

**Race/Ethnicity and the Socioeconomic Status Gradient in
Women's Cancer Screening Utilization: A Case of Diminishing Returns?**

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Abstract

Using three years (2006, 2008, 2010) of nationally representative data from the Behavioral Risk Factor Surveillance System, I assessed the socioeconomic status (SES) gradient on odds of receiving a mammogram in the past two years and a Pap test in the past three years among white, black, Hispanic, and Asian women living in the US. Mammogram and Pap test utilization were less likely among low-SES women. However, women of color experience diminished returns to SES for both screenings; as income and education increased, white women experienced more pronounced increases in the likelihood of being screened than did women of color. In what might be referred to as “paradoxical returns,” Asian women actually experienced a decline in the likelihood of obtaining a recent Pap test at higher levels of education. My findings suggest that women of color differ from whites in their ability to transform socioeconomic resources into cancer screening utilization.

Key Words: health disparities, race/ethnicity, mammograms, pap tests, screening utilization, diminishing returns, SES gradient

Research consistently demonstrates that household income and educational attainment are crucial enabling factors in mammogram and Pap test utilization; women at higher levels of income and education are more likely to obtain timely screenings than their peers at lower levels of socioeconomic status.¹⁻⁷ There are inconsistencies in the literature, however, about the continued existence of racial/ethnic disparities in mammogram and Pap test utilization. On the one hand, some recent studies suggest that black and Hispanic women continue to have lower rates of screening than white women.⁸⁻¹² However, much of that research is based on samples limited to specific states or regions, Medicare beneficiaries, or HMO enrollees. Other recent studies demonstrate that screening rates among black and Hispanic women are now equal to or higher than rates among white women.^{1,13-16} Comparatively less is known about screening use among Asian women living in the U.S. Based on samples of women living in California, researchers have found that Asian women are significantly less likely than white women to report receiving recent mammograms and Pap tests.^{8,9,17}

We also know little about the ways in which race/ethnicity attenuates or conditions SES differences in screening use. Previous research on screening use within specific racial/ethnic groups in individual states lends some support to the idea that returns to SES may be smaller for women of color.^{11,17,18} Understanding the direct and interactive influences of race/ethnicity and socioeconomic status on the use of health care services is important for theory, research and health policy. If a goal is to design health policy interventions to increase the use of screenings among all women and reduce disparities in morbidity and mortality, an important step is uncovering the extent to which the SES gradient functions differently across different groups. Accordingly, this study used three years of nationally representative data to examine the

conditional effect of race/ethnicity on the relationship between SES and mammogram and Pap test utilization among white, black, Hispanic, and Asian women living in the US.

This paper makes a substantial contribution to our understanding of the extent to which race/ethnicity moderates associations between SES and cancer screening utilization among women and the extent to which women of color receive diminished returns to SES in screening utilization. Although research on disparities in mammogram and Pap test utilization has generally moved beyond debates about whether it is race or class that influences screening utilization, much of this literature focuses only on the main effects of race/ethnicity and SES without utilizing an interactive approach to examine conditional effects on cancer screening use. This study is the first to examine interactions between race/ethnicity and SES on mammogram and Pap test utilization among a nationally representative sample of white, black, Hispanic, and Asian women living in the US.

The SES Gradient and Racial/Ethnic Differences in Cancer Screening Use

There is a long history of public health and social science research on the SES gradient in health. This research consistently finds that individuals at higher levels of SES enjoy better health than those at the levels directly below.¹⁹⁻²¹ According to Link and Phelan,²² socioeconomic status is a “fundamental cause” of health disparities because it influences access to and use of health promoting resources. Mirowsky & Ross²³ suggest that education creates knowledge, skills and resources that enable individuals to make better informed choices, including those related to obtaining medical services and health screenings. When information about health promotion is available, those with more resources should be best able to take advantage of protective opportunities like routine cancer screenings. However, as suggested by

Link & Phelan,²² we must ask under which social conditions enabling factors like income and education might be stronger or weaker predictors of health care use. Applied to the present study, this means exploring whether SES enabling factors of screening utilization are context-dependent in the sense of increasing screening use at a greater rate for one racial/ethnic group vs. another.²⁴ Farmer & Ferraro apply this “diminishing returns” perspective in their analysis of the interactive effects of race/ethnicity and education on self-rated health, finding that as education levels increased, black adults did not report the same improvements in self-rated health as white adults.²⁵

As suggested by Hayward et al., not only does race differentially channel groups into positions of social advantage, but race may also transform the meaning of socioeconomic status.²⁶ For example, blacks and Hispanics may receive diminished returns from educational attainment because the quality of education in predominantly black and Hispanic communities lags behind that in schools that serve predominantly white communities. Lower quality education may be related to lower health literacy, reduced likelihood of health information seeking, and less efficacy in health care use.^{27,28} The health promoting characteristics of social control, mastery, and social standing that are supposed to increase with rising levels of education²³ may increase less for women of color compared to white women. Because belief in personal control and mastery are learned experiences, women of color, who have lifetime experiences with racism and discrimination may have reduced perceptions of mastery and social control relative to their similarly educated white peers. The income that is used to purchase screening services or to cover the co-pays of those services may also have lower benefits for racial minorities compared with whites because of perceived or actual racial discrimination in the quality of care.^{16,29,30} In addition, highly educated women of color are more likely to work in occupations that are

predominantly white,³¹ where they may be more isolated than are similarly educated white women from support networks that provide information and advice about the necessity of cancer screenings and where to obtain screenings. Ultimately, race/ethnicity may influence an individual's exposure to adverse conditions throughout the life course that may transform the meaning of acquired socioeconomic resources that are thought to increase the use of cancer screenings. The hypothesis of this study is that the SES gradient in screening will be steeper for white women than for women of color; white women should experience the steepest gains in likelihood of obtaining screenings as income and educational attainment increase.

Method

Data and sample. Data came from the 2006, 2008, and 2010 Behavioral Risk Factor Surveillance System (BRFSS) – the only three years for which the cancer screening questions were used by all states. The BRFSS is an annual cross-sectional random-digit-dial (RDD) telephone survey conducted by the Centers for Disease Control (CDC) and U.S. states to collect information on preventive health practices, access to health resources, health behaviors, and demographic characteristics among the civilian, non-institutionalized household population. The BRFSS is the largest telephone-based health survey in the world and has been used by multiple researchers to examine predictors of mammogram and Pap test use.^{2,3,13} Although BRFSS sampling strategies and certain questionnaire modules vary across states and over time, the cancer screening questions were consistent across the three years included in this study. Accordingly, the BRFSS is uniform enough to permit pooling data across states and years for items that were asked of all states.⁵ Throughout all analyses, I used the BRFSS final weight to adjust for post-stratification non-response and non-coverage bias. Given that states administer their own surveys and

response rates vary across states, I also used multilevel models with random intercepts to adjust for the clustering of respondents within states.

There has been a great deal of variation in the age groups included in previous studies on mammogram and Pap test utilization. Part of the inconsistency is due to contradictions in the recommended age groups by the ACS and USPSTF. While the ACS recommends annual mammograms beginning at age 40 and continuing for as long as the woman is in good health,³² the USPSTF recommends biennial screening mammography for women aged 50-75.³³ Both recommending bodies encourage Pap tests every three years for women aged 21-65. Because black women present with breast cancer earlier than age 50 and have more advanced tumor diagnosis, I elected to include women aged 40-75 in the mammogram sample for this study.^{12,13,34} For the Pap test analysis I included women aged 25-65. Although most Pap studies include women aged 18 and older or women aged 18-65 who have not undergone hysterectomy,^{2,13,15,17,35} because educational attainment was one of the main independent variables of interest in this study, starting the sample at age 25 is more empirically sound under the presumption that most women have completed their educational attainment by that age.^{1,7} To assess the sensitivity of my results to the selected age groups, I repeated all analyses with various age groups. The results were robust to all age specifications.

