first defined annual adherence as follows: 1) for women ≥51 years of age, adherence was defined as having a screening mammogram in the 10–15 months prior; 2) for women 41–50 years without a family history of breast cancer, adherence was defined as having another screening mammogram in the 10–27 months prior; and 3) for women 41–50 years with a family history of breast cancer, adherence was defined as having a screening mammogram in the 10–15 months prior. All screening mammograms done on women who were 40 years old at the time of the exam were considered adherent. We defined our second adherence (biennial) dependent variable as follows: for all women ≥41 years of age, adherence was defined as having another screening mammogram in the 10–27 months prior.

Race/Ethnicity

A race/ethnicity designation for each woman was created on the basis of the self-reported race and Hispanic origin data items in her first screening mammogram within this dataset. A woman whose race was American Indian was included in the American Indian group, regardless of possible Hispanic origin. Women whose race was White and who were not of Hispanic origin were grouped as non-Hispanic White women.

Independent Variables

Variables considered in this study were components of the prediction model previously used by Rahman with CMAP data.[31] The prediction model was developed based on the constructs of the Health Belief Model[22] and Andersen's model of health services utilization.[23] The predisposing variables included age (grouped as 40–49, 50–64, and ≥65 years) and educational attainment (grouped as less than high school graduate vs high school graduate or higher). Enabling factors considered were health insurance (grouped as private insurance, Medicare/Medicaid/other, or no insurance) and community economic status determined by assigned median annual family income per zip code of residence (grouped as <$40,000, $40,000–$69,999, and ≥$70,000).[24] An additional variable in the prediction model was family history of breast cancer (yes/no). This factor could be used as perceived need or evaluated need for the screening decision-making process, according to the Health Belief Model. All of these factors were selected because they have been shown to be associated with adherence to mammography screening recommendations in previous studies. The goal of this study was to examine the effect of race on adherence, after adjusting for these factors known to be predictors of adherence.

Analytic Method

In this study, we retrospectively examined the results of each screening mammogram for every American Indian and non-Hispanic White woman in the

CMAP database during the study period. To facilitate analyses, we created a binary variable, for which one equaled adherence to mammography screening guidelines and zero equaled nonadherence, to indicate whether the screening mammogram fell within the recommended screening guidelines as described previously. This analytic technique was similar to the system previously used to analyze screening mammography adherence in the CMAP database.[25] However, in this analysis, we included multiple adherence assessments for each woman in our database. This modified approach allowed us to assess a pattern of adherence/nonadherence for these women across the five-year period of the study.

Other variables analyzed as predisposing, enabling, and prediction factors were age, educational attainment, health insurance, community economic status, and family history of breast cancer. We investigated the relationship between the main independent variable of race/ethnicity with each of the other factors by comparing the frequency distributions by race/ethnicity with chi-square tests. Crude analyses, bivariate, and multivariate analyses employed logistic mixed models including a random subject effect using PROC NLMIXED in SAS version 8.2 (SAS Institute, Cary, NC). Using mixed models allowed us to assess the effect of race/ethnicity, with each factor added separately and simultaneously, on the dependent variables for adherence.

In the bivariate and multivariate models, we chose as the referent category for each of these factors the group with the largest proportion of women, with the exception of age. For the age group variable, we chose 50–64 years as the referent category, as this was the age group with most women targeted by recommendations for screening mammography.[20,21] We retained variables in the models if they changed the relationship between race/ethnicity and adherence by ≥10% or if the variables had been shown by previous studies to be associated with adherence to screening mammography recommendations. Interactions between independent variables were also assessed to see if they had an effect on race/ethnicity and adherence relationships.

