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Examining the Impact of Adverse Childhood Experiences (ACEs) on Breast and Colorectal Cancer Screening Behaviors in Adulthood

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Abstract

Objective: To investigate the relationship between adverse childhood experiences (ACEs) and screening for breast and colorectal cancer in adulthood.

Methods: This cross-sectional study utilized nationwide survey data from the 2022 Behavioral Risk Factor Surveillance System (BRFSS). Data regarding ACEs and compliance with breast and colorectal cancer screening guidelines were analyzed from 12 states. Weighted logistic regression models were used to assess the relationship between ACEs and breast cancer screening compliance in a population of 18,369 women, and colorectal cancer screening compliance in a population of 30,884 men and women. Screening compliance among those with a high ACE score was compared to those with a low ACE score.

Results: The odds of cancer screening compliance differed by ACE score. A high ACE score was significantly associated with increased odds of colorectal cancer screening compliance but was associated with decreased odds of breast cancer screening compliance.

Conclusions: This study provided further evidence that ACEs have a significant impact on health behaviors. To reduce the burden presented by childhood trauma, public health initiatives focused on reducing ACEs should be implemented.

Introduction

Adverse childhood experiences, or ACEs, characterize the abuse, trauma, or neglect endured prior to adulthood.[1] ACEs impact over half of the United States population and are correlated with a number of health conditions including ischemic heart disease, depression, chronic lung disease, sexually transmitted disease, liver disease, and cancer.[1–17] Previous research has revealed an association between ACEs and a number of risk factors for disease such as alcoholism, drug abuse, attempted suicide, smoking, poor self-rated health, physical inactivity, and severe obesity. The Adverse Childhood Experiences Study was the first to uncover the relationship between ACEs and multiple adverse health outcomes.[1] Published over 20 years ago, this study precipitated an increase in the interest of this topic, paving the way for an expansive body of research on ACEs and the life-long effects of exposure.

Several studies have focused on the relationship between ACEs and cancer,[3,5,10,12,18] One study found that individuals exposed to multiple ACEs were at increased risk of cancer, compared to those with no ACE history.[3] Physical abuse, specifically, was found to be significantly associated with cancer risk,[3,7,12] as well as intimate partner violence, financial struggles[3], and sexual abuse.[5] A major threat to public health, cancer is one of the leading causes of morbidity and mortality among adults in the United States. Within the year 2023 alone, an estimated 1,958,310 new cases of the disease will be diagnosed, and 609,820 people will die as a result of cancer.[19]

Despite this, it is possible to reduce the disease burden by improving cancer screening uptake. As a result of cancer screening in the U.S., colorectal cancer mortality declined by 47% among men and 44% among women, and breast cancer mortality among women declined by 39% from 1990 to 2015.[20] High-quality cancer screening methods improve outcomes by detecting the disease prior to the emergence of symptoms,[21] when treatment is more effective.[22] Additionally, public health initiatives have been implemented to improve screening accessibility and inform the public of the importance of being screened.[22] Despite the numerous benefits, many individuals do not undergo screening when it is recommended, leading researchers to investigate why barriers to cancer screening persist.

While some forgo cancer screening due to emotional factors such as a fear of the results, embarrassment, or discomfort, others assert they are unaware of the benefits, were not recommended by a physician, or because they do not have health insurance.[22] Similar disparities in health care access have been observed among adults that experienced childhood trauma.[2,23–28] Research found that exposure to ACEs is associated with greater use of specialty care and emergency services,[23,24] non-preventive outpatient visits,[25] and lower odds of having health insurance.[28]

However, very little research has focused on the impact of ACE exposure and the use of preventative healthcare services, such as cancer screening, and the majority of the studies have been conducted by the same author.[21,23] Also, several of these studies examined the relationship between ACEs and a single cancer screening type.[23] This is a key limitation, as previous work suggested the effect of ACEs may be dependent on the type of screening.[21] One of the few studies on this topic found that physical abuse, parental separation, and household violence were associated with lower odds colorectal cancer screening, while emotional and sexual abuse were associated with higher odds.[23] A later study found women exposed to specific ACEs were more likely to be compliant with colorectal cancer screening guidelines, while men were less likely to be compliant.[21] While this study examined the association between ACEs and several cancer screening types, the analyses were limited to residents of one state, which may not be representative of the U.S. population.[21] Therefore, this study looked to investigate this relationship with both breast and colorectal cancer screening, across a larger study population.