BRFSS sample sizes were large enough to include white, black, Hispanic and Asian women. Small sample sizes prevented the inclusion of other racial groups (i.e., American Indians, and mixed-race). The BRFSS does not ask about ethnic subgroups or national origin, so I was unable to explore differences in screening likelihood across those subgroups. Across the three years, a total of 475,822 white, black, Hispanic and Asian women aged 40-75 completed the survey, and a total of 352,374 white, black, Hispanic and Asian women aged 25-65 who had

not undergone hysterectomy completed the survey. After eliminating respondents with missing information on any of the variables of interest, my analytic sample was 366,194 for the mammogram analysis (women aged 40-75) and 289,161 for the Pap test analysis (women aged 25-65). Supplemental analyses revealed no significant differences in the characteristics of women who answered all of the relevant questions vs. those with missing information on the variables of interest.

Dependent variables. I explored two cancer screening indicators. First, among women aged 40-75, I assessed whether the respondent reported receiving a mammogram (“an x-ray of each breast to look for breast cancer”) within the past 2 years. The BRFSS data do not distinguish between mammograms for the purpose of screening vs. diagnosis. Second, among women aged 25-65, I assessed whether the respondent reported receiving a “pap test for cancer of the cervix” within the past 3 years. Although the validity of self-report measures have been questioned for the purposes of monitoring individual women’s routine timely screening, Some researchers suggest that self-report data overestimates recent mammography and does so more for black women than for white women.³⁶ The implications of these potential overestimations are discussed at the end of the paper.

Independent variables. Race/ethnicity was determined using two questions. In the BRFSS, respondents were asked to identify themselves as Hispanic or non-Hispanic *and* to identify the racial category or categories that best represent them. From the responses to these questions, I created four mutually exclusive categories: non-Hispanic white (referent), non-Hispanic black, non-Hispanic Asian, and Hispanic (any race). I measured socioeconomic status with household

income and educational attainment. Household income was an 8-category measure asking respondents to report annual household income: less than \$10,000, \$10,000-14,999, \$15,000-19,999, \$20,000-24,999, \$25,000-34,999, \$35,000-49,999, \$50,000-74,999, and \$75,000 or more. I created dummy variables for each of the income categories and used ‘less than \$10,000’ as the reference groups. I assessed educational attainment with three categories indicating highest degree attained: less than high school (referent), high school graduate and four-year college graduate. The BRFSS does not ask respondents about graduate level education or professional degrees, so the highest educational level available for analysis is the ‘four-year college graduate’.

Control variables. I included several demographic and health characteristics based upon findings from previous studies on mammogram and Pap test utilization (Kagay et al., 2006; Lees et al., 2005; Selvin and Brett, 2003; Somkin et al., 2004). Dichotomous variables indicated whether the respondent was employed, married, had children living in the household, always or usually got the emotional support needed, had any type of health insurance coverage, experienced a cost barrier to obtaining medical care in the past year, had one or more personal doctors, received a routine physical checkup in the past two years, rated her health as fair or poor, reported being limited in any activities because of physical, mental, or emotional problems, and lived outside of a metropolitan area. Smoking status was measured with three categories: never smoked (referent), former smoker, and current smoker. Weight was measured with three categories that were pre-constructed within the BRFSS: not overweight or obese (referent), overweight (BMI between 25 and 30), and obese (BMI over 30). For the mammogram analysis, I grouped age into three categories: 40-49 (referent), 50-59 and 60-75. For the Pap test analysis, I used four age

groups: 25-34 (referent), 35-44, 45-54, and 55-65. I controlled for survey year in all analyses with 2006 as the referent.

Approach. I begin by presenting descriptive statistics. I then used multilevel binary logistic regression to examine the relationship between race/ethnicity, SES, and mammogram and Pap test utilization and to explore the interactive effects of race/ethnicity with household income and educational attainment on odds of having a recent screening. Although I was not explicitly interested in modeling contextual predictors of mammogram and Pap test utilization, and the lack of neighborhood level identifiers in the data prevented me from conducting a contextual analysis, multilevel models are useful for controlling for the clustering of respondents within geographic areas. Because states administered their own surveys, it is pragmatic to adjust the regression analyses for this clustered sampling design. Null models for both dependent variables produced significant state-level intercept variances, indicating significant variation in mammogram and Pap test use across states. Therefore, I included random intercepts with state as the level-2 unit in all regression models. I conducted all analyses with SAS 9.3.

Results

Descriptive Data. Table 1 presents descriptive statistics for all variables used in both analyses. Nearly 77% of women aged 40-75 reported receiving a mammogram within the past two years, and 91% of women aged 25-65 reported receiving a Pap test within the past three years. Figure 1 displays the percentages of women reporting recent mammogram and Pap test use by race/ethnicity. Black women were significantly more likely and Hispanic and Asian women were

significantly less likely than white women to report recent mammograms. Black, Hispanic, and Asian women were all significantly more likely than white women to report recent pap tests.

<Table 1>

<Figure 1>

Figure 2 demonstrates racial/ethnic variation in the household income gradient on recent mammogram use. Consistent with the diminishing returns perspective, although the percentage of women from each racial/ethnic group who reported obtaining a recent mammogram rose with levels of household income, the increase from the lowest to highest household income categories was more substantial for white women than for the other groups. It is noteworthy that although the lowest income white women were the least likely to report recent mammograms, the percentages converged at the highest income categories for white, black, and Hispanic women, with Asian women having the lowest rates of recent mammogram use among the highest household income group. Figure 3 displays the variation in mammogram use by race/ethnicity and educational attainment. As with the household income analysis, the lowest educated white women were least likely to report a recent mammogram. Increased educational attainment resulted in greater increases in the percentage of white women reporting a recent mammogram than for the other three groups of women.

<Figure 2>

<Figure 3>

<Figure 4>

<Figure 5>

Results were somewhat similar for the Pap test analysis. Figure 4 displays the percentages of women who reported having a Pap test in the past 3 years by race/ethnicity and

household income. Once again, white women at the lowest household income levels reported the lowest rates of Pap test use. While Pap test use increased slightly for black and Hispanic women with rising levels of income, the increases were much more pronounced for white women. This is at least partly a function of white women having more ground to gain as a result of their lower starting point. The association between household income and Pap test use for Asian women was less clear. Although Asian women at the highest levels of household income were more likely to report a recent pap test than those at the lowest level of income, the increase in Pap test use over levels of household income was not consistent. Figure 5 demonstrates that white women with less than high school were the least likely to report having a pap test in the past three years at 76.3%. While educational attainment increased the likelihood of having a recent pap test for white, black and Hispanic women, the percentage of Asian women reporting a recent pap test decreased with rising levels of education, indicating a potential case of paradoxical returns to education for that group.

Regression Results

Table 2 presents the results of the main effects regression analysis for both mammogram and Pap test utilization, controlling for various demographic and health history characteristics. For both analyses, black and Hispanic women were significantly more likely and Asian women were significantly less likely than white women to report recent screenings. Relative to women with household incomes of less than \$10,000 per year, those with higher incomes were significantly more likely to report having a recent mammogram. The relationship between household income and Pap test utilization was more complicated. Relative to women with household incomes of less than \$10,000, those with incomes of \$10,000-14,999 and \$20,000-

24,999 were significantly less likely to report a recent Pap test, while those at the highest income levels (\$50,000 and above) were significantly more likely to report a recent Pap test.

<Table 2>

<Table 3>

<Table 4>

Table 3 presents the results of the models that tested interactions between race/ethnicity and household income. As demonstrated by the significant negative race/ethnicity and income interactions, the associations between household income and mammogram use were weaker for black and Hispanic women than for white women. This is consistent with the descriptive results displayed in Figure 2 earlier. With the exception of the \$10,000-14,999 household income group, there were no significant income interactions for Asian women, suggesting that the relationship between household income and mammogram utilization is similar for white and Asian women. Because interaction effects cannot be interpreted in isolation from main effects, I calculated predicted probabilities of mammogram utilization for the “typical” woman, varying only household income and race/ethnicity; all other characteristics are held at their means. These predicted probabilities are presented in Figure 6. Consistent with the descriptive results presented earlier, white women experience a steeper household income gradient in mammogram use than do women of color.

