Characteristics Associated with Mammography Screening among Both Hispanic and Non-Hispanic White Women

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Abstract

Aims: This study explores whether certain population characteristics are associated with adherence to mammography screening guidelines among Hispanic and non-Hispanic white (NHW) women living in the southwestern United States.

Methods: Participants in a population-based study (4-Corners' Breast Cancer Study) included in this analysis were 790 Hispanic women and 1441 NHW women. Multivariate logistic regression was used to compute the ethnic-specific adjusted odds ratios (OR) and 95% confidence intervals (CI) for the association of the outcome variable (adherent vs. nonadherent) and its correlates. Women were adherent if they had obtained their first mammogram between 41 and 50 years of age and had received at least one mammogram per 2 years or less.

Results: Ethnic-specific associations were observed with certain population characteristics and mammography adherence. Specifically, characteristics that were significantly associated with adherence among Hispanic women were younger age (50–59 years), having a family history of breast cancer, nulliparity, hormone replacement therapy (HRT) use, nonsteroidal anti-inflammatory drug (NSAID) use, and performing regular breast self-examinations (BSE). Among NHW women, younger age (50–59 years), family history of breast cancer, obesity, consuming moderate amounts of alcohol, and taking HRT were associated with mammography adherence. When adjusting for the evaluated population characteristics, the relationship between ethnicity and mammography adherence was no longer apparent.

Conclusions: Ethnic-specific characteristics appear to explain differences in mammography adherence among Hispanic and NHW women. Disparities in screening rates, late-stage disease and breast cancer mortality that impact Hispanic women could potentially be addressed more effectively by interventions that specifically target the unique characteristics of the Hispanic population.

Introduction

ACCORDING TO THE AMERICAN CANCER SOCIETY (ACS), mammography screening is the single most effective method of detecting breast cancer (BC) at an early stage, when women have a greater chance to be treated successfully and reduce their mortality from the disease.¹ The effectiveness of

mammography screening is dependent on the adherence of women to screening guidelines. The ACS recommends that all women at average BC risk obtain a mammogram every year starting at age 40. However, mortality reductions have been observed at screening intervals of 12 and 24 months.² Information about the characteristics of women who do and do not adhere to mammography screening guidelines is limited

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and would be beneficial in improving adherence, particularly for ethnic/racial populations who have been shown to be less adherent.³⁻⁶

Population-based studies indicate that Hispanic women are significantly less likely to receive screening mammography and more likely to be diagnosed with late-stage BC compared with non-Hispanic white (NHW) women.^{7,8} Low socioeconomic status (SES) and healthcare access barriers are most commonly cited as factors that contribute to these disparities,⁹⁻¹⁸ although disparities in BC outcomes persist even when these factors are accounted for.^{3-6,10,16} Thus, understanding what other factors contribute to these disparities among Hispanic women is important, especially if these factors might be more cost-effective and feasible to target as opposed to eliminating low SES and healthcare access barriers.

Characteristics, such as increasing age, nulliparity, early onset of menstruation, late menopause, personal or family history of BC, late age of first childbirth, postmenopausal obesity, and use of hormone replacement therapy (HRT), have been identified as risk factors for developing BC.^{1,19} Consequently, women with these characteristics would be expected to be more predisposed or to be at greater need to adhere with mammography screening as recommended. With the exception of age and family history of BC, research on the association of other needs or predisposing factors with mammography adherence is limited.^{3,5,6,20-23}

Lifestyle habits, such as smoking and alcohol consumption, have been linked to increased BC risk, whereas physical activity and the use of nonsteroidal anti-inflammatory drugs (NSAIDs) have been reported to have an inverse association.²⁴⁻²⁸ Some studies suggest that women who are current smokers are more likely to report a lower mammography rate,^{14,16,23,29,30} whereas limited evidence indicates that women who consume moderate amounts of alcohol are more likely to report higher mammography rates.^{23,31} Inverse associations between mammography screening and physical activity have also been reported.³² Whether these predisposing lifestyle factors influence screening adherence similarly among Hispanic women compared with NHW women is unknown.

Ethnic disparities in screening adherence may also be attributed to characteristics that may enable or impede a woman's access and adherence to mammography screening. For example, certain sociodemographic characteristics, such as women's marital status and social support networks, have been found to be associated with mammography screening.^{7,10,33,34} There is a lack of knowledge, however, about whether these enabling characteristics are differentially related to mammography adherence across women of various ethnic groups.