While several studies have established a link between ACEs and an increased risk of developing cancer, the mechanisms underlying this relationship are not well understood, and very few have explored the relationship between ACE exposure and the likelihood of being screened for cancer as an adult. With a limited number of studies on this topic and the potential implications on public health, a population-based sample was used to examine the association between ACE exposure and screening for breast and colorectal cancer in adulthood, before and after adjustment for multiple sociodemographic and behavioral factors including age, race/ethnicity, income, educational attainment, marital status, gender, health insurance coverage, survey language, and previous cancer diagnosis.

Methods

Study Design

This epidemiological study is cross-sectional, utilizing survey data from the 2022 Behavioral Risk Factor Surveillance System (BRFSS). Employing random-digit-dialing of landlines and cell phones, BRFSS is a nationwide survey comprised of questions related to numerous disease risk factors and behaviors. BRFSS is administered by the Centers for Disease Control and Prevention (CDC) to the non-institutionalized United States population, 18 years and older.[29] For this study, survey data were obtained from several core modules, including breast and colorectal cancer screening, as well as modules representative of various sociodemographic characteristics, behaviors, and health outcomes. Analyses were limited to the 12 states that collected data for the optional ACE module in the 2022 BRFSS survey: Arizona, Arkansas, Florida, Iowa, North Dakota, New Jersey, Nevada, Ohio, Oklahoma, Oregon, South Dakota, and Virginia.

Study Population

The total study population was comprised of two separate groups, based on cancer screening type. Breast cancer screening behaviors were assessed in a sample of 18,369 women, and colorectal cancer screening behaviors were examined in a sample of 30,884 men and women. The United States Preventive Services Task Force (USPSTF) recommends that women aged 40 to 75 years undergo screening for breast cancer, and men and women aged 45 to 75 years are screened for colorectal cancer.[30,31] Inclusion criteria were based on these factors, as only those within the aforementioned age and sex guidelines for each screening type were included in the respective study populations.

Male respondents were excluded from breast cancer screening analyses, as they are not routinely recommended to undergo breast cancer screening. Women under 40 and over 75 years of age were excluded from breast cancer analyses, while men and women under 45 and over 75 years of age were excluded from colorectal cancer analyses. These exclusion criteria are consistent with the USPSTF guidelines suggesting the potential harms of screening individuals beyond the specified age parameters outweigh the foreseeable benefits.[30,31] For all study variables, responses of "don't know" or "refused" to any associated questions were set to missing and excluded from analyses. The only exception is the variable for income, which has a "not reported" category, as greater than 10% of the study population were missing income values.

Compliance with Cancer Screening Recommendations

The outcomes investigated in this study were breast and colorectal cancer screening compliance. Survey responses were dichotomized to indicate whether an individual met the USPSTF cancer screening guidelines. Participants in the breast cancer screening population that had a mammogram in the past 2 years were considered fully compliant.[30] Participants in the colorectal cancer screening population that had a colonoscopy, sigmoidoscopy, or fecal occult blood test in the past 5 years were considered fully compliant.[31] Consistent with previous studies, those compliant with cancer screening guidelines were modeled in comparison to those that were not compliant, which acted as the reference group, and breast cancer and colorectal cancer screening behaviors were examined separately.[21,23]

Adverse Childhood Experience (ACE) Score

Participant exposure to adverse childhood experiences (ACEs) was represented by an ACE score, a standardized method of measuring collective exposure to various facets of childhood trauma experienced before the age of 18.[32] Responses to the 11 questions in the ACE module were dichotomized to indicate whether an ACE was experienced or not. These questions formed 8 ACE categories, with exposure to each category being worth 1 point and the combined number of points representing the final

ACE score. Similar to previous studies,[4,27,33] experiencing ACEs in 0 to 2 categories was classified as a “low ACE score” and exposure to ACEs in 3 to 8 categories was classified as a “High ACE score.” Those with a high ACE score were modeled in comparison to those with a low ACE score.

