

Student-Mentored Research

Predictors of mammogram and Pap screenings among US women

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ABSTRACT

Background: The most common cancers among women are breast and cervical cancer. Although early detection of cancer has been shown to increase the likelihood of survival, many women are not screened for these cancers as often as practice guidelines recommend. The objective of this study was to examine the mammography and Papanicolaou (Pap) smear screening practices among women within the United States, and to determine predictors of screening.

Methods: Data from the 2012 and 2014 Behavioral Risk Factor Surveillance System were used. The association between demographic predictors (age, marital status, education level, employment status, income, health insurance, and medical cost concerns) and having Pap or mammogram screening consistent with guideline recommendations was assessed using logistic regression analysis.

Results: Pap and mammography screenings were positively associated with younger age, minority race, being married, having a higher level of education, being employed, having higher household income, having health insurance and not having financial concerns regarding affording doctor visits. Blacks and Hispanic women were more than twice as likely to have Pap screenings (Black: OR=2.16, 95% CI 1.97-2.36; Hispanic: OR=2.33, 95% CI = 2.11-2.58) and mammograms (Blacks: OR=2.11, 95% CI 1.88-2.36; Hispanics OR=1.82, 95% CI 1.60-2.07) compared to White women. Women earning less than \$10,000 per annum were much less likely to have cervical cancer screenings (OR=0.57, 95% CI 0.51-0.65) compared to women with higher incomes while mammography screening was less likely among women who reported financial barriers to health care (OR=0.59, 95% CI 0.53-0.64).

Conclusions: Women from minority ethnic groups were more likely to be screened for cervical cancer compared to White, non-Hispanic women. Women from low-income households and women who could not visit a doctor due to costs had the strongest association with lacking screenings.

Key words: screening, surveillance, cancer, access to care, health disparities, ethnicity

Statement of Student-Mentor Relationship: The authors, Sewuese Akuse, Koren Tate, Tiffany Addison, Tierra Drayton, and Deborah Kanda collaborated on the design, methodology, analysis, and discussion for this report as a part of an Epidemiology Research Methods course in the Master of Public Health program in the Jiann-Ping Hsu College of Public Health, Georgia Southern University. Dr. Kelly Sullivan, the senior author, was their mentor.

<https://doi.org/10.21633/jgpha.6.2s10>

INTRODUCTION

Breast cancer and cervical cancer are the most common cancers among women worldwide and in the United States (US) (Center for Disease Control and Prevention [CDC], 2015). Breast cancer is the second leading cause of death among women in the US, with an incidence of

231,840 and causing an estimated 40,290 deaths in 2015 (American Cancer Society [ACA], 2016). In 2010, the US recorded 4,210 deaths due to cervical cancer, and 12,200 newly diagnosed cases (Moyer, 2012). Early screening to detect breast and cervical cancer is vital in reducing women's morbidity and mortality. Cancer screening aims at promoting the early

detection and thus early presentation and treatment of malignancies (Pandey, 2014).

For both breast and cervical cancers, screening has been shown to be one of the modalities which have effectively reduced death rates from these diseases (Pandey, 2014). Numerous factors contribute to whether or not women receive screening services. These include education, socioeconomic status, access to facilities, health insurance, and health outcomes (Coughlin, King, Richards, & Ekwueme, 2006). These differences can play crucial roles in the use of preventive services for breast and cervical cancer. The purpose of this study was to examine the mammography and Papanicolaou smear screening practices among women within the United States, and to determine predictors of screening meeting the recommended guidelines.

METHODS

Setting

This study utilized data from the 2012 and 2014 Behavioral Risk Factor Surveillance System (BRFSS) to assess predictors of mammography and Pap screening. The BRFSS is a national telephone survey within the US that gathers health-related state data (Behavioral Risk Factor Surveillance System [BRFSS], 2015). Women's health is assessed by BRFSS during even numbered years and includes questions relating to mammogram and Pap screenings.

Institutional Review Board Approval

The current analysis was reviewed by the authors' Institutional Review Board and received exempt status.