The elucidation of which population characteristics are differentially associated with adherence to mammography screening would assist in reducing BC outcome disparities across racial/ethnic groups. Furthermore, understanding how various predisposing and enabling characteristics are associated with mammography screening adherence also has important implications for etiological studies. For example, if the prevalence of BC risk factors differs between mammography adherent and nonadherent women, this could introduce potential confounding tied to BC diagnosis, complicating the interpretation of both case-control and cohort studies. Identifying how population characteristics relate to regular

mammography screening could also aid in developing interventions that can effectively improve adherence. Designing targeted interventions based on population-specific characteristics could contribute toward closing the BC outcome disparities that impact ethnic minority women so profoundly.

The present study addresses the gap in the literature by investigating the association of mammography adherence with women's BC risks, lifestyle, and medical behavior characteristics (need and predisposing factors) as well as with certain sociodemographic characteristics (enabling factors) that have been less studied and are in need of further empirical support. The study also assesses whether such characteristics are differentially associated with mammography adherence among women from two ethnic groups, NHW and Hispanic women.

Materials and Methods

Theoretical framework

The Behavioral Model for Vulnerable Populations^{35,36} is a theoretical framework that is used to organize population characteristics likely to impact the use of healthcare services by vulnerable populations, such as women and ethnic minorities. This behavioral model proposes that a group of characteristics, such as need, predisposing, and enabling characteristics, either facilitate or impede the use of health services. Need characteristics are those that constitute both objective and subjective assessment of health status or illness propensity. In the case of BC, known factors that place women at risk of developing the illness are older age, postmenopausal status, and personal or family history of BC.^{3,5,6,20-23} Consequently, women with these characteristics have a greater need to adhere to mammography screening recommendations.

Predisposing characteristics are those that indirectly predispose individuals to develop an illness and, consequently, to use health services. According to the literature, there is evidence suggesting that nulliparity, late age of first childbirth, HRT use, and postmenopausal obesity place women at risk of BC.^{1,19} Lifestyle factors, such as smoking and alcohol use, are also BC predisposing factors and, thus, should also predispose women to engage in BC screening. Enabling characteristics explain differences in the resources available to the individual in using healthcare services. SES and such social characteristics as being partnered and being highly acculturated to mainstream U.S. culture enable women to access and adhere with mammography screening services. Using this model of health services use by vulnerable NHW women and Hispanic women can be especially helpful in identifying the challenges each group faces in obtaining needed mammography and may provide insights into maintaining or improving their adherence with this early BC detection and potentially lifesaving procedure.

Participants

Participants included in this analysis were women between 40 and 79 years of age who participated as control subjects in the 4-Corners' Breast Cancer Study. This was a population-based case-control study conducted in four states (Colorado, Arizona, New Mexico, and Utah) between 2000 and 2005. Participants up to age 64 were selected at random from computerized drivers' license lists in New Mexico and Utah

or from commercially available lists in Arizona and Colorado. Participants ≥ 65 years were selected from Medicare lists in all four states.

The larger study hypotheses were formulated specifically to explore BC risk factor differences between Hispanic and NHW women. Of the participants, 790 self-identified as Hispanics and 1441 self-identified as NHW. Complete selection and recruitment procedures for this study have been described in detail elsewhere³⁷ Cooperation rates were 35% for Hispanic women and 47% for NHW women. Each data collection site received human subjects research approval to recruit subjects and obtained written informed consent from each participant.

Data collection methods

Computerized interviews were administered by trained and certified interviewers.²⁴ In an effort to make recall similar for case and control participants in the original study, cases were asked questions with respect to the year prior to the date of diagnosis, and controls were asked questions with respect to the year prior to selection for the study. The interview was administered in either English or Spanish at the preference of the participant. The questionnaire collected information about participants' history of weight, medical conditions, and reproductive and family health, as well as information about their diet, physical activity, medication, and tobacco use. Height and weight measurements were taken at the time of the interview using a stadiometer and a portable scale.

Body mass index (BMI) was calculated using the formula of weight in kilograms (kg)/height in meters (m)². Regular use (at least three times a week for at least 1 month) of aspirin and of NSAIDs was reported along with age of last use of these medications. To define menopausal status, an algorithm based on age at referent date and women's responses to eight questions about menstrual status, HRT use, and surgical or medical menopause was used.²⁴ Information about physical activity was assessed through a modified version of the Cross-Cultural Activity Participation Study questionnaire,³⁸ which has been found to be a valid and reliable measure of physical activity of ethnic minority women. The modified version³⁸ was used to collect information on frequency and intensity of activities done at home and work and during leisure.^{24,38,40} For the Hispanic participants, we used language (English or Spanish) most commonly used for speaking and reading as the indicator of acculturation. Values ranged from 1 to 5 (1 = read or speak Spanish only; 5 = read or speak English only), and the average of these two values was used to create categories of language acculturation.