Measures

Similar to previous research, several categorical variables representative of sociodemographic and behavioral factors were examined in this study as potential confounders.[21,23] Age was categorized into 4 groups (40-49 years for breast cancer screening analyses or 45 to 49 years for colorectal cancer screening analyses, 50-59, 60-69, or 70 years and older), as was race/ethnicity (White non-Hispanic, Black non-Hispanic, Hispanic, or other races including American Indian/Alaskan Native, Asian, Native Hawaiian/Pacific Islander, or multiracial), income (Less than $50,000, $50,000 to $100,000, greater than $100,000, or not reported), education (did not graduate high school, graduated high school, attended college, or graduated college), and marital status (married, divorced/separated, widowed, or never married). Gender (male or female) was included only in colorectal cancer screening analyses, as male respondents were not administered questions in that module. Other study covariates included health insurance coverage, survey language (English or Spanish), and previous cancer diagnosis excluding skin cancer.

Statistical Analysis

Univariate statistics were calculated in the breast cancer and colorectal cancer screening populations separately, providing the frequency and percentage of responses from all study variables. Bivariate analyses, using weighted logistic regression models and $\chi 2$ tests, were performed for study covariates and ACE score categories by cancer screening compliance outcomes, and for both ACE score categories by each covariate. These analyses resulted in weighted, unadjusted odds ratios and 95% confidence intervals quantifying the crude association between ACE score and cancer screening compliance, and the relationship of each covariate with ACE score and screening behavior.

For each cancer screening compliance group, separate, weighted, multivariate logistic regression models were constructed, with ACE score category as the independent variable, and adjustments made for potential confounding variables. During model selection, all study covariates were added to the model, the fit was assessed, and covariates with a p-value greater than 0.05 were removed from the final model. The variables for race, age, education, marital status, income, and health insurance status were included in the final models for both screening populations. The covariates representing survey language and lifetime cancer diagnosis were included in the colorectal cancer model but were removed from the breast cancer model due to lack of statistical significance. Gender was removed from the final colorectal cancer screening model because it did not remain significant after adjustment for confounders. Analyses provided weighted, adjusted odds ratios and 95% confidence intervals for each screening outcome, according to high or low ACE score.

Model fit was assessed with the calculation of R-Squared values for each multivariate logistic regression model. Due to the complex survey design of BRFSS, appropriate survey weights were applied to all calculations. Statistical analyses were conducted using SAS Studio version 3.82 (SAS Institute, Cary, NC).

Results

A total of 30,884 participants responded to both the ACE module and the colorectal cancer screening module, a response rate of 88.89%, and 18,369 participants responded to the ACE module and the breast cancer screening module, a response rate of 87.90%. The sociodemographic and behavioral characteristics of these study samples are shown in Table 1. The colorectal cancer and breast cancer screening populations were demographically very similar, with the majority of respondents from both groups being of white non-Hispanic race (70.66%, 69.60%), 60 to 69 years old (36.19%, 31.38%), graduating from college (34.11%, 35.14%), with a yearly income less than $50,000 (31.80%, 34.09%), having health insurance coverage (95.54%, 95.43%), and no previous diagnosis of cancer (87.61%, 87.32%). The colorectal cancer screening sample had a greater percentage of female respondents than male (52.23%), while the breast cancer screening sample was entirely female.