Participants

The BRFSS used Standardized questionnaires to collect demographic and health-related information (BRFSS, 2015). Participants in this analysis included women who were interviewed during the BRFSS 2012 and 2014 telephone survey. The BRFSS asks women if they have ever had a mammogram and if they have ever had a Pap test. Those who responded affirmatively were asked how long ago their last mammogram or Pap test took place. All women aged 18 years or older who provided valid answers to the Pap questions were included in the analysis. Responses that were refused/blank and "don't know/not sure" were excluded from the analysis. Women aged 45 years or older who provided valid answers to the mammogram

questions were included in the analysis of mammography predictors.

Assessments

Mammogram and Pap Screening

American College of Obstetricians and Gynecologist (ACOG) guidelines were used in assessing adequacy of mammography and pap screening. The ACOG recommends women aged 21-29 years have a Pap test every 3 years and women aged 30-65 years to have a Pap test and HPV (Human Papilloma Virus) test every 5 years ("Practice Advisory: Breast Cancer Screening - ACOG," 2016). Annual mammography screening is recommended for women aged 40-49 years and biennial screening for women aged 50-74 years; evidence is insufficient regarding the effectiveness of screening in women 75 years and older ("Cervical Cancer Screening - ACOG", 2016). The previous 2003 cervical cancer guidelines recommended annual Pap test screening starting three years after a woman becomes sexually active for the first time, yet no later than age 21 (American College of Obstetricians and Gynecologists [ACOG], 2003). In order to better compare the present results with previously published work, the 2003 guidelines were used for this analysis. Due to the age groupings used by BRFSS, women aged 40-44 were excluded from the mammography analysis because they were combined with younger women in the data. Women's reports of the time since their last Pap and mammogram screenings, if done, was coded to indicate if it was compliant with the guidelines or not. Women who reported never having a Pap or mammogram were considered not meeting guideline recommendations for screening.

Predicting variables

Age was reported in six pre-determined categories: 18-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years, and 65-99 years. Race was classified as "White (non-Hispanic)", "Black (non-Hispanic)", "Hispanic" and "Other". The "Other" race group included Asians and American Indians/Alaskan Natives. Level of education was categorized as less than high school graduate, high school graduate or equivalent, some college education, or college graduate (4 years or more). Income categories were based on total household annual income and included less than \$10,000, \$10,000-<\$15,000, \$15,000-<\$20,000, \$20,000-<\$25,000, \$25,000-<\$35,000, \$35,000-<\$50,000, \$50,000-<\$75,000 and greater than or equal to \$75,000. Employment status was

categorized as employed (employed for wages and self-employed) or unemployed (out of work, a homemaker, a student, retired or unable to work). Marital status was divided into married (defined as married or a member of an unmarried couple) and not married (including those divorced, widowed, separated and never married). Additional covariates included self-reported answers to having concerns regarding medical costs and having health insurance.

Statistical Analysis

Bivariate associations between each predictor variable (age, marital status, education level, employment status, income, health insurance, and medical cost concerns) and the outcome variable (having Pap or mammogram screening consistent with guideline recommendations) were assessed through frequency distributions and chi-square tests. Estimates of odds ratio of timely mammogram and Pap screenings were calculated using logistic regression models. Separate models were constructed to measure the

associations for Pap screening and mammography. Analyses were conducted using SAS software version 9.4 and incorporated survey weighting procedures (BRFSS, 2015). A *p* value of <.05 (two-sided) was established as the threshold for statistical significance.

RESULTS

A total of 196,356 women were included in the Pap screening group and 147,706 women were included in the mammography group (Table 1). The majority of women were within guidelines for Pap screening (N=138,235 (70.4%)). Similarly, the majority of women were within guidelines for mammography screening (N=116,899 (79.1%)). Specific demographic characteristics are shown in Table 1. In bivariate analyses, Pap and mammography screening were associated with age, race, marital status, education, employment, income, health insurance and concerns about medical expenses.