<Figure 6 about here>

<Figure 7 about here>

Results were only slightly different for the Pap test analysis. Negative income interactions for Hispanics indicate that increases in household income were more weakly associated with Pap test utilization for Hispanics than for whites. The negative interaction for

black women at the highest level of household income (\$75,000 or more), suggests that experiencing an increase in income from the lowest to highest income category was more weakly related to increases in odds of Pap test utilization for black women than for white women. Among Asian women, the significant negative interactions at the \$20,000-24,999, \$35,000-49,999, and \$75,000+ categories suggests that being in these household income categories was more weakly associated with increased odds of Pap test use for Asian women than for white women. In fact, adding the applicable main effect and interaction effect coefficients for the Asian*\$75,000+ interaction produces a negative coefficient; Asian women at the highest household income level have significantly lower odds of reporting a recent Pap test relative to white women at the same high income level. This can be seen more clearly in Figure 7 which displays variation in predicted probabilities of Pap test use by race/ethnicity and household income for the “typical woman” based upon the coefficients from Model 4 presented in Table 3. White women at the lowest levels of household income start with the lowest predicted probabilities of pap test use, but the increase in use is quite steep for white women and much weaker for women of color who have significantly higher probabilities of pap test use at the lowest levels of household income.

The results of the tests for interactions between race/ethnicity and educational attainment are presented in Table 4. For both analyses, the negative significant educational attainment interactions for blacks and Hispanics suggest that while educational attainment increased odds of mammogram and Pap test use for women in general, it did so at significantly weaker rates for black and Hispanic women than for white women. Predicted probabilities from Models 5 and 6 and presented in Figures 8 and 9. As demonstrated in Figure 8, the educational attainment gradient for mammogram use was steeper for white women than for women of color. White

women with less than high school also had the lowest predicted probability of mammogram use (0.64). As can be seen in Figure 9, the significant negative educational attainment interactions for Pap test use among Asian women were so substantial that once they were added to the main effects coefficients, educational attainment was actually negatively associated with Pap test use among Asian women. Relative to Asian women without a high school diploma, Asian women with a high school diploma or college degree had significantly lower odds of reporting a recent Pap test.

<Figure 8 about here>

<Figure 9 about here>

Discussion

Some researchers have suggested that racial minorities differ from whites in their ability to transform socioeconomic resources into good health.^{24,25,37-39} Yet we know little about the extent to which race/ethnicity and SES interact to influence various types of health care utilization. The present research takes a first step toward understanding the interactive influences of race/ethnicity and SES on one particular type of health care utilization - women's use of mammograms and pap tests – among white, black, Hispanic, and Asian women living in the U.S. There are a number of important findings that both support and extend the existing research on racial/ethnic and SES disparities in women's cancer screening utilization.

First, consistent with a number of previous studies, mammogram and pap test screening continue to be less likely among poor women compared with higher income women, and with the exception of Asians, more highly educated women have a greater likelihood of obtaining screenings than women with less education.^{1-4,6,7} Second, the finding that black and Hispanic women have higher odds of reported screenings than white women net of controls for a host of

individual characteristics is consistent with other recent nationally representative studies of women in similar age groups.^{13,34,35} Higher utilization rates among black and Hispanic women may indicate greater success at intervention efforts, including media campaigns, interventions directed at health care providers, increased use of mobile screening vans, and Medicare reimbursement for screening.⁴⁰

The main objective of this study was to test the applicability of the SES diminishing returns perspective²⁵ to mammogram and Pap test utilization. I found that, relative to white women, black and Hispanic women did not experience as pronounced of increases in the likelihood of receiving recent mammogram and Pap tests with rising levels of household income and education, providing support for the diminishing returns perspective. The simplest explanation for this finding is that these groups simply had less ground to make up than do white women. For example, black and Hispanic women at the lowest level of household income still had rates of mammogram and Pap test use in the low 70s and high 80s, respectively. Therefore, the results of the interaction analyses may simply reflect a ceiling effect.

Nevertheless, there is a clear pattern by which higher income and higher education white women are able to transfer those socioeconomic resources into increased cancer screening utilization at a greater rate than women of color. There are several potential explanations for why the SES returns may be lower for women of color. Higher SES black and Hispanic women may be more aware of or have greater perceptions of racial discrimination within the health care system than their lower SES peers³⁰ that may act as a barrier to screening utilization among higher SES black and Hispanic women. In addition, social awareness of and personal experiences with racial injustices in society may reduce the sense of personal control, social status, and mastery among higher SES women of color,²³ contributing to a weaker SES gradient

in health promoting behaviors like cancer screening utilization than what might otherwise be anticipated based on SES alone. Through processes of occupational segregation,³¹ more highly educated women of color are more likely to work in occupations with higher concentrations of whites. Accordingly, they may be more isolated from support networks that can provide health information and advice than are similarly educated white women. Further, it is possible that black and Hispanic women experience diminished returns to SES because of the lower quality of education in predominantly black and Hispanic communities. The lower quality of education may be related to low health literacy, less health information seeking, and less efficacy in health care use.^{27,28} Although I was unable to test these potential pathways with existing data, future research should explore the ways in which race/ethnicity transforms the meaning of socioeconomic status in health care utilization.²⁶

My findings also extend the literature on cancer screening utilization among Asian women, a group that is often overlooked in nationally representative research on mammogram and Pap test use. With the exception of a positive interaction for Asians at the \$10,000-14,999 level of household income, there were no significant income or education interactions for Asian women in the mammogram analyses, suggesting that the relationship between SES and mammogram use is similar for white and Asian women. However, in what might be referred to as “paradoxical returns,” Asian women actually experienced declines in the likelihood of obtaining a recent Pap test at higher levels of education. This reflects a similar pattern found by Kagawa-Singer et al. in their research on Asian women in California; South Asian women with the most education had fewer screenings.¹⁷ They suggested that this may be partially explained by length of time in the US. Recently arriving immigrants tend to have less education and locate in ethnic enclaves where ethnic-specific health services are provided. With increased time in the

US, these women are able to obtain more education, become more economically stable, and move to suburbs⁴¹ where access to culturally competent health services is less likely.

Unfortunately, the BRFSS does not request information about national origin, immigrant status, or length of time in the US. Previous research has demonstrated that there is a great deal of variation in screening use among subgroups of Asians and Hispanics.^{17,34} If the BRFSS under samples the Asian subgroups that are the least likely to be screened, this may explain the very high rates of Pap test use among low education Asian respondents.

The finding that low SES women of color had substantially higher likelihood of recent screening use relative to low SES white women was unexpected and adds a glitch the diminishing returns perspective. The diminishing returns perspective suggests that the white advantage should be the greatest at the highest levels of SES.²⁵ However, the results of my research demonstrate that women of color actually have higher odds of reporting recent mammograms and Pap tests relative to white women, and their advantage relative to white women is the greatest at the lowest levels of income and educational attainment. Based on their research conducted with low income urban black women in Missouri, Lukawago et al. concluded that there was a growing awareness among low income women of color that programs exist to pay for screenings if they cannot afford them.¹⁸ Makuc et al. found that increases in mammography use since 1987 have been most pronounced among low income black women.⁴⁰ The CDC's National Breast and Cervical Cancer Early Detection Program provides funding to all states to help minority and underserved women gain access to cancer screening. Many interventions throughout the late 1980s targeted low income women of color with educational campaigns and free or low-cost mammography.^{42,43} Low-SES white women may be less likely to live in the communities that have been targeted for these interventions.