Colorectal Cancer Screening

In the colorectal cancer screening population, a total of 23,036 respondents (72.43%) reported experiencing 0 to 2 ACEs and were characterized as having a low ACE score, while 7,848 respondents (27.57%) reported experiencing 3 or more ACEs and were categorized as having a high ACE score. Approximately 21,202, or 65.98% of the study sample, were compliant for current colorectal cancer screening recommendations (Table 1). In bivariate analyses, we observed significant differences by ACE score for several covariates. Women were more likely than men to report a high ACE score ($p<0.001$), as were those in the younger age groups ($p<0.001$), of lower income ($p<0.001$), lesser educational attainment ($p<0.001$), and those not married ($p<0.001$). Additionally, respondents previously diagnosed with cancer ($p=0.04$) and those taking the survey in English ($p=0.02$), as opposed to Spanish, were more likely to have a high ACE score. Race ($p=0.22$), health insurance coverage ($p=0.79$), and colorectal cancer screening compliance ($p=0.32$) were not significantly associated with ACE score in bivariate analyses (Data not shown).

Weighted, multivariate logistic regression analyses examining the association between ACE score and colorectal cancer screening compliance are shown in Table 2, with statistically significant relationships indicated in bold. After controlling for potential confounders, a high ACE score was associated with increased odds of being compliant with colorectal cancer screening recommendations, compared to those with a low ACE score (AOR=1.14, 95% CI: [1.01, 1.28]). In the final adjusted model, colorectal cancer screening compliance also differed in accordance with several covariates. The odds of screening compliance increased with increasing age ($p<0.001$), rising income ($p=0.001$), and greater educational attainment ($p<0.001$). Participants in the “other races” category (including American Indian/Alaskan Native, Asian, Native Hawaiian, Pacific Islander, or multiracial) were less likely to be compliant than non-Hispanic, White participants (AOR=0.69, 95% CI: [0.56, 0.86]). Those administered surveys in English were more likely to be compliant than those taking the survey in Spanish (AOR=2.16, 95% CI: [1.31, 3.56]). Compared to married respondents, those divorced (AOR=0.79, 95% CI: [0.67, 0.92]) or never married (AOR=0.65, 95% CI: [0.54, 0.77]) had decreased odds of colorectal cancer screening compliance, while insured participants (AOR=4.82, 95% CI: [3.58, 6.50]) and those previously diagnosed with cancer (AOR=1.54, 95% CI: [1.30, 1.83]) were more likely to be compliant.

Breast Cancer Screening

In the breast cancer screening population, a total of 12,941 respondents (68.41%) reported experiencing 0 to 2 ACEs and were categorized as having a low ACE score, while 5,428 respondents (31.59%) reported experiencing 3 or more ACEs and were characterized as having a high ACE score. Approximately 13,708 individuals, or 72.64% of the study sample, were compliant for current breast cancer screening recommendations (Table 1). In bivariate analyses, we observed significant differences by ACE score for several covariates. Those in the younger age groups were more likely to report a high ACE score ($p<0.001$), as were respondents of lower income ($p<0.001$), lesser educational attainment ($p=0.001$), and those not married ($p<0.001$). Additionally, participants previously diagnosed with cancer ($p=0.01$) and those taking the survey in English ($p<0.001$), as opposed to Spanish, were more likely to have a high ACE score. Race ($p=0.06$) and health insurance coverage ($p=0.56$) were not significantly associated with ACE score in bivariate analyses (Data not shown).

Weighted, multivariate logistic regression analyses examining the association between ACE score and breast cancer screening compliance are shown in Table 2, with statistically significant relationships indicated in bold. A high ACE score was significantly associated with decreased odds of being compliant with breast cancer screening recommendations, compared to those with a low ACE score, after adjustment for potential confounders (AOR=0.74, 95% CI: [0.64, 0.85]). Breast cancer screening compliance also differed in accordance with several covariates. In the final adjusted model, the odds of screening compliance increased with increasing age ($p<.0001$), rising income ($p<0.001$), and greater educational attainment ($p=0.02$). Black, non-Hispanic (AOR=1.69, 95% CI: [1.33, 2.15]) and Hispanic (AOR=1.57, 95% CI: [1.13, 2.17]) participants were more likely to be compliant than those of White, non-Hispanic race. Compared to married respondents, those divorced (AOR=0.76, 95% CI: [0.63, 0.92]), widowed (AOR=0.76, 95% CI: [0.59, 0.97]), or never married (AOR=0.73, 95% CI: [0.59, 0.90]) had decreased odds of compliance. Insured participants (AOR=4.11, 95% CI: [2.97, 5.69]) were more likely to be compliant with breast cancer screening recommendations. Survey language (p=0.62) and previous cancer diagnosis (p=0.79) were not significantly associated with breast cancer screening compliance in multivariate analyses, so they were removed from the final model.

