Racial Disparities in Routine Health Checkup and Adherence to Cancer Screening Guidelines Among Women in the United States

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Abstract

Purpose: Routine health checkup and cancer screening rates among women are suboptimal, partially due to the health care disparities by race/ethnicity in the United States. This study examined the previously understudied associations between routine health checkup, cervical cancer screening, and breast cancer screening by race/ethnicity using the national representative sample of women.

Methods: Data were obtained from three cycles (2017, 2018 and 2019) of the Health Information National Trends Survey (HINTS) (n = 12,227). Survey weighted logistic regressions were evaluated to assess associations between routine health checkup, and cervical and breast cancer screening compliance with the established guidelines with the age criteria and frequency of screening by race/ethnicity (Black, White, Hispanic, and Other).

Results: This study included 6,941 women in the cervical cancer screening and 8,005 women for breast cancer screening, considering the age criteria. Women who had received routine health checkups were more likely to meet the cervical cancer screening guideline (Odds ratio = 3.24, $p < 0.05$) and breast cancer screening guideline (OR = 5.86, $p < 0.05$) compared to women who did not receive routine health checkups. While routine health checkups were associated with both types of cancer screenings in most racial/ethnic groups, analyses stratified by race/ethnicity suggests that Hispanic women and Other women did not benefit from routine health checkup in relation to cervical and breast cancer screening, respectively.

Conclusions: Promotion of routine health checkups could promote cancer screening among women across racial/ethnic groups although specific racial/ethnic groups may require additional support.

Key words: health disparities; cancer; gender; social inequality

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Introduction

Breast Cancer is the most prevalent form of cancer among racial/ethnic minority women; and cervical cancer is the fourth most prevalent form of cancer among minority women.[1,2] Greater rates of cancer related mortality among racial or ethnic minority women compared to White women are mainly attributable to cancer screening disparities.[3,4] In the past several decades, breast cancer mortality rates have declined by approximately 40 % due to increased participation in mammography screening among women within the age range of 40 to 74 years while cervical cancer mortality rates have reduced by 49% due to increased Pap screening in the United States.[5,6] However, higher incidence rates and higher cancer-specific mortality rates are still evident among racial/ethnic minority women compared to white women.[7-9,10]

The purpose of this study was to examine associations between routine health checkups and adherence to cancer screening guidelines among women, and by race/ethnicity in the United States. Routine general health checkups are the first steps to assess potential health issues, but the association with specific cancer screening is still unclear. To date, a relatively small number of studies have focused on association between routine health checkups and cancer screening using the nationally representative data. Findings of this study can inform development of interventions to promote the routine health checkup and cancer screening rates among the minority women in the United States; and ultimately, help reduce racial/ethnic cancer mortality disparities.

Cervical Cancer Prevalence and Prevention Practice

Cervical cancer is one of the most common preventable neoplastic diseases that affects women, with a combined global incidence of almost half a million new cases yearly and approximately 570,000 cases in the United States.[11,12] The Human Papillomavirus (HPV) is the most common sexually transmitted infection and a major cause of cervical cancer in the United States; women with multiple sexual partners and unprotected intercourse are at a higher risk of being infected with the disease.[13]It is estimated that about 80% of women will be infected with HPV in their lifetime.[14]

According to CDC[13] it is estimated that about 12,000 new cases of cervical cancer caused by HPV are diagnosed in the United States annually. Approximately 70% of cervical cancers and other precancerous lesions of the cervix are caused by HPV 16 and HPV 18 which are mostly acquired during sexual activity.[15,16] HPV is prevalent particularly among Black and Hispanic women in the United States, who contract HPV related cervical cancer more than women of other races or ethnicities. About 8 Black women and 9 Hispanic women were diagnosed with HPV associated cervical cancer per 100,000 women compared to 7 white women in the United States. white women account for 7.8 per 100,000 new cases of cervical cancer compared with 10.4 per 100,000 cases for Black women.[17,18] Black women also continued to have the highest cervical cancer mortality rate (4.3 per 100,000 persons) than any other racial/ethnic group.[19]

Cervical cancer incidence and mortality rates have declined since the introduction of the Papanicolaou (Pap) test in the mid-twentieth century in the United States. Over the past ten years, rates for new cervical cases have been reducing at an average of 0.9%, while mortality rates for cervical cancer have been reducing at an average of 0.8% per year. The availability and utilization of the Pap test, routine screening and checkup seem to contribute to the lower cervical cancer prevalence and mortality.[20,17] Generally, cervical cancer can be prevented by adhering to

safe sexual activity, compliance with routine Pap smears, immunization with HPV vaccines.[21,9] The Pap test is imperative for early detection and prevention of cervical cancer; in addition to the Pap test, cervical cancer screening can include testing for HPV.[20] Despite the acclaimed and recognized benefits of cervical cancer screening and recommended guidelines, national screening rates remain low especially among minority populations.