The interpretation of these findings should be considered in light of some additional limitations. Because these data are cross-sectional, I was only able to examine associations between current education, income, and cancer screening use. These measures capture only a small part of individuals' socioeconomic experiences and do not include accumulated wealth, childhood socioeconomic experiences, or neighborhood socioeconomic conditions. Women of color are disadvantaged relative to whites on each of these measures, and they may all be significantly associated with use of cancer screenings.⁹ In addition, because these data relied on self-reports rather than Medicare or other administrative claims, the results are subject to recall bias. Previous research suggests that self-report data overestimates screenings more so for black women than for white women.³⁶ However, that research did not control for SES and other demographic and social predictors of screening use. Other previous research suggests that the accuracy of recall for mammogram and Pap tests is reasonably good.^{44,45} I can be further confident in my results because the percentages of women reporting recent mammograms and Pap tests are consistent with previous recent studies.^{4,13,15} Nevertheless, if women of color are more likely than white women to overestimate recent screening, this would not disqualify the findings related to diminished returns to SES for women of color. If anything, it would make those findings more robust.

Conclusions

The present study adds evidence to the growing body of research suggesting that the relationship between socioeconomic status and health is conditional on race/ethnicity. Relative to white women, women of color experience diminished returns to household income and educational attainment on mammogram and Pap test utilization, but an additional compelling

storyline to these findings is that use of these screenings are relatively high among the lowest SES women of color and are the lowest among low SES white women. Efforts to increase breast and cervical cancer screening among low SES black and Hispanic women appear to have been effective. Future interventions that aim to increase the use of other types of preventive health care and screening services may wish to model their strategies after those used by the mammogram and Pap test community intervention experts. In addition to continuing these efforts, future mammogram and Pap test campaigns should focus on increasing screening use among low SES white women. This may mean stepping up efforts in low income and low education rural communities that house a larger percentage of poor white women. We must also keep in mind that women of color, particularly black women, continue to be diagnosed at later stages and have higher mortality rates from these cancers than white women.⁴⁶ This suggests the need to promote earlier and more frequent screenings (e.g. annual) among women of color, improve follow-up to treatment after positive screening results, and ensure equitable quality of screening services across groups. One-size-fits-all screening intervention efforts may not be enough to increase the use of routine screening and to reduce breast and cervical cancer mortality rates across racially and socioeconomically diverse groups of women.

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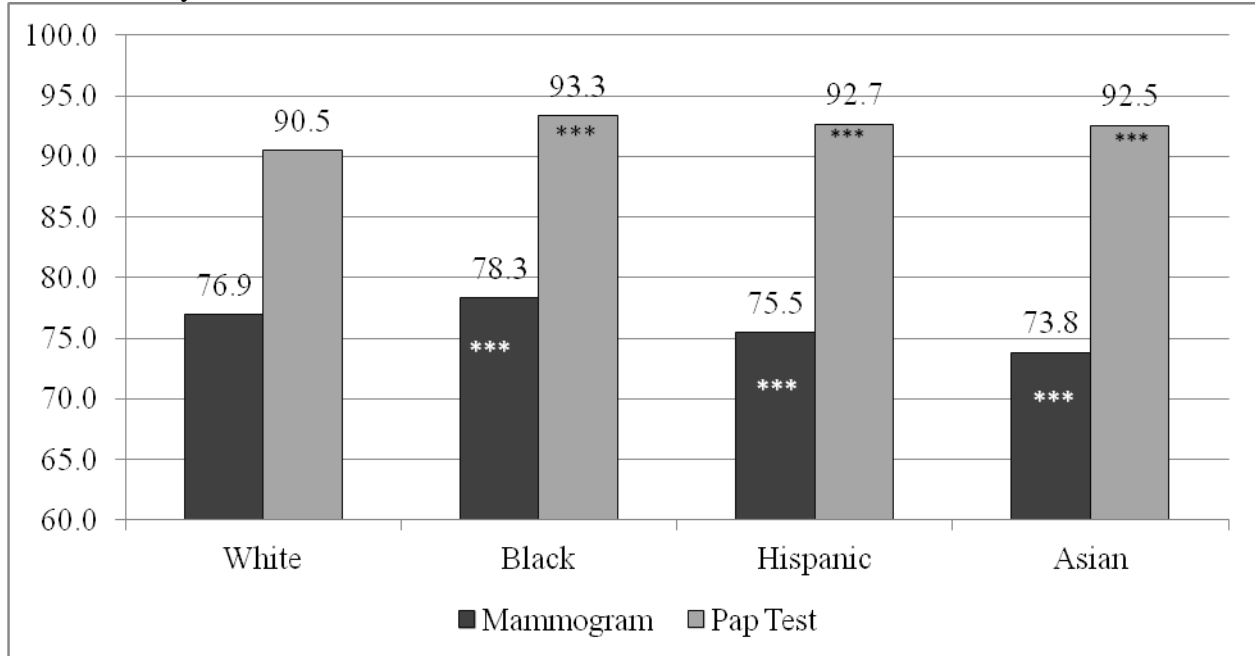
Table 1. Descriptive Statistics (Percentages) for Mammogram and Pap test Samples

	Mammogram Sample (N=366,194)	Pap Test Sample (N=289,161)
Mammogram in past 2 years	76.9	-----
Pap test in past 3 years	-----	91.2
INDEPENDENT VARIABLES		
<i>Race/Ethnicity</i>		
White	77.1	72.3
Black	10.6	10.9
Hispanic	10.0	13.6
Asian	2.3	3.2
<i>Household Income</i>		
Less than \$10,000	4.8	4.4
\$10,000-14,999	4.9	3.9
\$15,000-19,999	6.4	5.6
\$20,000-24,999	8.0	7.1
\$25,000-34,999	10.6	9.6
\$35,000-49,999	14.8	14.3
\$50,000-74,999	17.5	18.5
\$75,000 or more	33.1	36.6
<i>Educational Attainment</i>		
Less than high school	8.2	7.3
High school graduate	55.5	49.8
Four-year college graduate	36.3	42.9
COVARIATES		
Currently employed	58.1	67.7
Has health insurance	89.5	85.6
Experienced medical cost barrier in past year	14.0	16.6
Has at least one personal doctor/HCP	90.6	85.3
Has had a routine health checkup in past 2 years	87.3	83.9
Poor/fair self-rated health	18.2	12.0
Has a functional limitation	25.5	17.2
Smoking status		
Never smoked	57.0	62.3
Former smoker	26.0	19.9
Current smoker	17.1	17.8
Weight		
Not overweight or obese	38.7	44.3
Overweight	31.8	29.3
Obese	29.4	26.4
Married	66.0	68.0
At least one child living in household	33.2	57.4
Usually/always gets emotional support needed	81.4	82.2

Lives in nonmetropolitan county	18.6	16.5
Pap test age groups		
25-34	-----	27.5
35-44	-----	30.2
45-54	-----	25.5
55-65	-----	16.9
Mammogram age groups		
40-49	37.4	-----
50-59	33.2	-----
60 and older	29.4	-----
Survey year		
2010	35.3	34.5
2008	33.5	33.9
2006 (ref)	31.3	31.6

Note: Weighted; Mammogram sample includes ages 40-75; Pap test sample includes ages 25-65