Table 1. Participant Demographics in BRFSS Study on Cancer Screening

	Papanicolaou (Pap) test			Mammography		
	Within Guidelines	Not Within Guidelines	<i>p</i> value	Within Guidelines	Not Within Guidelines	<i>p</i> value
	(N= 138,235) N (%)	(N=58,121) N (%)		(N=116,899) N (%)	(N=30,807) N (%)	
Age Group (years)						
18-24	4,771 (3%)	211 (<1%)	<.001	n/a	n/a	<.001
25-34	17,296 (13%)	1,537 (3%)		n/a	n/a	
35-44	22,250 (16%)	3,348 (6%)		n/a	n/a	
45-54	28,506 (21%)	7,046 (12%)		26,931 (23%)	6,735 (22%)	
55-64	33,952 (25%)	12,956 (22%)		37,484 (32%)	9,003 (29%)	
65-99	31,460 (23%)	33,023 (57%)		52,484 (45%)	15,069 (49%)	
Race						
White, non-Hispanic	103,808 (75%)	49,432 (85%)	<.001	93,828 (80%)	25,884 (84%)	<.001
Black, non-Hispanic	12,428 (9%)	2,997 (5%)		9,660 (8%)	1,571 (5%)	
Hispanic	13,931 (10%)	3,018 (5%)		8,179 (7%)	1,756 (6%)	
Other	8,068 (6%)	2,674 (5%)		5,232 (4%)	1,596 (5%)	
Marital Status						
Married	82,027 (59%)	25776 (44%)	<.001	62,943(54%)	13,285 (43%)	<.001
Not Married	56,208 (41%)	32345 (56%)		53,956(46%)	17,523 (57%)	
Education						
< HS Graduate	8,465 (6%)	4,998 (9%)	<.001	7,781 (7%)	2,819 (9%)	<.001
HS Graduate	32,869 (24%)	19,139 (33%)		32,786 (28%)	9,913 (32%)	
Some College	38,977 (28%)	17,812 (31%)		33,102 (28%)	9,089 (30%)	
College	57,924 (42%)	16,172 (28%)		43,230 (37%)	8,986 (29%)	
Employment						
Employed	67,130 (49%)	14,701 (25%)	<.001	41,297 (35%)	8,869 (29%)	<.001
Not Employed	71,105 (51%)	43,420 (75%)		75,602 (65%)	21,938 (71%)	
Income						
<\$10,000	8,012 (6%)	4,013 (7%)	<.001	6,285 (5%)	2,400 (8%)	<.001

	Papanicolaou (Pap) test			Mammography		
	Within Guidelines	Not Within Guidelines	p value	Within Guidelines	Not Within Guidelines	p value
	(N= 138,235)	(N=58,121)		(N=116,899)	(N=30,807)	
	N (%)	N (%)		N (%)	N (%)	
\$10,000-<\$15,000	7,447 (5%)	5,235 (9%)		7,167 (6%)	2,959 (10%)	
\$15,000-<\$20,000	9,831 (7%)	6,484 (11%)		9,163 (8%)	3,591 (12%)	
\$20,000-<\$25,000	11,745 (9%)	7,917 (14%)		11,355 (10%)	4,105 (13%)	
\$25,000-<\$35,000	14,278 (10%)	8,557 (15%)		13,906 (12%)	4,215 (14%)	
\$35,000-<\$50,000	19,640 (14%)	8,906 (15%)		17,672 (15%)	4,277 (14%)	
\$50,000-<\$75,000	22,755 (17%)	7,661 (13%)		18,923 (16%)	3,880 (13%)	
≥ \$75,000	44,527 (32%)	9,348 (16%)		32,428 (28%)	5,380 (17%)	
Insurance						
Yes	129,499 (94%)	53,461 (92%)	<.001	113,436 (97%)	28,006 (91%)	<.001
No	8,736 (6%)	4,660 (8%)		3,463 (3%)	2,801 (9%)	
Could not see doctor due to cost						
Yes	15,886 (12%)	7,552 (13%)	<.001	9,138 (8%)	4,765 (15%)	<.001
No	122,349 (88%)	50,569 (87%)		107,761 (92%)	26,042 (85%)	

Note: N (%) reported for all categories. Percentages may not total 100% due to rounding.

Pap Screening Predictors

The results of logistic regression analysis are shown in Table 2. After adjusting for other covariates, the odds of a 25-34 year old having Pap screening within the recommended guidelines was about half that of someone aged 18 to 24 years (OR=0.46, 95% CI 0.36-0.58). The odds of screening was two times higher among the Black, non-Hispanic women compared to White, non-Hispanic participants

(OR =2.16, 95% CI = 1.97-2.36). Pap screening was inversely associated with being unmarried, having less than a college education, being unemployed, having lower annual household income, and not seeing a doctor due to financial concerns. Participants with insurance were 2.11 (95% CI = 1.92-2.31) times as likely to have had a Pap screening within the recommended time frame as those without insurance.