Discussion

Using nationwide survey data representative of the United States population, this study investigated the relationship between ACE score and compliance with recommendations for breast and colorectal cancer screening. This study found that respondents with a high ACE score had decreased odds of being compliant with breast cancer screening guidelines, compared to those with a low ACE score. A previous study examining the impact of specific ACEs found that there were no individual ACEs associated with breast cancer screening compliance, but several ACEs were associated with lower odds of undergoing a clinical breast exam.[21] These results imply that although there may not be a single, definitive ACE exposure that can be attributed to breast cancer screening compliance, exposure to a high number of ACEs significantly reduces the odds of being screened for breast cancer.

The effect of ACEs on cancer screening behaviors differed by the cancer screening type, as those with a high ACE score had increased odds of being compliant with colorectal cancer screening recommendations. A study investigating the effect of individual ACEs found that several ACEs were associated with higher odds of colorectal cancer screening, but this relationship was observed only among women.[21] Therefore, the opposite association observed for screening compliance in the breast cancer population, when compared to that of colorectal cancer, could be due to the differences in the gender composition of the separate study populations. Previous research found that women are not only more likely to report exposure to ACEs, but they may also experience a greater impact as a result of ACE exposure. One study suggested that the relationship between ACEs and cancer predominantly pertains to women.[21] In the present study, gender was significantly associated with both ACE score and colorectal cancer screening compliance in crude logistic regression analyses, but the relationship with screening compliance did not remain significant in the multivariate model following adjustment. While the association between ACE exposure and cancer screening may be particularly impactful among women as previous research has concluded, these results suggest that the association between ACEs and cancer screening behaviors may not be exclusive to women.

This study also revealed that cancer screening compliance differs significantly by age, as study participants 40 to 49 years of age had significantly lower odds of breast cancer screening compliance compared to those in all other age groups. A similar association was observed with respect to colorectal cancer screening compliance among those 45 to 49 years, with even greater disparity in compliance among those in the younger age group. It is highly probable that these disparities can be attributed to recent changes in cancer screening guidelines that lowered the recommended age of screening initiation from 50 to 40 years for breast cancer,[30] and 50 to 45 years for colorectal cancer.[31]

There are several limitations to this study that must be taken into consideration. Because BRFSS is a survey that collects cross-sectional data, it is not possible to draw causal conclusions. In addition, the possibility of response bias cannot be ruled out due to data collection reliant upon retrospective self-reporting of ACEs. Despite this, BRFSS is regarded as a credible data source and previous research indicates that an overestimation of ACEs is unlikely.[32] It is also important to note that BRFSS surveys only the non-institutionalized population. Members of the population not surveyed may represent a significant portion of those with a high ACE score, due to the relationship between ACEs and the propensity to engage in hazardous behaviors.[1,5,16,25,26,34] Additionally, while ACE score is considered a reliable measure of cumulative ACE exposure, it does not allow the impact of each ACE to be examined individually, and using an ACE score could potentially mask,[32] or overestimate[34] the association. This is an important consideration, as an existing study found only specific ACEs had a significant impact on cancer screening behaviors.[21] Lastly, due to the poor fit of the breast cancer screening model, the inclusion of additional demographic variables should be considered in future analyses.