Table 1. Factors potentially associated with adherence to screening mammography guidelines as assessed at first screening mammogram in dataset (one record per woman) among American Indian and non-Hispanic White women, CMAP 1999–2003

Factor	American Indian *N*=229	Non-Hispanic White *N*=60,197
	% or Mean (SD)	% or Mean (SD)
Age, mean years at first screening mammogram, *P*=.0006*	52.2 (10.2)	54.6 (11.9)
Age groups, years, %, *P*=.0089*		
40–49	51%	42%
50–64	34%	36%
≥65	15%	22%
Education, %, *P*≤.0001*		
Less than high school	13%	3%
High school or greater	87%	97%
Health insurance, %, *P*≤.0001)*		
Private	76%	80%
Medicare/Medicaid	20%	19%
None	4%	1%
Community economic status†, %, *P*=.0003)*		
<$40,000	31%	21%
$40,000–$69,999	54%	58%
≥$70,000	15%	21%
Family history of breast cancer, %, *P*=.5756*		
Yes	12%	14%
No	88%	86%

* *P* value from chi-square statistic among non-missing values. The percent missing across all factors except age at first screening mammogram (no missing values) ranged from 1% to 15%.

† Community economic status=median family income for zip codes of residence.

CMAP=Colorado Mammography Project; SD=standard deviation.

RESULTS

Study Population Characteristics

This study included 229 American Indian and 60,197 non-Hispanic White women aged ≥40 years with at least one screening mammogram in the CMAP database, from January 1, 1999, to December 31, 2003. Table 1 contains the distribution of factors that are potentially associated with adherence to screening mammography guidelines for the first screening exam per woman, by race/ethnicity. On average, American Indian women were younger than non-Hispanic White women at the time of their first screening mammogram in this time period. Among American Indians, higher proportions of women had less than a high school education, had no health insurance, and lived in areas where the median family income was <$40,000 per year, compared to non-Hispanic White women.

Analysis of Adherence

Adherence and Race/Ethnicity

Our study included all screening mammograms, which resulted in 354 exams among American Indian women and 119,466 exams among non-Hispanic White women in the study period. Table 2 shows the proportion of adherent cases, in accordance with our annual and biennial definitions, across the predisposing, enabling, and prediction factors among American Indian women. A higher percentage of

Table 2. Associations between adherence outcome variables and factors potentially associated with adherence to screening mammography guidelines among American Indian only, CMAP 1999–2003

Among American Indian Women (*N*=229)	Annual Adherence*	Biennial Adherence†
Factor	% Adherent‡	% Adherent‡
Age, years		
40–49	69%	72%
50–64	52%	73%
≥65	65%	75%
Education		
Less than high school	45%	59%
High school or greater	65%	76%
Health insurance		
Private	64%	75%
Medicare/Medicaid	63%	76%
None	40%	50%
Community economic status (by zip code)§		
<$40,000	53%	64%
$40,000–$69,999	66%	78%
≥$70,000	66%	75%
Family history of breast cancer		
Yes	61%	85%
No	69%	71%

* Annual adherence defined by woman's age and family history of breast cancer.
† Biennial adherence defined as having had a screening mammogram in 10–27 months prior.
‡ The percentage of exams eliminated due to missing values ranged from 0% to 17%.
§ Community economic status=median family income for zip code of residence.
CMAP=Colorado Mammography Project.

American Indian women age ≥50 years were more likely to be annually adherent than biennially adherent. Additional analyses found that American Indian women recommended to have annual mammograms were less likely to be adherent than non-Hispanic White women with the same recommendation (62% vs 73%). Assessing our secondary outcome of biennial adherence, we found again that American Indian women were less likely to be adherent than non-Hispanic White women (73% vs 85%).

Adherence and Other Factors

We also examined the relationship between the two outcome measures of adherence and the other factors potentially associated with adherence, ie, age, education, health insurance, community economic status, and family history of breast cancer. Final multivariable models included variables based on best fit and precision. Table 3 details these results. Age at time of screening mammogram was associated with adherence; the relationship between age and annual adherence was nonlinear; the lowest proportion of mammograms was obtained by the largest (referent) group of women in the 50- to 64-year age group (70%). For the youngest group of women, 40–49 years of age, annual adherence was defined as essentially every two years. These younger women had higher adherence rates than the referent group. However, for biennial adherence, we found age to trend upward. Education was associated with both outcome variables, with greater degree of adherence among women who had achieved a high school diploma or higher. Community economic status (median family annual income by zip code) also had an ordinal relationship with adherence. Women whose residences were from zip codes with income ≥$70,000 exhibited the highest proportion of adherence for both outcome measures. Biennial adherence was higher among women who had a family history of breast cancer than among those who did not. Annual adherence was only slightly higher among women with a family history of breast cancer.