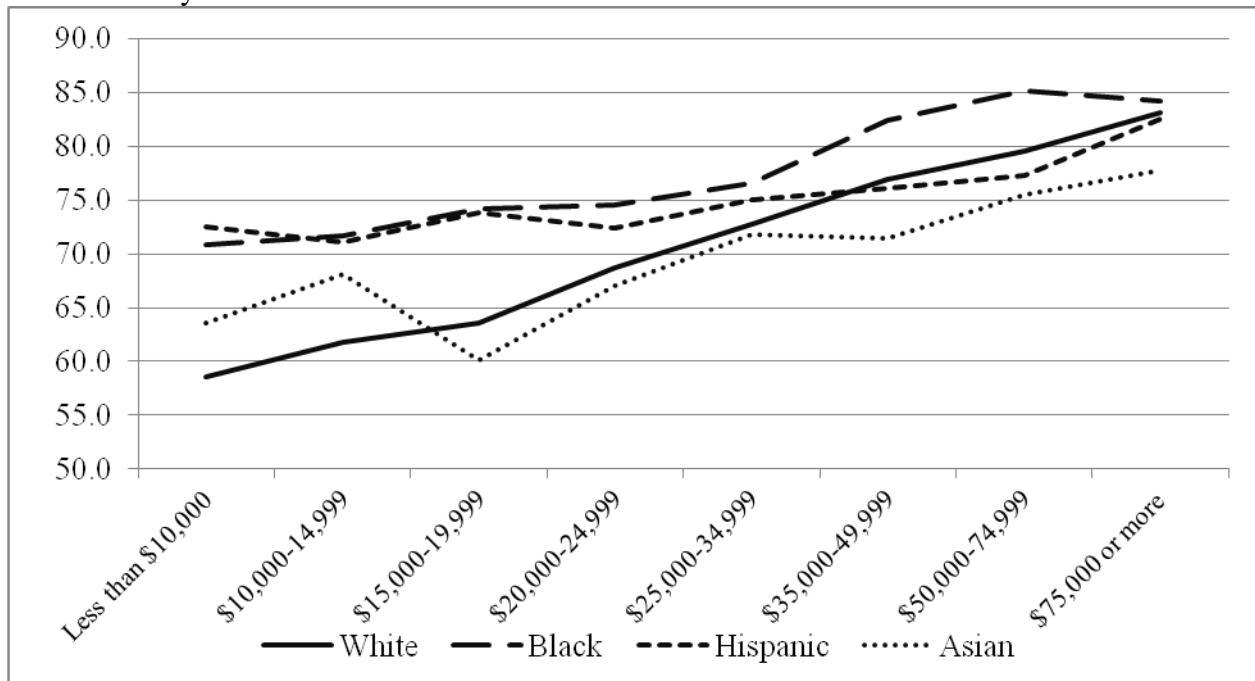
Figure 1. Percentages of Women Reporting Recent Mammogram and Pap test Use by Race/Ethnicity



Note: weighted

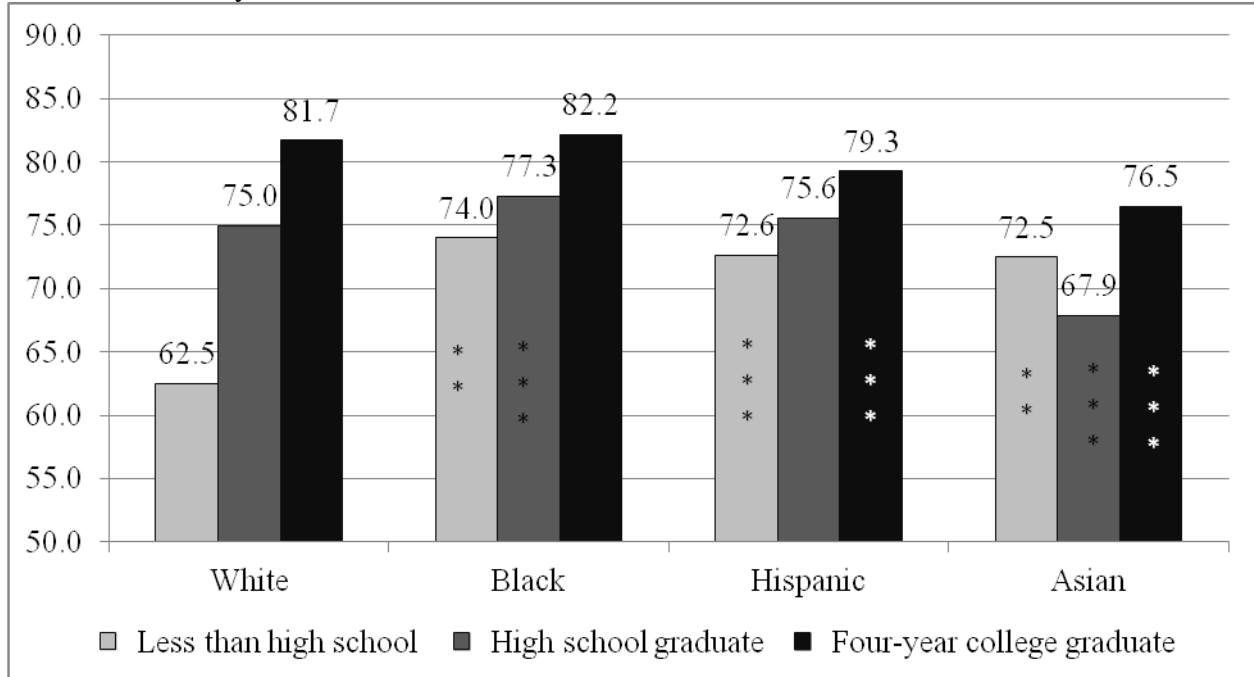
***p<.001 significantly different from whites; two-tailed test

Figure 2. Percentages of Women Reporting Recent Mammogram Use by Household Income and Race/Ethnicity



Note: N=366,194; weighted

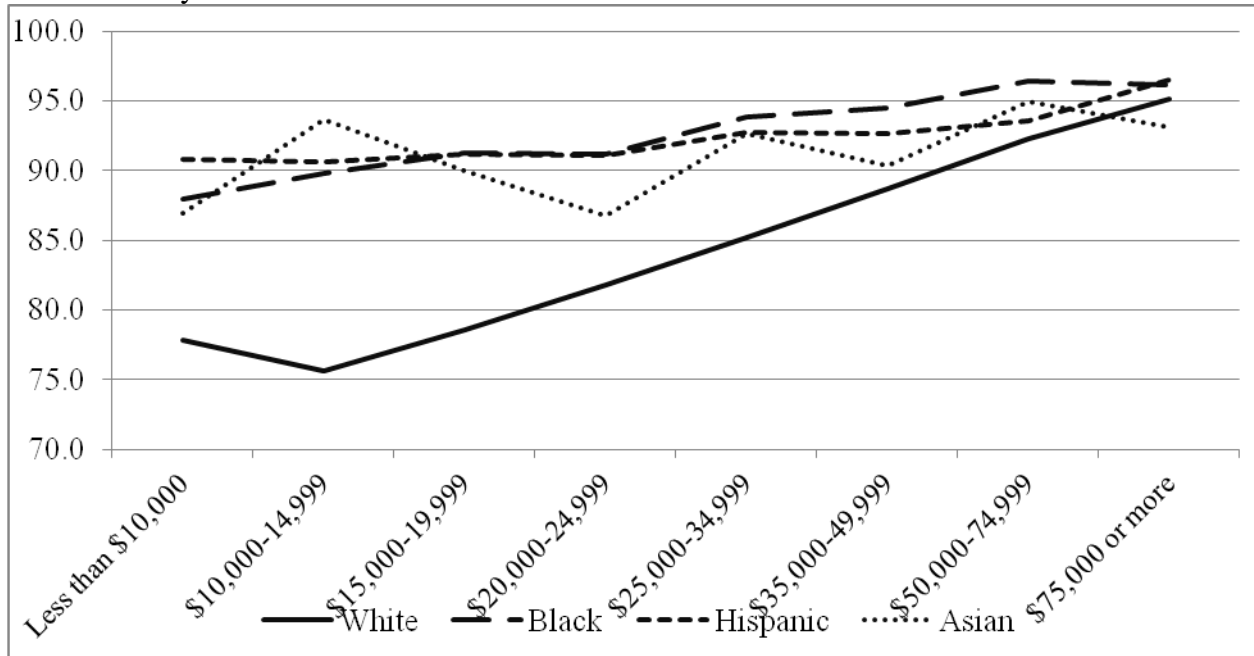
Figure 3. Percentages of Women Reporting Recent Mammogram Use by Educational Attainment and Race/Ethnicity