Public Health Importance

This study expanded upon the existing research on ACEs and the impact of these traumatic events in adulthood. Due to the abundance of studies that explored the relationship between ACEs and various health conditions, this study opted to investigate how ACEs impact participation in breast and colorectal cancer screening, a preventative healthcare service. Despite compliance outcomes differing in accordance with the type of cancer screening, this study provided further evidence that ACEs have a significant impact on health behaviors. Due to the specific health needs of those impacted by ACEs, strategies that allow for ACE exposure to be identified in a clinical setting should be considered. Furthermore, to decrease the burden presented by childhood trauma, public health initiatives aimed at reducing ACEs should be implemented. Future research should attempt to investigate the association between specific ACEs and health behaviors so that these programs can focus on reducing the ACEs that have the greatest impact on the health and well-being of the public.

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Data Tables

Table 1. Distribution of Sociodemographic and Behavioral Characteristics of Study Population – Behavioral Risk Factor Surveillance System (BRFSS), 2022

	Colorectal Cancer Screening Population (Men and Women 45-75) n=30,884		Breast Cancer Screening Population (Women 40-75) n=18,369	
Variable	*n*	Adjusted %	*n*	Adjusted %
Compliant with Cancer Screening Guidelines				
Yes	21,202	65.98	13,708	72.64
No	9,682	34.02	4,661	27.36
Adverse Childhood Experiences (ACEs)				
Low ACE Score (0-2)	23,036	72.43	12,941	68.41
High ACE Score (3 or more)	7,848	27.57	5,428	31.59
Sex				
Male	14,252	47.77	N/A	N/A
Female	16,632	52.23	18,369	100.0
Race/Ethnicity				
White, non-Hispanic	25,956	70.66	15,196	69.60
Black, non-Hispanic	1,782	9.87	1,206	10.16
Hispanic	1,446	11.71	950	12.52
Other Race	1,700	7.77	1,017	7.71
Age				
45-49 years***	3,518	13.95	3,776	25.99
50-59 years	9,061	33.49	4,752	28.41
60-69 years	12,209	36.19	6,590	31.38
70+ years	6,096	16.37	3,251	14.21
Education				
Did not graduate high school	1,456	8.95	782	7.74
Graduated high school	7,292	24.91	3,854	23.82
Attended college/tech school	9,109	32.03	5,656	33.29
Graduated college/tech school	13,027	34.11	8,077	35.14
Marital Status				
Married	18,705	63.52	10,637	61.01
Divorced/Separated	5,938	17.60	3,598	18.60
Widowed	2,874	7.90	2,144	9.35
Never married/Unmarried couple	3,367	10.98	1,990	11.04
Income				
0-$49,999	10,438	31.80	6,476	34.09
$50,000-$99,999	8,723	26.60	5,096	25.49
$100,000+	7,397	27.20	3,997	24.88
Not Reported	4,326	14.40	2,800	15.54
Health Insurance Coverage				
Yes	29,834	95.54	17,769	95.43
No	1,050	4.46	600	4.57
Survey Language				
English	30,390	96.00	18,029	95.61
Spanish	494	4.00	340	4.39
Lifetime Diagnosis of Cancer				
Yes	4,134	12.39	2,436	12.68
No	26,750	87.61	15,933	87.32

*Abbreviations: n= population, %= percent
**Percentages are adjusted to account for complex survey data
***Age category is 40-49 years for breast cancer population

Table 2. Odds of Compliance with Cancer Screening Guidelines for Breast and Colorectal Cancer – Behavioral Risk Factor Surveillance System (BRFSS), 2022