Participants' breast cancer screening behaviors, specifically breast self-examinations (BSEs) and mammography, were assessed through self-reports. To obtain an estimate of adherence with regular BSEs, women were asked to respond Yes, No, or Don't know to the question: Before [referent date], did you perform breast self-exams on a regular basis? By regular, I mean in most months. Women who responded Yes were classified as performing BSE on a regular basis, and women who responded No or Don't know were classified as not regular in performing BSE. To determine mammography screening behaviors, participants were asked to respond Yes, No, or Don't know to: Before [referent date], did you ever have a mammogram? Those who responded Yes were further

asked: In what year did you have your first mammogram? These women were further asked: Before [referent date], how many mammograms did you have?

Analysis

For this analysis, adherence to mammography screening guidelines was based on the ACS mammography screening guidelines for women at average BC risk.² To be classified as adherent, women should have (1) obtained their first mammogram at <51 years of age and (2) had an estimated frequency of screening of one mammogram per 2 years or less during the time interval from their first mammogram. The estimated frequency of screening was determined based on the following calculation: age at referent year – age at first mammogram/total number of mammograms reported. Women who did not meet the criteria were classified as nonadherent to screening guidelines. Participants who reported never having obtained a mammogram were also placed in the category of nonadherent. For example, a woman was classified as nonadherent if she was 61 years old at the referent year and/or had obtained about five mammograms after her first mammography screen at 46 years of age [(61 years – 46 years)/5 mammograms = 3-year interval].

All statistical analyses were conducted using SAS, version 9.1 (SAS Institute, Cary, NC). Chi-square tests were initially used to compare characteristics according to adherence or lack thereof to mammography screening guidelines (adherent, not adherent) among Hispanic and NHW women separately. Among Hispanic and NHW women separately, multivariate logistic regression was used to compute ethnic-specific adjusted odds ratios (OR) and 95% confidence intervals (CI) to evaluate the associations between the outcome variable (adherent vs. nonadherent) and the specified need, predisposing, and enabling characteristics that facilitate or impede mammography adherence. Using an ethnic-combined model, we evaluated the relationship between ethnicity and adherence when accounting for all the characteristics. In addition, to determine if the relationship between any of the evaluated characteristics and adherence to mammography screening was significantly different among Hispanic and NHW women, we assessed the *p* value of the multiplicative interaction term created between each factor and ethnicity in the ethnic-combined model.

The following characteristics were evaluated and adjusted in the ethnic-specific multivariate models: age at referent year (40–49, 50–59, 60–69, 70+), menopausal status at referent year (premenopausal, perimenopausal, postmenopausal), BMI at referent year (<25 , 25–29.9, ≥ 30 kg/m²), pregnancies (0, 1–2, ≥ 3), marital status (married or living as married, not married), education (did not graduate from high school, high school graduate or equivalent, some college or college graduate), lifetime activity score (low, moderate, high), alcohol consumption (none, >0 g– <10 g/day, >10 g/day), smoking status (current, former, never), HRT use among postmenopausal women (yes, no), regular aspirin use (yes, no), NSAID use (yes, no), and regular BSE (yes, no). Family history of BC (yes, no, unknown) was defined as any first-degree relative who was diagnosed with BC. In analyses of only Hispanic women, acculturation was estimated as low (score ≤ 2), moderate (score >2 but <4), and high (score ≥ 4). Acculturation was adjusted in the race-specific multivariate model with Hispanic women. In

addition, study center (Arizona, Colorado, New Mexico, Utah) was adjusted in the multivariate models for both NHW women and Hispanic women.

For both ethnic groups, missing data were minimal (i.e., less than 5 subjects) for all covariates with the exception of acculturation (33 subjects). Multivariate analysis was conducted using both overall mean imputation⁴¹ (except acculturation) and subject exclusion for missing data. Because the results were very similar for both methods, the presented results are based on subject exclusion. Hispanic women who were missing data for acculturation were included in the analysis by creating a category for missing values.

Results

As seen in Table 1, adherence to mammography screening guidelines significantly varied by ethnic group ($p=0.001$). Fewer Hispanic women than NHW women (42.3% vs. 44.6%) reported adhering to mammography screening guidelines as recommended by the ACS.² Similarly, Hispanic women were more likely than NHW women (12% vs. 7%) to have never obtained a mammogram in their lifetime (data not shown).