Table 2. Odds of Screening (Adjusted*) for Cervical Cancer (Pap Test) and Breast Cancer (Mammography) among US Women Using Logistic Regression

	Papanicolaou (Pap) test		Mammography	
	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
Age Group (years)				
18-24	Ref		n/a	n/a
25-34	0.46	(0.36-0.58)	n/a	n/a
35-44	0.22	(0.18-0.28)	n/a	n/a
45-54	0.15	(0.12-0.18)	Ref	
55-64	0.09	(0.07-0.11)	1.00	(0.93-1.08)
65-99	0.04	(0.03-0.05)	0.92	(0.85-1.00)
Race				
Black, non-Hispanic	2.16	(1.97-2.36)	2.11	(1.88-2.36)
Hispanic	2.33	(2.11-2.58)	1.82	(1.60-2.07)
Other	1.20	(1.04-1.40)	1.04	(0.88-1.22)
White, non-Hispanic	Ref		Ref	
Marital Status				
Not Married	0.84	(0.79-0.88)	0.80	(0.75-0.85)
Married	Ref		Ref	
Education				
< HS Graduate	0.75	(0.67-0.83)	0.89	(0.79-1.00)

HS Graduate	0.76	(0.71-0.81)	0.92	(0.85-0.99)
Some College	0.77	(0.73-0.82)	0.92	(0.86-0.99)
College	Ref		Ref	
Employment				
Not Employed	0.79	(0.75-0.84)	0.88	(0.82-0.95)
Employed	Ref		Ref	
Income				
<\$10,000	0.57	(0.51-0.65)	0.72	(0.62-0.84)
\$10,000-<\$15,000	0.56	(0.50-0.63)	0.64	(0.55-0.73)
\$15,000-<\$20,000	0.58	(0.52-0.65)	0.62	(0.54-0.70)
\$20,000-<\$25,000	0.59	(0.54-0.66)	0.70	(0.62-0.78)
\$25,000-<\$35,000	0.60	(0.55-0.66)	0.71	(0.63-0.80)
\$35,000-<\$50,000	0.70	(0.65-0.76)	0.86	(0.78-0.95)
\$50,000-<\$75,000	0.78	(0.71-0.84)	1.01	(0.91-1.11)
≥ \$75,000	Ref		Ref	
Insurance				
Yes	2.11	(1.92-2.31)	2.56	(2.26-2.90)
No	Ref		Ref	
Could not see doctor due to cost				
Yes	0.66	(0.61-0.71)	0.59	(0.53-0.64)
No	Ref		Ref	

*All ORs are adjusted for other variables listed in table.

Ref= Reference group

Mammography Screening Predictors

Mammography was more than twice as likely to occur within the recommended time frame among Black, non-Hispanics and among Hispanics compared to White, non-Hispanics (for Black participants OR=2.11, 95% CI = 1.88-2.36; Hispanic participants OR=1.82, 95% CI = 1.60 – 2.07). Similar to Pap screenings, the odds of mammography were lower among women who were un-married, had less than a college education, were unemployed, had a lower household income, and had financial concerns that prevented doctor's visits. Women with health insurance were more than twice as likely to have mammograms within guidelines (OR=2.56, 95% CI = 2.26 – 2.90).

DISCUSSION

These findings provide an understanding of the predictors of Pap and mammogram screenings among US women. Pap screening practices within guidelines were more likely among Hispanic and Black non-Hispanic women in comparison to White, non-Hispanic women, whereas mammogram screening practices within guidelines were higher among Black, non-Hispanics in comparison to the same reference population. This may reflect positive attitudes towards cancer screening among minority groups leading to greater screening practices. Possible

strategies to boost awareness can be set in place among White non-Hispanic women to optimize their chances of screening. These results are similar to screening practices among Georgian women: 84% of Blacks and Hispanics with health insurance had been screened for breast cancer within two years compared to 81% of White, non-Hispanic women with health insurance (Georgia Department of Public Health, 2015). There was a slight change noticed with pap screenings: 93% of Blacks, 92% of White, non-Hispanics and 89% of Hispanic women with health insurance had been screened for cervical cancer within two years (Georgia Department of Public Health, 2016).