Note: N=366,194; weighted

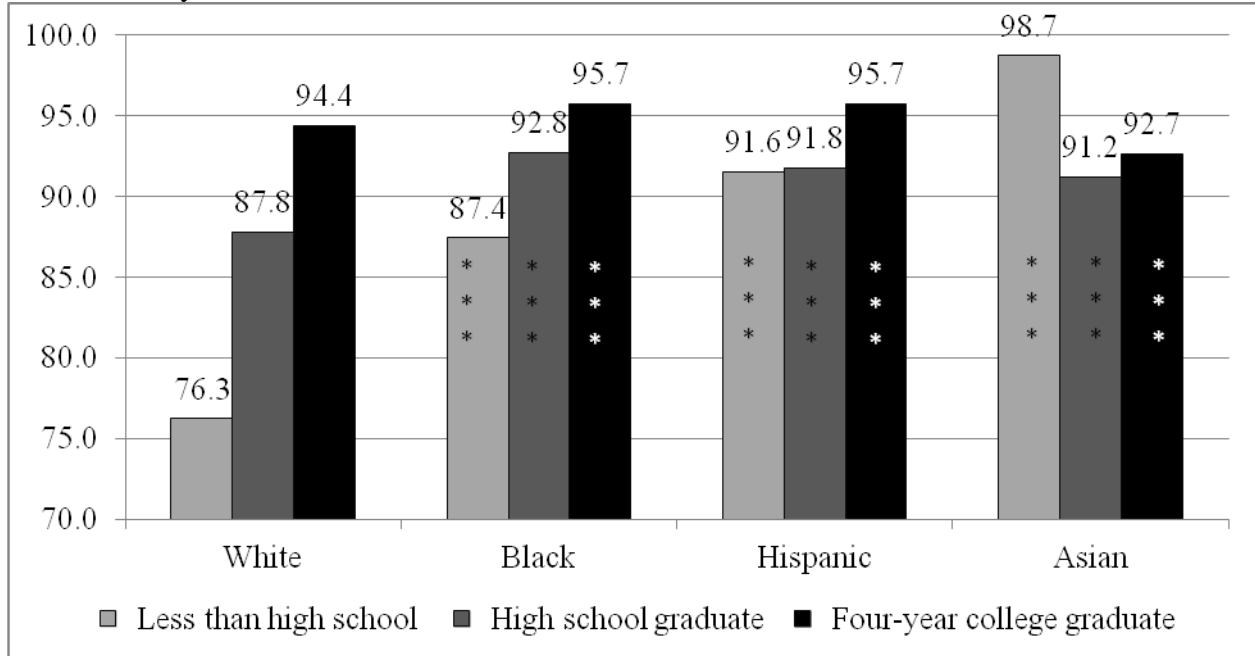
***p<.001; **p<.01 (significantly different from white women at same education level); two-tailed tests

Figure 4. Percentages of Women Reporting Recent Pap test by Household Income and Race/Ethnicity



Note: N=289,161; weighted

Figure 5. Percentages of Women Reporting Recent Pap test by Educational Attainment and Race/Ethnicity



Note: N=289,161; weighted

***p<.001 significantly different from white women at same education level; two-tailed tests

Table 2. Logistic Regression Coefficients Predicting Recent Mammogram and Pap test Use

	Model 1 Mammograms (N=366,194)			Model 2 Pap Tests (N=289,161)		
INDEPENDENT VARIABLES						
<i>Race/Ethnicity</i>						
White (ref)						
Black	.281	(.016)	***	.371	(.029)	***
Hispanic	.409	(.017)	***	.635	(.028)	***
Asian	-.367	(.029)	***	-.265	(.047)	***
<i>Household Income</i>						
Less than \$10,000 (ref)						
\$10,000-14,999	-.021	(.026)		-.094	(.042)	*
\$15,000-19,999	.022	(.025)		-.024	(.039)	
\$20,000-24,999	.082	(.024)	***	-.051	(.038)	*
\$25,000-34,999	.130	(.024)	***	-.017	(.038)	
\$35,000-49,999	.242	(.037)	***	-.041	(.038)	
\$50,000-74,999	.306	(.024)	***	.126	(.039)	**
\$75,000 or more	.453	(.025)	***	.322	(.040)	***
<i>Educational Attainment</i>						
Less than high school (ref)						
High school graduate	.016	(.017)		.005	(.027)	
Four-year college graduate	.101	(.019)	***	.254	(.032)	***
COVARIATES						
Currently employed	-.008	(.010)		.019	(.017)	
Has health insurance	.524	(.015)	***	.394	(.021)	***
Experienced medical cost barrier in past year	-.208	(.013)	***	-.172	(.020)	***
Has at least one personal doctor/HCP	.701	(.014)	***	.560	(.019)	***
Has had a routine health checkup in past 2 years	1.774	(.012)	***	2.229	(.016)	***
Poor/fair self-rated health	-.100	(.013)	***	-.203	(.022)	***
Has a functional limitation	-.066	(.011)	***	-.184	(.020)	***
<i>Smoking status</i>						
Never smoked (ref)						
Former smoker	.008	(.011)		-.040	(.020)	**
Current smoker	-.519	(.012)	***	-.517	(.019)	***
<i>Weight</i>						
Not overweight or obese (ref)						
Overweight	.020	(.011)		-.086	(.019)	***
Obese	-.089	(.011)	***	-.334	(.019)	***
Married	.096	(.011)	***	.104	(.018)	***
At least one child living in household	-.264	(.011)	***	.022	(.018)	
Usually/always gets emotional support needed	.186	(.011)	***	.138	(.019)	***
Lives in nonmetropolitan area	-.121	(.012)	***	-.169	(.020)	***

Mammogram age groups					
40-49 (ref)					
50-59	.485	(.011)	***		
60-75	.490	(.014)	***		
Pap test age groups					
18-29 (ref)					
30-39				-.809	(.023) ***
40-49				-1.190	(.024) ***
50-65				-1.574	(.027) ***
Survey year					
2006 (ref)					
2008	-.022	(.011)	*	-.036	(.019)
2010	-.107	(.011)	***	-.124	(.018) ***
Intercept	-1.854	(.041)	***	.965	(.057) ***
State Level Variance	.030	(.007)	***	.027	(.007) ***
Chi-Square/DF	0.99			0.98	

Notes: Log odds (standard errors); weighted
 ***p<.001; **p<.01; *p<.05; two-tailed tests

Table 3. Logistic Regression Coefficients for Race/Ethnicity*Household Income Interactions on Recent Mammogram and Pap test Use

	Model 3 Mammograms (N=366,194)			Model 4 Pap Tests (N=289,161)		
INDEPENDENT VARIABLES						
<i>Race/Ethnicity</i>						
White (ref)						
Black	.629	(.046)	***	.445	(.074)	***
Hispanic	.867	(.048)	***	.930	(.076)	***
Asian	-.258	(.125)	*	.498	(.219)	*
<i>Household Income</i>						
Less than \$10,000 (ref)						
\$10,000-14,999	.046	(.034)		-.164	(.055)	**
\$15,000-19,999	.080	(.032)	*	-.047	(.052)	
\$20,000-24,999	.234	(.031)	***	.034	(.049)	
\$25,000-34,999	.301	(.030)	***	.040	(.048)	
\$35,000-49,999	.429	(.030)	***	.068	(.047)	
\$50,000-74,999	.514	(.030)	***	.247	(.048)	***
\$75,000 or more	.670	(.030)	***	.485	(.048)	***
<i>Educational Attainment</i>						
Less than high school (ref)						
High school graduate	.063	(.017)	***	.043	(.028)	
Four-year college graduate	.149	(.019)	***	.292	(.032)	***
Interactions						
Black*						
Less than \$10,000 (ref)						
\$10,000-14,999	-.203	(.066)	**	.259	(.116)	*
\$15,000-19,999	-.121	(.063)		.166	(.107)	
\$20,000-24,999	-.338	(.063)	***	-.121	(.104)	
\$25,000-34,999	-.420	(.060)	***	.111	(.104)	
\$35,000-49,999	-.305	(.061)	***	-.098	(.103)	
\$50,000-74,999	-.334	(.063)	***	-.030	(.113)	
\$75,000 or more	-.642	(.058)	***	-.569	(.104)	***
Hispanic*						
Less than \$10,000 (ref)						
\$10,000-14,999	-.061	(.066)		.123	(.103)	
\$15,000-19,999	.007	(.064)		.049	(.098)	
\$20,000-24,999	-.269	(.063)	***	-.195	(.096)	*
\$25,000-34,999	-.363	(.062)	***	-.224	(.097)	*
\$35,000-49,999	-.668	(.062)	***	-.410	(.097)	***
\$50,000-74,999	-.987	(.063)	***	-.881	(.102)	***
\$75,000 or more	-.820	(.061)	***	-.647	(.104)	***