Table 1 shows that among NHW participants, adherent and nonadherent women differed significantly from one another on four need and predisposing characteristics (age, family history of BC, number of live births, and HRT use), one lifestyle predisposing behavior (alcohol consumption), one medical behavior (aspirin use), and two social enabling characteristics (marital status and education). With the exception of family history, aspirin use, and marital status, adherent and nonadherent Hispanic women differed significantly on the same factors. In addition, adherent Hispanic women were more likely to be premenopausal/perimenopausal, use NSAIDs, practice regular BSE, and be more acculturated than nonadherent Hispanic women.

Findings from the multivariate logistic regression analysis of the determinants of mammography with minimally adjusted (only for age and study center) and more fully adjusted ORs and 95% CIs are shown in Table 2. The categories of nonadherent and never were considered separately (data not shown). When compared to the adherent category, the pattern of associations for adjusted ORs was similar for the nonadherent and never categories for both ethnic groups; therefore, those are combined into the nonadherent category. Although most of the described factors were associated with adherence among both Hispanic and NHW women in the minimally adjusted models, many of these associations were not significant in the fully adjusted models. Furthermore, not all the characteristics that were associated with adherence were the same for both ethnic groups. In the fully adjusted multivariable models (Table 2), within the need characteristics, NHW women and Hispanic women who were ≥ 60 years were less likely to be adherent to mammography screening than were women who were 50–59 years old. For both ethnic groups, women who had a family history of BC were more likely to be to mammography adherent than women who did not have a family history of BC. Of the predisposing characteristics, number of live births associated differently for the two groups. NHW women who had three or more births were less likely to be mammography adherent than were women who had one or two births. In contrast, Hispanic women who had not had any births were more likely to be adherent with

mammography screening than were women who had one or two births.

Another predisposing characteristic, BMI, was associated with mammography only among NHW women (Table 2). Obese ($\text{BMI} \geq 30$) NHW women were more likely to be mammography adherent compared with women with normal weight ($\text{BMI} < 25$). HRT use was significantly associated with mammography adherence for both NHW and Hispanic women. Accordingly, women who were on HRT were almost twice as likely to be mammography adherent as were women who were not on HRT.

Lifestyle health behaviors that predispose women to develop BC were significantly associated with mammography adherence only among NHW women (Table 2). Compared with women who did not consume any alcohol, those who consumed between 5 g and 10 g/day and those who consumed >10 g/day were more likely to be adherent. NHW women who were current smokers were less likely to be mammography adherent compared with those who never smoked. No association with physical activity was observed for Hispanic women, but among NHW women, those who engaged in vigorous activity were more likely than women with low physical activity to be mammography adherent.

In contrast to NHW women, adherence was associated with various medical and disease preventive behaviors among Hispanic women only. For example, Hispanic women who take aspirin or use NSAIDs were more likely to be mammography adherent compared with those who did not. In addition, BSE was significantly associated with adherence among Hispanic women but not among NHW women.

Among the social enabling characteristics, marital status was the only variable that remained significant after all other variables were accounted for. NHW women who were not married were less likely to be adherent with mammography screening than were women who were married or living as married. No such association was observed for Hispanics.

In order to determine if the observed ethnic differences in the relationships between the described characteristics and mammography adherence were statistically significant, we evaluated the interaction between ethnicity and each factor in an ethnic-combined model (data not shown). Of the factors found significant in the ethnic-specific models (Table 2), marital status, NSAID use, and menopausal status were found to interact significantly with ethnicity ($p \leq 0.05$, data not shown). In other words, the relationships between these characteristics and adherence are significantly different for Hispanic and NHW women. To determine if the evaluated characteristics explain the observed association between ethnicity and adherence, we compared the relationship between ethnicity and adherence in the minimally adjusted with the fully adjusted ethnic-combined model. In the minimally adjusted ethnic-combined model, Hispanic women were less likely than NHW women to be adherent ($\text{OR} = 0.84$, 95% CI 0.70–1.00, $p = 0.05$). When adjusting for the evaluated population characteristics in the ethnic-combined model, the relationship between ethnicity and mammography adherence was no longer apparent ($\text{OR} = 1.09$, 95% CI 0.88–1.35).

Discussion

Consistent with the literature, our findings reflect that Hispanic women are significantly less likely to adhere to

TABLE 1. RISK FACTORS, SOCIAL, LIFESTYLE, AND HEALTH-RELATED BEHAVIOR
CHARACTERISTICS OF NON-HISPANIC WHITE AND HISPANIC WOMEN