Basic Models: Adherence=Race/Ethnicity and Age

Due to the unequal distribution of age by race/ethnicity, we had to adjust for age in our basic mixed models. Results of this modeling are presented in Table 3 along with the results of our multivariable models. The age-adjusted odds that American Indian women were adherent was less than that of non-Hispanic White women for annual and for biennial.

Preliminary Multivariable Models: Adherence=Race/Ethnicity and Age and Other Factors

Our multivariable analyses included modeling the two outcome variables on race, age, and adding separately, each of the other factors associated with the outcome variables, as well as in combinations. In preliminary models predicting annual adherence, the addition of the health insurance variable increased the base odds ratio for race/ethnicity by >10%; none of the other factors had a substantial effect on the main effect of race/ethnicity. In preliminary models predicting biennial adherence, the separate additions of education, health insurance, and community economic status resulted in increases in the base odds ratio for race/ethnicity. However, since these measurements are representing the same underlying concept, socioeconomic status and access, we assumed multicollinearity existed. We verified this finding by exploring simple correlations among these variables. Since all variables increased the base odds ratio of race/ethnicity, we chose community economic status because it had the least amount of missing data.

Multivariable Models

Table 3 shows the results of the addition of family history of breast

Table 3. Adherence models among American Indian and non-Hispanic White women, CMAP 1999–2003

Factor	Model 1: Dependent Variable Annual Adherence* Basic OR (95% CI)	Multivariable OR (95% CI)
Race/ethnicity		
American Indian	.5 (.3–.7)	.5 (.3–.8)
Non-Hispanic White	1.0 (referent)	1.0 (referent)
Age, years		
40–49	1.5 (1.4–1.6)	1.5 (1.4–1.5)
50–64	1.0 (referent)	1.0 (referent)
≥65+	1.2 (1.2–1.3)	1.3 (1.2–1.4)
Family history of breast cancer, Multivariable models only	–	
Yes	–	1.1 (1.02–1.2)
No	–	1.0 (referent)
Community economic status (by zip code)‡ multivariable models only	–	
<$40,000	–	.7 (.6–.7)
$40,000–$69,999	–	1.0 (referent)
≥$70,000	–	1.4 (1.3–1.4)
Model 2: Dependent Variable Biennial Adherence†		
	Basic OR (95% CI)	**Multivariable OR (95% CI)**
Race/ethnicity		
American Indian	.3 (.2–.5)	.4 (.2–.6)
Non-Hispanic White	1.0 (referent)	1.0 (referent)
Age, years		
40–49	.4 (.3–.4)	.3 (.3–.4)
50–64	1.0 (referent)	1.0 (referent)
≥65	1.2 (1.1–1.3)	1.3 (1.2–1.3)
Family history of breast cancer, multivariable models only	–	
Yes	–	2.3 (2.1–2.6)
No	–	1.0 (referent)
Community economic status (by zip code)‡§, multivariable models only	–	
<$40,000	–	.6 (.5–.6)
$40,000–$69,999	–	1.0 (referent)
≥$70,000	–	1.5 (1.4–1.6)

* Annual adherence defined by woman's age and family history of breast cancer.
† Biennial adherence defined as having had a screening mammogram in 10–27 months prior.
‡ odds ratio (95%) confidence interval
§ Community economic status=median family income for zip code of residence.
CMAP=Colorado Mammography Project; OR=odds ratio; CI=confidence interval.

cancer and community economic status to the models that considered race/ethnicity and age. The multivariable model predicting annual adherence showed an increase in the race/ethnicity odds ratio (8%), while the addition of these other factors to the model predicting biennial adherence led to a larger increase in the race/ethnicity odds ratio (15%). Adjusted models also show that family history of breast cancer leads to a minimally elevated probability of "annual" adherence, while it is more substantially associated with "biennial" adherence. An increasing level of community economic status (median family income by zip code) was associated with an increased likelihood of both annual and biennial adherence outcomes.