Asian*

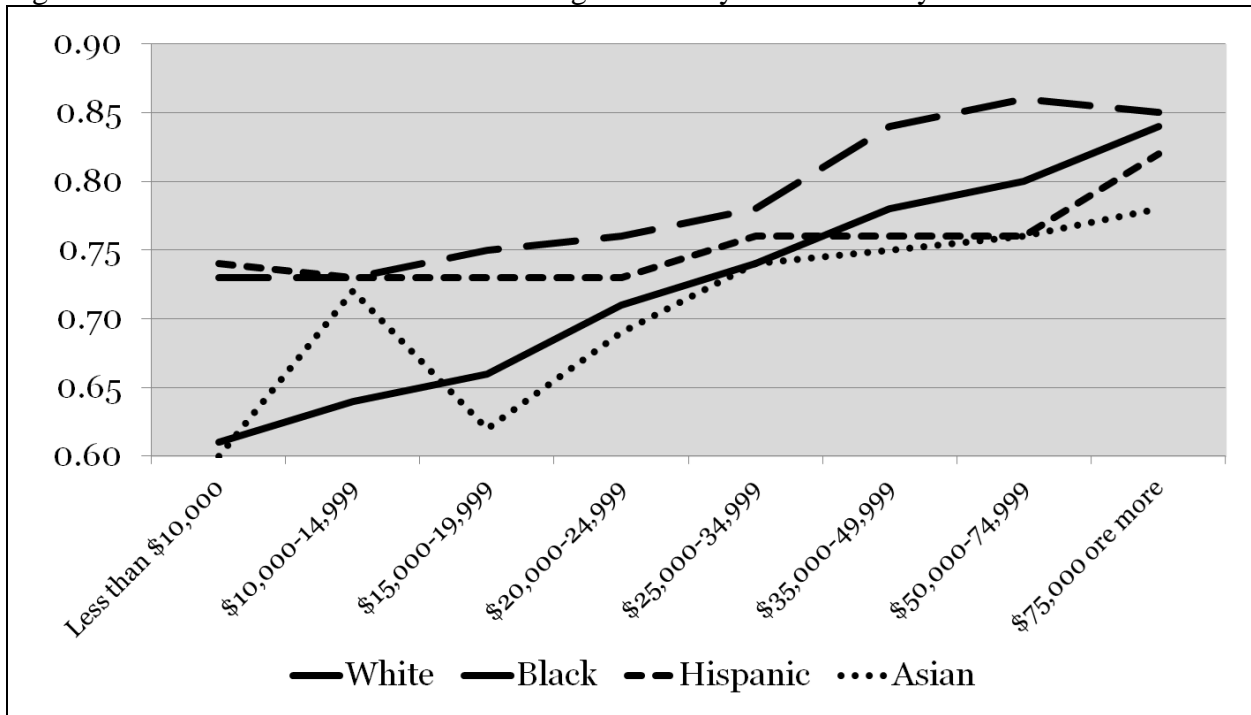
Less than \$10,000 (ref)						
\$10,000-14,999	.455	(.199)	*	.687	(.435)	
\$15,000-19,999	-.239	(.171)		-.216	(.302)	
\$20,000-24,999	-.147	(.161)		-.788	(.280)	**
\$25,000-34,999	.115	(.157)		-.213	(.271)	
\$35,000-49,999	-.011	(.147)		-.802	(.247)	**
\$50,000-74,999	-.077	(.144)		-.269	(.253)	
\$75,000 or more	-.191	(.131)		-1.245	(.228)	***
Intercept	-2.099	(.045)	***	.827	(.063)	***
State Level Variance	.030	(.006)	***	.027	(.007)	***
Chi-Square/DF	0.99			0.97		

Notes: Log odds (standard errors) reported; weighted

***p<.001; **p<.01; *p<.05; two-tailed tests

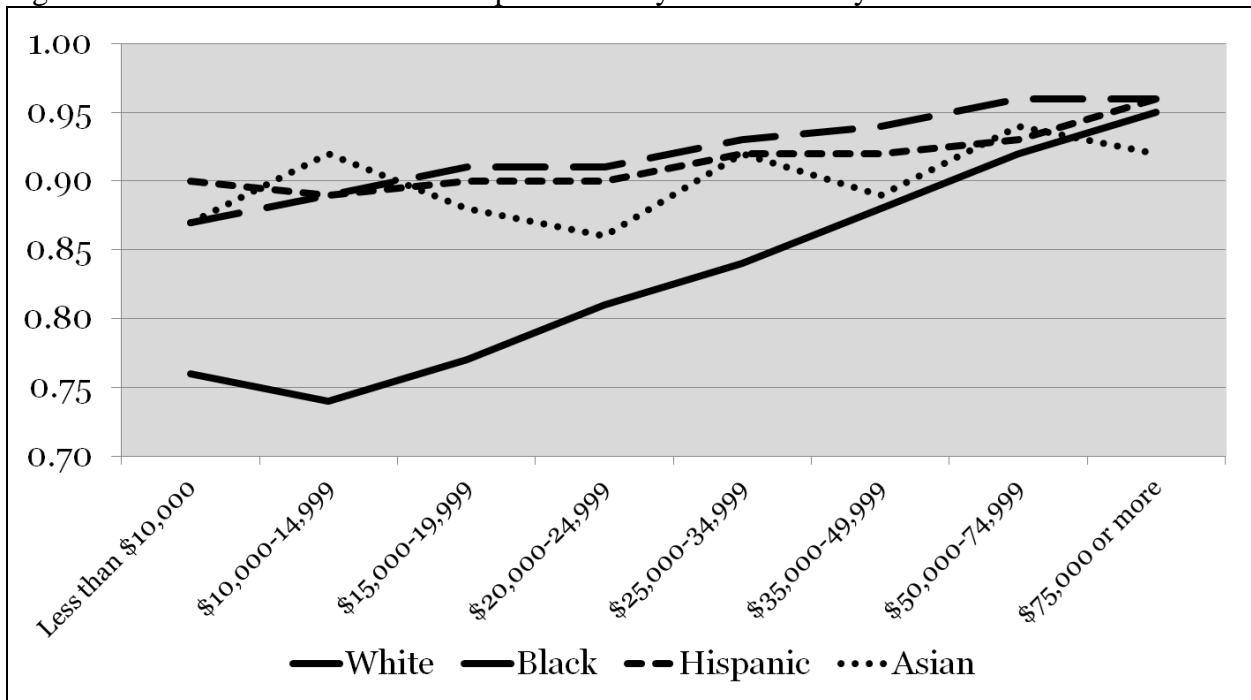
Models control for all covariates included in Table 2.