Characteristic	Non-Hispanic white		p value	Hispanic		p value
	Adherent ^a n = 642 (44.6%)	Nonadherent n = 799 (55.4%)		Adherent n = 334 (42.3%)	Nonadherent n = 456 (57.7%)	
Need						
Age (years)			<0.01			<0.01
40–49	179 (27.9) ^b	239 (29.9)		116 (34.7)	128 (28.1)	
50–59	233 (36.3)	178 (22.3)		123 (36.8)	112 (24.6)	
60–69	167 (26.0)	183 (22.9)		73 (21.9)	129 (28.3)	
70+	63 (9.8)	199 (24.9)		22 (6.6)	87 (19.1)	
Menopausal status ^c			0.53			0.03
Premenopausal	96 (15.0)	134 (16.8)		63 (18.9)	63 (13.9)	
Perimenopausal	74 (11.5)	82 (10.2)		53 (15.9)	56 (12.3)	
Postmenopausal	472 (73.5)	583 (73.0)		217 (65.2)	335 (73.8)	
Family history of breast cancer			<0.01			0.19
Unknown	10 (1.5)	12 (1.5)		8 (2.4)	11 (2.4)	
No	516 (80.4)	693 (86.7)		273 (81.7)	393 (86.2)	
Yes	116 (18.1)	94 (11.8)		53 (15.9)	52 (11.4)	
Predisposing						
Biological/hormonal factors						
Body mass index (BMI)			0.34			0.50
<25	280 (43.6)	368 (46.1)		93 (27.9)	112 (24.5)	
25–29.9	181 (28.2)	233 (29.1)		117 (35.0)	175 (38.4)	
≥30	181 (28.2)	198 (24.8)		124 (37.1)	169 (37.1)	
Number of live births ^c			<0.01			<0.01
None	105 (16.4)	115 (14.4)		45 (13.5)	29 (6.4)	
1 or 2	304 (47.4)	287 (36.0)		125 (37.4)	129 (28.4)	
3 or more	233 (36.3)	396 (49.6)		164 (49.1)	297 (65.2)	
Hormone replacement therapy ^d			<0.01			<0.01
Yes	435 (79.7)	430 (64.7)		185 (68.5)	197 (50.4)	
No	111 (20.3)	235 (35.3)		85 (31.5)	194 (49.6)	
Lifestyle health behaviors						
Lifetime activity score ^e			0.06			0.16
Low (0–4)	95 (14.8)	156 (19.5)		89 (26.7)	147 (32.2)	
Moderate (5–8)	204 (31.8)	237 (29.7)		116 (34.7)	135 (29.6)	
Vigorous (9–12)	343 (53.4)	406 (50.8)		129 (38.6)	174 (38.2)	
Alcohol consumption ^c			<0.01			0.01
None	240 (37.4)	402 (50.4)		153 (45.8)	254 (56.1)	
>5≤10 g/day	309 (48.2)	301 (37.7)		151 (45.2)	160 (35.3)	
>10 g/day	92 (14.4)	95 (11.9)		30 (9.0)	39 (8.6)	
Smoking status ^c			0.07			0.29
Never	363 (56.7)	466 (58.5)		220 (65.9)	291 (64.2)	
Former	204 (31.9)	216 (27.1)		79 (23.6)	98 (21.6)	
Current	73 (11.4)	115 (14.4)		35 (10.5)	64 (14.1)	
Breast self-examination ^c			0.02			0.12
Regular (yes on most months)	369 (57.5)	427 (53.5)		234 (70.1)	82 (18.0)	
Not regular (no on most months)	273 (42.5)	371 (46.5)		100 (29.9)	374 (82.0)	
Medication use behaviors						
Aspirin use ^c			0.79			<0.01
Yes	183 (28.6)	184 (23.1)		75 (22.5)	111 (24.3)	
No	458 (71.4)	614 (76.9)		259 (77.5)	345 (75.7)	
NSAID use ^f			0.13			<0.01
Yes	193 (30.1)	245 (30.7)		115 (34.4)	267 (58.8)	
No	449 (69.9)	553 (69.3)		219 (65.6)	187 (41.2)	
Enabling						
Social characteristics						
Marital status			<0.01			0.07
Married	499 (77.7)	534 (66.8)		227 (68.0)	281 (61.6)	
Not married	143 (22.3)	265 (33.2)		107 (32.0)	175 (38.4)	
Education (years) ^c			<0.01			<0.01
<High school (<12 years)	19 (3.0)	44 (5.5)		76 (22.8)	165 (36.3)	
High school (12 years)	129 (20.1)	191 (23.9)		81 (24.3)	132 (29.1)	
Some college (13+ years)	493 (77.0)	564 (70.6)		177 (53.0)	157 (34.6)	

(continued)

TABLE 1. (CONTINUED)

Characteristic	Non-Hispanic white		p value	Hispanic		p value
	Adherent ^a n = 642 (44.6%)	Nonadherent n = 799 (55.4%)		Adherent n = 334 (42.3%)	Nonadherent n = 456 (57.7%)	
Acculturation ^c		N/A				<0.01
Low	N/A			42 (13.1)	103 (23.6)	
Moderate				141 (44.1)	157 (35.9)	
High				137(42.8)	177 (40.5)	

^aAdherent: to mammography screening guidelines; Nonadherent: to mammography screening guidelines; Never, never had a mammogram.