Additionally, we tested interaction terms individually with the main effects of race, age, family history of breast cancer, and community economic status included in the models. However, the addition of these terms did not substantially alter the main effect of race/ethnicity on either outcome measure.

DISCUSSION

In recent years, American women have made steady progress toward the goals of Healthy People 2000 pertaining to breast cancer screening.[26,27] However, as demonstrated in numerous studies, racial/ethnic minority women continue to have lower rates of adherence to screening recommendations.[28–37] The results of our study hold with previous findings. We focused on utilization of screening mammography by American Indian women living in the Denver metropolitan area. As anticipated, our comparison between racial/ethnic groups indicated that American Indian women were significantly less adherent than non-Hispanic Whites in both annual and biennial outcome categories.

Community economic status was the most significant factor related to

…our comparison between racial/ethnic groups indicated that American Indian women were significantly less adherent than non-Hispanic Whites in both annual and biennial outcome categories [for screening mammography].

adherence for American Indian women in this study, influencing both annual and biennial adherence outcome measures. A substantially larger proportion of American Indian women, 31% vs 21% for the non-Hispanic White women, resided in zip code areas with annual family income <$40,000. This factor alone may not have influenced adherence behavior, as numerous free screening opportunities are available in Colorado.[38–40] However, as we found that a larger proportion of American Indian women had less than high school education, this factor may enter into the equation. The combined effect of low income and low educational attainment may result in a lack of awareness of programs promoting screening mammography because of barriers such as lack of transportation.

While the proportion of American Indian women with a family history of breast cancer was slightly lower than that observed for the non-Hispanic White group, this factor appeared to play a significant role in biennial adherence. A family history of breast cancer may contribute to cancer-related worries. In the context of screening behavior, the construct called anxiety, fear, or worry remains the most extensively studied emotion variable. However, as indicated in a comprehensive critical review of current literature,[41] the role of fear as a barrier or facilitator of screening is unclear. On the one hand, this review shows that fear of cancer and the medical establishment has been linked to poorer screening; on the other, greater worry has been associated with a higher likelihood of screening. Lower level of adherence among American Indian women with family history of breast cancer, is compatible with two interpretations. One explanation is that American Indian women are more afraid of cancer than non-Hispanic White women. Complementarily, the screening behavior may be inhibited by fear.

This study had some limitations. Our study contained small numbers of American Indian women, as reflected by the population distribution in this community. Furthermore, our study included only women who had ever received a mammogram in a CMAP facility. We had no way of quantifying the number of women who have never had a mammogram. We also had no information on women who visit clinics other than those that participated in CMAP. Missing mammograms in this study are because clinics did not participate in CMAP rather than because individual women refused to participate. While it is not likely, some potential bias may have been introduced if the women who visited CMAP clinics were substantially different from women who visited clinics not participating in CMAP. Also, we examined only factors available in the CMAP database or imputed factors, such as community economic status. Our lack of information regarding additional factors influencing adherence to screening guidelines, along with the small American Indian sample, limit generalization.

In sum, the results from this study add to the body of knowledge regarding possible facilitators and barriers to screening mammography among American Indian women, as they are based on race/ethnicity-specific, comprehensive, and up-to-date data that are unavailable elsewhere. By examining these factors by means of multivariable modeling techniques, this study provided evidence that, in the metropolitan Denver area, American Indian women are less likely than non-Hispanic White women to be adherent with screening mammography guidelines, even after adjusting for age, family history of breast cancer, and community economic status. However, adherence with recommendations for biennial screening is decidedly higher than adherence with annual screening. Additional research is needed to explore the effect of biennial screening on adherence patterns among American Indian women and women of other races/ethnicities.

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