Figure 6. Predicted Probabilities of Mammogram Use by Race/Ethnicity and Household Income



Note: Based on results from Model 3. All control variables held at means. Weighted

Figure 7. Predicted Probabilities of Pap Test Use by Race/Ethnicity and Household Income



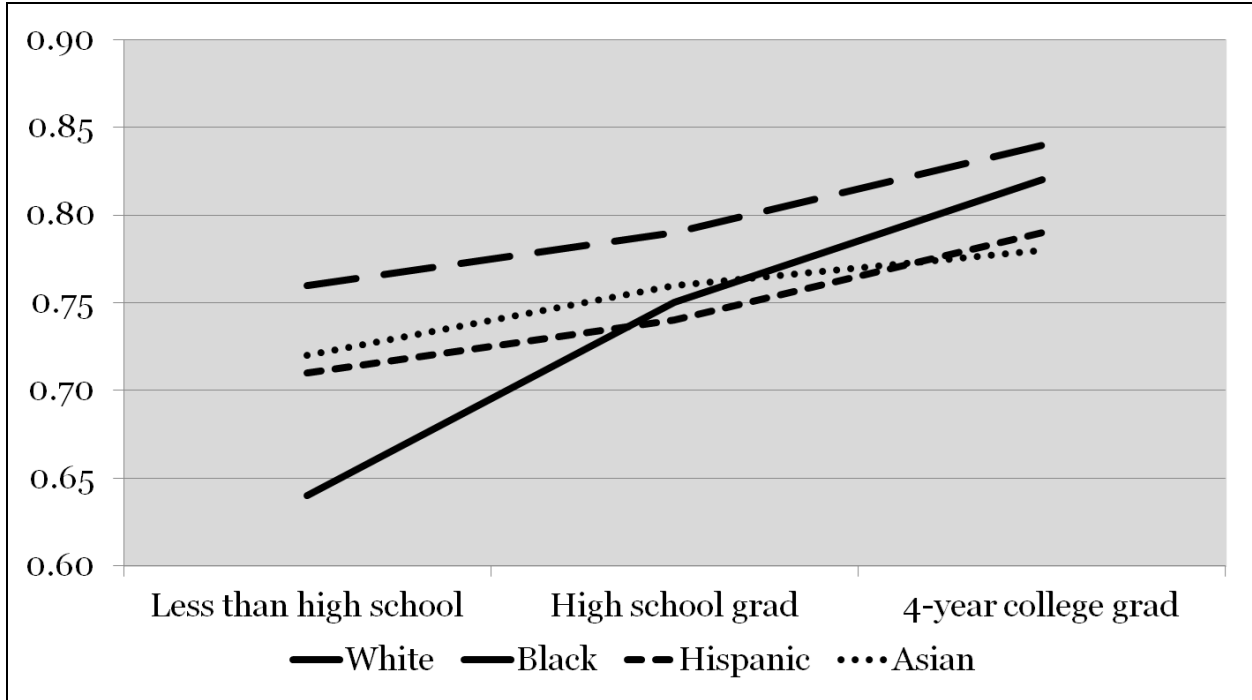
Note: Based on results from Model 4. All control variables held at means. Weighted

Table 4. Logistic Regression Coefficients for Race/Ethnicity*Education Interactions on Recent Mammogram and Pap test Use

	Model 5 Mammograms (N=366,194)			Model 6 Pap Tests (N=289,161)		
INDEPENDENT VARIABLES						
<i>Race/Ethnicity</i>						
White (ref)						
Black	.632	(.044)	***	.556	(.077)	***
Hispanic	.937	(.034)	***	1.218	(.054)	***
Asian	-.225	(.117)		2.861	(.548)	***
<i>Household Income</i>						
Less than \$10,000 (ref)						
\$10,000-14,999	-.016	(.026)		-.094	(.042)	*
\$15,000-19,999	.035	(.025)		-.012	(.039)	
\$20,000-24,999	.096	(.024)	***	-.038	(.038)	
\$25,000-34,999	.148	(.024)	***	-.003	(.038)	
\$35,000-49,999	.260	(.024)	***	-.027	(.038)	
\$50,000-74,999	.323	(.024)	***	.140	(.039)	***
\$75,000 or more	.465	(.025)	***	.333	(.040)	***
<i>Educational Attainment</i>						
Less than high school (ref)						
High school graduate	.246	(.022)	***	.276	(.036)	***
Four-year college graduate	.370	(.024)	***	.580	(.039)	***
Interactions						
Black*						
Less than high school (ref)						
High school graduate	-.303	(.047)	***	-.099	(.084)	
Four-year college graduate	-.561	(.052)	***	-.435	(.094)	***
Hispanic*						
Less than high school (ref)						
High school graduate	-.596	(.038)	***	-.725	(.060)	***
Four-year college graduate	-.821	(.046)	***	-.755	(.078)	***
Asian*						
Less than high school (ref)						
High school graduate	-.134	(.127)		-2.665	(.554)	***
Four-year college graduate	-.149	(.122)		-3.450	(.550)	***
Intercept	-2.126	(.044)	***	.671	(.061)	***
State Level Variance	.029	(.006)	***	.027	(.007)	***
Chi-Square/DF	0.99			0.97		

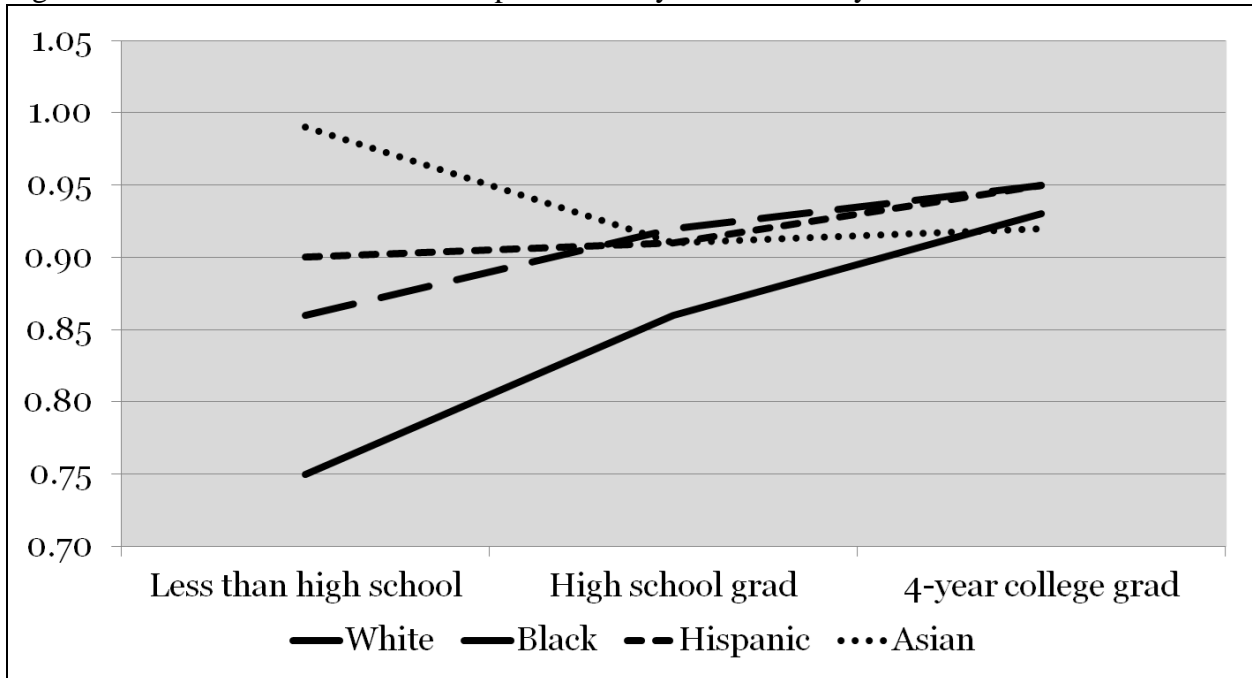
Notes: Log odds (standard errors) reported; weighted
 ***p<.001; **p<.01; *p<.05; two-tailed tests
 Models control for all covariates included in Table 2.

Figure 8. Predicted Probabilities of Mammogram Use by Race/Ethnicity and Educational Attainment



Note: Based on results from Model 5. All control variables held at means. Weighted

Figure 9. Predicted Probabilities of Pap Test Use by Race/Ethnicity and Educational Attainment



Note: Based on results from Model 6. All control variables held at means. Weighted