^bn (%).

^cMissing data: Menopausal status, *n* = 3 for Hispanic; live births, *n* = 1 NHW and 1 Hispanic; education, *n* = 1 NHW and 2 Hispanic; alcohol, *n* = 2 NHW and 3 Hispanic; smoking, *n* = 4 NHW and 3 Hispanic; aspirin, *n* = 2 NHW; breast self-examination, *n* = 1 NHW and 2 Hispanic; acculturation, *n* = 33 Hispanic.

^dPostmenopausal only.

^eScores derived from previous studies using this dataset.²⁴

^fNSAID, nonsteroidal anti-inflammatory drugs.

mammography screening guidelines compared with NHW women. Although this difference is relatively small (<3%), we observed ethnic differences in the associations between certain population characteristics and mammography adherence. After accounting for these characteristics, the relationship between ethnicity and mammography adherence was no longer apparent, suggesting that these factors might better explain the adherence disparities. These findings reflect the need to focus on the characteristics that impact each ethnic group rather than on ethnicity as the explaining variable.

Unlike most studies, we assessed whether women were adherent with mammography screening based on both the age when they obtained their first mammogram (before 51 years old) and the estimated frequency of mammography screening (an average of one mammogram every 2 years) rather than whether they had obtained a mammogram in the past 2 years. Moreover, unlike other studies, we did not focus on ethnicity as the explaining factor in mammography disparities but focused on population-specific characteristics that help us to better understand what characteristics may contribute to ethnic disparities in mammography adherence.

Overall, this study found that older women (>60 years of age), who are at greater risk of BC, were less likely to be adherent with mammography screening among both NHW and Hispanic women. Changes in screening recommendations over the past several years, however, are likely to have at least partially contributed to this finding. As expected, both NHW and Hispanic women with a first-degree family history of BC were more likely than women without such history to be adherent. This suggests that the importance of screening for women with a family history is being recognized and acted on not only among NHW women but also among Hispanic women. Another encouraging finding was that both NHW women and Hispanic women who reported taking HRT, another recognized BC-predisposing factor,^{39,42,43} were also more likely to be mammography adherent. Interestingly, Hispanic women, but not NHW women, were more likely to adhere with mammography if they had not had any pregnancies, an established risk factor for BC. The reasons for the observed ethnic difference regarding this particular factor need to be further explored.

Ethnic disparities in mammography screening rates among Hispanic women appear to be explained by the lack of association with other BC-predisposing characteristics. For example, NHW women who were obese, another BC risk factor,^{1,44-46} were significantly more likely to engage in mammography. This obesity pattern was found among Hispanics, but it was not significant, meaning that this BC-predisposed group in need of regular mammography screening is not adhering to the guidelines as recommended. Similar to other studies, we found that consuming moderate amounts of alcohol and not smoking were also significantly associated with better adherence to mammography screening among NHW women,^{14,16,29,30,33} although neither of these factors was associated with mammography adherence among Hispanic women. Among this study population, <5% of subjects (both NHW and Hispanic women) reported consuming more than two drinks per day (>26 g/day). Thus, our results are more reflective of the moderate drinker, which could be a surrogate for healthier lifestyle habits. In addition, vigorous physical activity, another healthy lifestyle behavior, was significantly associated with mammography adherence among NHW women only. These findings suggest that in contrast to NHW women, Hispanic women who demonstrate healthy lifestyle behaviors are not necessarily more likely to practice disease control measures, such as mammography screening.

In contrast, other healthy lifestyle and medical behaviors, specifically regular BSE and NSAID use, were significantly associated with mammography adherence among Hispanics but not among NHW women. Aspirin use was borderline significant in both ethnic groups. These findings suggest that Hispanic women who practice BSE or take aspirin as a preventive behavior may also value mammography screening as a similar preventive measure.⁴² Interestingly, the use of NSAIDs was significantly associated with adherence among Hispanic women only. We speculate that NSAID use may be a proxy for access to healthcare (e.g., physician visits, insurance) among this ethnic group.