	Colorectal Cancer Screening Population (Men and Women 45-75) n=30,884		Breast Cancer Screening Population (Women 40-75) n=18,369	
Variable	Crude OR (95% CI)	Adjusted OR (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)
Adverse Childhood Experiences (ACEs)				
Low ACE Score (0-2)	Reference	Reference	Reference	Reference
High ACE Score (3 or more)	0.95 (0.85, 1.05)	**1.14 (1.01, 1.28)**	**0.67 (0.59, 0.77)**	**0.74 (0.64, 0.85)**
Sex				
Male	Reference	N/A	N/A	N/A
Female	**1.13 (1.03, 1.25)**			
Race/Ethnicity				
White, non-Hispanic	Reference	Reference	Reference	Reference
Black, non-Hispanic	0.90 (0.74, 1.09)	1.19 (0.95, 1.49)	**1.27 (1.00, 1.61)**	**1.69 (1.33, 2.15)**
Hispanic	**0.59 (0.48, 0.73)**	1.33 (0.96, 1.84)	0.90 (0.69, 1.17)	**1.57 (1.13, 2.17)**
Other	**0.58 (0.47, 0.70)**	**0.69 (0.56, 0.86)**	0.76 (0.57, 1.00)	0.86 (0.64, 1.17)
Age				
45-49 years***	Reference	Reference	Reference	Reference
50-59 years	**3.697 (3.12, 4.38)**	**4.03 (3.41, 4.77)**	**1.97 (1.66, 2.34)**	**1.92 (1.61, 2.30)**
60-69 years	**7.01 (5.90, 8.32)**	**7.79 (6.56, 9.26)**	**2.30 (1.95, 2.71)**	**2.32 (1.93, 2.79)**
70+ years	**9.03 (7.36, 11.08)**	**9.53 (7.75, 11.73)**	**2.51(1.99, 3.15)**	**2.56 (2.00, 3.28)**
Education				
Did not graduate high school	Reference	Reference	Reference	Reference
Graduated high school	**1.79 (1.45, 2.23)**	**1.39 (1.09, 1.77)**	1.28 (0.97, 1.69)	1.03 (0.76, 1.39)
Attended college/tech school	**1.95 (1.57, 2.41)**	**1.44 (1.13, 1.84)**	**1.34 (1.02, 1.75)**	1.03 (0.77, 1.39)
Graduated college/tech school	**2.32 (1.89, 2.86)**	**1.78 (1.39, 2.29)**	**1.88 (1.44, 2.45)**	**1.32 (0.97, 1.82)**
Marital Status				
Married	Reference	Reference	Reference	Reference
Divorced/Separated	**0.70 (0.62, 0.79)**	**0.79 (0.67, 0.92)**	**0.64 (0.54, 0.76)**	**0.76 (0.63, 0.92)**
Widowed	1.14 (0.95, 1.37)	0.86 (0.70, 1.06)	0.85 (0.68, 1.05)	**0.76 (0.59, 0.97)**
Never married	**0.52 (0.45, 0.61)**	**0.65 (0.54, 0.77)**	**0.58 (0.48, 0.71)**	**0.73 (0.59, 0.90)**
Income				
0-$49,999	Reference	Reference	Reference	Reference
$50,000-$99,999	**1.35 (1.19, 1.54)**	1.15 (0.99, 1.34)	**1.56 (1.32, 1.84)**	**1.35 (1.12, 1.62)**
$100,000+	**1.37 (1.21, 1.56)**	**1.35 (1.13, 1.60)**	**1.82 (1.53, 2.16)**	**1.57 (1.27, 1.95)**
Not Reported	1.162 (1.00, 1.35)	0.96 (0.81, 1.15)	**1.51 (1.24, 1.84)**	**1.24 (1.00, 1.54)**
Health Insurance Coverage				
Yes	**7.84 (6.02, 10.22)**	**4.82 (3.58, 6.50)**	**5.32 (3.92, 7.22)**	**4.11 (2.97, 5.69)**
No	Reference	Reference	Reference	**Reference**
Survey Language				
English	**3.18 (2.24, 4.52)**	**2.16 (1.31, 3.56)**	**1.51 (1.04, 2.19)**	N/A
Spanish	Reference	Reference	Reference	
Lifetime Diagnosis of Cancer				
Yes	**2.09 (1.78, 2.44)**	**1.54 (1.30, 1.83)**	1.15 (0.95, 1.39)	N/A
No	Reference	Reference	Reference	

*Abbreviations: CI=Confidence Interval, n= population, OR=Odds Ratio, %= percent
**Percentages are adjusted to account for complex survey data
***Age category is 40-49 years for breast cancer population