Women who were concerned about paying for medical expenses were less likely to receive these screenings. Having a lower household income was also found to be more detrimental to Pap screening odds for women. Household income, as well as the presence of health insurance, are influential predictors of screening behavior as these are directly related to the costs of screening services. Previous studies have shown that women from high-income homes or with health insurance had an increased incidence of breast and cervical cancer screening (Meyer et al, 2016). Among women in Georgia, only 40% of White non-Hispanic women and 57% of Blacks without health insurance had been

screened for breast cancer (Georgia Department of Public Health, 2015). For pap tests among the uninsured in Georgia, 81% of Blacks and 68% of White, non-Hispanics had had a pap test within three years. There was no recorded data for uninsured Hispanic women (Georgia Department of Public Health, 2016).

It is also recorded that women in states without Medicaid expansion were found to be less likely to be screened for both breast and cervical cancer (Akinyemiju et al., 2016; Choi et al., 2015; Ku et al., 2016; Sabik et al., 2015).

Women from low-income families would benefit from policies focused on providing screening services for those not able to afford the expenses incurred. Programs such as the National Breast and Cervical Cancer Early Detection Program (NBCCEDP) which provides breast and cervical cancer screenings to low-income, uninsured, and underserved women (CDC, 2016) are likely to improve screening availability to these women. In the state of Georgia, the Breast and Cervical Cancer Program (BCCP) provides access to screening facilities for residents in all counties who are uninsured (Adams et al., 2015). These programs thus help to reach out to women who otherwise would not have had the resources to seek medical care early on.

Age, race, marital status, education, employment, income, insurance, and financial concerns regarding doctor visits were independently significantly associated with both Pap and mammogram screening practices. These findings are consistent with previous studies which found these factors to be associated with Pap and mammogram screening (CDC, 2012; ACA, 2016; BRFSS, 2015; "Cervical Cancer Screening, 2014; ACOG, 2003; Ives et al., 1996; Coughlin et al., 2008; Stanley et al., 2014; CDC, 2016).

The odds for being screened decreased as the age of the participants increased. Women in older age groups may be less concerned with reproductive health issues as their rate of fertility drops and hence may not seek screening for complementary gynecological conditions. Not being married was also associated with a reduced likelihood of mammography and Pap screenings. This may be due to the possible absence of emotional support from a spouse which could encourage women to go for regular screening or could reflect contraceptive practices in this group. Further research is needed to better

understand the observed associations between these factors and screening practices.

The sociodemographic factors of younger age, being married, having a college education, being employed, living above poverty, and being able to see a doctor regardless of financial concerns contribute to the likelihood of being screened. These associations have also been found in other studies (Ives et al., 1996; Coughlin et al., 2008; Stanley et al., 2014; Kirkman-Liff & Kronenfeld, 1992; Benjamins et al., 2004; Jennings-Dozier & Lawrence, 2000; Coughlin et al., 2006; Millon-Underwood & Kelber, 2015; Oran et al., 2008; Jacobs et al., 2014).

The BRFSS is a national survey based on self-reported responses that could be subject to recall bias or information bias if answers were influenced by social desirability. Further, this study is a cross-sectional study which has limited causal inference. In addition, age was categorized into 5-year age groups, as a continuous variable since exact age was not available in of the 2012 and 2014 BRFSS data. This limitation caused some age groups to be included in the data that should have been excluded for evaluation of mammography (e.g. ages 35 to 39). However, a major strength of the BRFSS survey is that it provided a large dataset and a nationwide random sample of subjects. This permits generalizability of our results. The BRFSS also includes both cell phones as well as landline phones which reduce the likelihood of selection bias. The use of a standardized questionnaire and interview procedures reduces the likelihood of differential information bias. Finally, the characteristics we found to be associated with good screening practices were not only statistically significant, but also are clinically meaningful: revealing the importance of positive screening practices in cancer prevention. Future studies should seek to collect data to examine why women did not receive recommended screenings to get an accurate reasoning for limited access to screening or barriers preventing women from getting screened in the appropriate time frame.

CONCLUSIONS

Future studies will be needed to evaluate the effect of the Affordable Care Act on women in low-income areas as well. Although this is likely a helpful change for women who qualify, women who are in states that did not expand Medicaid will not have access to the free screenings and

will most likely not qualify for the benefits with a Marketplace insurance plan ("Affordable Care Act Rules on Expanding Access to Preventive Services for Women," 2011). Results from this study can guide the development of outreach programs to best target groups of women at highest risk of missing screenings.

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