Regarding the social enabling characteristics of interest, marital status significantly varied by ethnicity in its association with mammography screening. Among NHW women,

TABLE 2. PREDICTORS OF ADHERENCE TO MAMMOGRAPHY SCREENING GUIDELINES BY NON-HISPANIC WHITE AND HISPANIC WOMEN (ADHERENT VS. NONADHERENT)^a

Characteristic	Non-Hispanic white		Hispanic	
	Adjusted ^b OR ^c (95% CI)	Adjusted ^d OR (95% CI)	Adjusted ^b OR (95% CI)	Adjusted ^d OR (95% CI)
Need				
Age (years)				
40–49	0.58 (0.44-0.77)*	0.72 (0.50-1.02)	0.86 (0.60-1.24)	1.03 (0.65-1.63)
50–59	Reference	Reference	Reference	Reference
60–69	0.68 (0.51-0.91)*	0.66 (0.48-0.92)*	0.51 (0.34-0.75)*	0.51 (0.33-0.81)*
70+	0.22 (0.16-0.32)*	0.23 (0.16-0.34)*	0.22 (0.13-0.38)*	0.24 (0.13-0.45)*
Menopausal status				
Premenopausal	0.79 (0.53-1.16)	1.24 (0.79-1.96)	1.08 (0.65-1.80)	1.76 (0.99-3.13)
Perimenopausal	0.80 (0.54-1.17)	0.89 (0.59-1.35)	0.95 (0.60-1.52)	1.19 (0.72-1.99)
Postmenopausal	Reference	Reference	Reference	Reference
Family history of breast cancer				
Unknown	1.06 (0.44-2.55)	0.98 (0.38-2.53)	1.45 (0.54-3.90)	1.21 (0.40-3.71)
No	Reference	Reference	Reference	Reference
Yes	1.82 (1.33-2.48)*	1.95 (1.41-2.71)*	1.83 (1.18-2.85)*	1.92 (1.20-3.07)*
Predisposing				
Biological/hormonal factors				
Body mass index (BMI)				
<25	Reference	Reference	Reference	Reference
25–29.9	1.04 (0.81-1.35)	1.10 (0.84-1.44)	0.88 (0.60-1.28)	0.97 (0.64-1.46)
≥30	1.24 (0.95-1.61)	1.39 (1.04-1.86)*	0.93 (0.64-1.36)	1.03 (0.68-1.56)
Number of live births				
None	0.87 (0.63-1.19)	0.86 (0.62-1.20)	1.74 (1.01-3.00)*	1.85 (1.07-3.33)*
1 or 2	Reference	Reference	Reference	Reference
3 or more	0.62 (0.49-0.79)*	0.63 (0.48-0.81)*	0.72 (0.51-1.00)*	0.82 (0.57-1.18)
Hormone replacement therapy ^e				
Yes	2.22 (1.68-2.94)*	2.03 (1.51-2.73)*	2.27 (1.60-3.23)*	2.15 (1.46-3.18)*
No	Reference	Reference	Reference	Reference
Lifestyle health behaviors				
Lifetime activity score ^f				
Low (0–4)	Reference	Reference	Reference	Reference
Moderate (5–8)	1.42 (1.02-1.97)*	1.38 (0.98-1.95)	1.37 (0.94-2.00)	1.25 (0.83-1.88)
Vigorous (9–12)	1.42 (1.05-1.92)*	1.39 (1.01-1.92)*	1.12 (0.78-1.62)	0.84 (0.56-1.26)
Alcohol consumption				
None	Reference	Reference	Reference	Reference
>5≤10 g/day	1.61 (1.27-2.05)*	1.59 (1.23-2.06)*	1.40 (1.03-1.91)*	1.29 (0.91-1.82)
>10 g/day	1.45 (1.03-2.05)*	1.48 (1.01-2.15)*	1.05 (0.62-1.79)	0.98 (0.55-1.76)
Smoking status				
Never	Reference	Reference	Reference	Reference
Former	1.16 (0.90-1.49)	0.94 (0.71-1.23)	1.02 (0.72-1.47)	0.88 (0.59-1.29)
Current	0.70 (0.50-0.98)*	0.68 (0.47-0.99)*	0.68 (0.43-1.09)	0.75 (0.45-1.26)
Breast self-examination (before referent date)				
Regular (Yes on most months)	1.19 (0.96-1.48)	1.15 (0.91-1.44)	1.77 (1.29-2.42)*	1.63 (1.16-2.30)*
Not regular (No on most months)	Reference	Reference	Reference	Reference
Medication use behaviors				
Aspirin use				
Yes	1.45 (1.13-1.87)*	1.26 (0.97-1.65)	1.61 (1.10-2.36)*	1.35 (0.89-2.04)
No	Reference	Reference	Reference	Reference
NSAID ^g use				
Yes	0.95 (0.75-1.20)	0.88 (0.68-1.22)	1.71 (1.23-2.36)*	1.49 (1.05-2.12)*
No	Reference	Reference	Reference	Reference
Enabling				
Social characteristics				
Marital status				
Married	Reference	Reference	Reference	Reference
Not Married	0.66 (0.52-0.84)*	0.63 (0.48-0.82)*	0.96 (0.70-1.32)	1.04 (0.73-1.47)
Education (years)				
<High school (less than 12 years)	Reference	Reference	Reference	Reference
High school (12 years)	1.46 (0.80-2.68)	1.35 (0.72-2.53)	1.09 (0.72-1.64)	0.84 (0.53-1.34)
Some college/college (13+ years)	1.73 (0.97-3.07)	1.43 (0.78-2.60)	1.85 (1.28-2.67)*	1.31 (0.84-2.03)

(continued)

TABLE 2. (CONTINUED)^a

Characteristic	Non-Hispanic white		Hispanic	
	Adjusted ^b OR ^c (95% CI)	Adjusted ^d OR (95% CI)	Adjusted ^b OR (95% CI)	Adjusted ^d OR (95% CI)
Acculturation				
Low	N/A	N/S	0.63 (0.40-1.00)*	0.94 (0.55-1.60)
Moderate			1.31 (0.93-1.84)	1.37 (0.95-1.97)
High			Reference	Reference

^aA separate multivariate logistic regression analysis was conducted for non-Hispanic white women and for Hispanic women.

^bMinimally adjusted for age and study center (AZ, CO, NM, UT).

^cOdds ratios (OR) refer to odds of being nonadherent to mammography screening guidelines.

^dAdjusted for all variables presented in the table, as well as study center.

^ePostmenopausal only.

^fScores derived from previous studies using this dataset.²⁴

^gNSAID, nonsteroidal anti-inflammatory drugs.

* $p < .05$

those who were not married or lacked a partner were significantly less likely to adhere to mammography screening than were women who were married. Although we would expect Hispanic women would also benefit from having a partner, this association was not observed. Another social characteristic that would have been expected to be associated with adherence among Hispanic women was language acculturation; that is, being fluent in English might be an enabling factor to use health services, such as mammography, whereas speaking primarily Spanish might be a barrier to services. In fact, in the minimally adjusted model, Hispanic women who were low on language acculturation were less likely to adhere to mammography screening. When the association of other variables was accounted for, however, acculturation was no longer significant.

Limitations and contributions

As discussed elsewhere,²⁴ this study has several potential limitations. First, response rates were low for both NHW and Hispanic women. Selection bias could result if the sample participants were health conscientious and, thus, were more willing to take part in the study. However, adherent mammography screening rates by NHW women (44.6%) and Hispanics (42.3%) were lower than those reported for recent mammography (within 2 years) by others using national population-based samples.⁷ Lower rates could be due to the use of more stringent criteria, including age of first mammogram and number of mammograms thereafter, to determine adherence to mammography guidelines. Another limitation is that our definition of mammography adherence reflects broad trends in screening adherence, which may include women who have experienced gaps in screening regularity. For example, a woman who obtained annual mammograms from ages 46 to 51 and then stopped screening thereafter would be classified as adherent if she entered the study at 58 years of age because she had had six mammograms, although none of these in the last few years.

It should also be noted that we used current ACS guidelines to define adherence.² It is difficult to determine if participants actually received advice about mammography screening consistent with this guideline because guidelines have changed over time and other organizations have made somewhat different recommendations.^{47,48} Thus, the issue of what con-

stitutes compliance with mammography screening is problematic regardless of the criteria used. It is probable that our definition of adherence may have misclassified some women. However, a less stringent measure of having obtained a mammogram in the last 1 or 2 years, typically used in other studies, is also susceptible to misclassification. Another limitation common to most studies is that our assessments of adherence to mammography as well as of some characteristics of interest were based on self-report, which leaves room for potential errors in reporting.

In spite of these limitations, this study is of value because it adds to the limited research that uses representative data from populations who suffer from mammography screening disparities.³⁻⁵ Our study shows that whereas both NHW and Hispanic women with certain BC risks factors (e.g., family history, HRT use) are more likely to be mammography adherent, women with other BC risk factors are not adhering and may require more targeted interventions to promote their regular screening for example, it would be important to target older women among both Hispanic and NHW women. Additionally, it would be advantageous to target NHW with such characteristics as smoking and having multiple children. Thus, information gained from this study may aid in creating interventions that target breast cancer risk characteristics that are particularly problematic for women from different ethnic groups. Such interventions have the potential to contribute toward the elimination of disparities in late detection of BC and consequent higher mortality that persist among medically underserved women.⁷

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The authors have no conflicts of interest to report.

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