According to the latest American Cancer Society 2012 guideline (ACS) at the time of this study, [22] sexually active women and women within the age range of 21 to 29 regardless of any sexual encounter should receive Pap test for cervical cancer screening every 3 years. These women should receive testing for HPV DNA in case a Pap smear is abnormal. The ACS also provides guidelines for cervical cancer screening which include women within the age range of 30 to 65 years should be tested for both Pap test and HPV DNA every 5 years; women who are 65 years and above who have had adequate screening and not considered high risk should stop routine screening, but those with history of abnormal test should continue with routine screening.[22-24,20]

Breast Cancer Prevalence and Preventive Practice

Breast Cancer is the most common form of cancer affecting women in the United States and the leading cause of cancer death in women.[5] It is indeed the most prevalent cancer that affects women of every ethnic group in the United States.[25] Breast Cancer is a metastatic cancer and it is usually considered incurable once it transfers to distant organs; the bones, liver, lung and brain which is why early diagnosis of the disease leads to a high survival rate.[26] Multiple studies have provided information on certain risk factors which include sex, aging, estrogen, family history of breast cancer, late menopause, BMI, gene mutations and unhealthy lifestyle et al.[26-28]

Breast Cancer accounted for approximately 570,000 deaths in 2015 and about 25% of women with cancer are diagnosed with breast cancer annually throughout the world.[29] Cancer prevalence and prevention practice disparities by race/ethnicity are evident in the United States. Despite the increasing rate of breast cancer, the mortality rate decreases due to the widespread early screenings. The mortality rate of breast cancer remains significantly higher by 40% among Black compared to White women and other ethnic groups. Black women also are diagnosed with breast cancer more often at a younger age than White women. Lack of insurance, fear of testing, delay in seeking care, barriers to early detection and screening, more advanced stages of disease at diagnosis among minorities, and unequal access to improvements in breast cancer treatment are some of the explanatory factors that cause a difference in the survival rates between Black and white individuals.[25]

Also, higher breast cancer mortality among Black women can be attributed to lower utilization of mammograms and lack of follow up care.[3,25,30] Mammography is an effective screening method that utilizes low energy X-rays to obtain high resolution images of the breast and this process of screening takes about twenty minutes.[26] According to the American Cancer Society[22] (2015), screening mammography in women should commence from age 40 and that women aged 40 to 54 years should be screened annually and that women aged 55 years and older should transition to being screened biennially or can continue annual screening if that is their preference.

Routine Health Checkup to Address Cancer screening Disparities

Routine health checkup is a form of preventive health care service and is known to enhance health promotion and disease prevention.[31] Health care professionals generally check, blood pressure, cholesterol and blood laboratory test results in routine health checkup.[32] In

addition, according to the CDC [33] (2017), getting routine health checkup is an important opportunity to promote cancer screening because health care professionals may make recommendations based on age, family history and, lifestyle choices. Routine health checkup is a critical and potentially efficient point of intervention to simultaneously promote screening of multiple types of cancer.[7] Empirical evidence to link routine health checkup and cancer screening among women and by race/ethnicity is still scarce at the national level in the United States. In responding to this gap in knowledge, the purpose of this current research was to identify the role of routine health checkup in relation to cancer screening among women by race/ethnicity.

Theoretical Framework

This study utilized Ronald Andersen's behavioral model to guide the research design and interpretation of results. The Andersen's model identifies relevant factors and depicts health care service utilization patterns.[33-35] The core of the model describes three major components responsible for health services utilization:

(1) Predisposing factors: involves the socio-cultural dynamics that existed prior to their illness. In this study, selected demographic characteristics such as age, educational status, marital status, and race were considered as predisposing factors.[34,35]

(2) Enabling factors: includes resources available to individuals to obtain care and utilize health care services. In this study, income, health care insurance, emotional support, health information seeking and history of family having cancer are considered as enabling factors.[34-36]

(3) Needs factors: represents both self-perceived health status and actual need for health care services. In this study obesity was considered as a needs factors.[34,35] Other factors such as self-rated health and comorbidity were considered but we only selected obesity considering the

relevance to the cancer screening, routine checkup, and racially/ethnically diverse target populations.

Routine health checkup was considered a healthcare service utilization outcome as well as the enabling factor of cervical and breast cancer screening in the Andersen's model.

Research Questions

Taken together, this study addressed two research questions.

I. Is there an association between routine health checkups and adherence to cervical and breast cancer screening guidelines among women?

II. Is there any difference in associations between routine health checkups and adherence to cervical and breast cancer screening guidelines by race/ethnic groups?

Materials and Methods

Data Sources

Data were derived from the National Cancer Institute (NCI)'s Health Information National Trends Survey 5 (HINTS 5) cycle 1 collected from January 25 through May 5, 2017, Cycle 2 collected from January 26 through May 2, 2018 and Cycle 3 collected from January 22 to April 30, 2019.[37] All cycles were conducted using the mail survey. HINTS is designed to assess cancer related knowledge and utilization of such knowledge among American adults aged 18 years old and above. Each cycle included multi-stage stratified random samples of the non-institutionalized adult population in the United States. The cycle 1 had a total of 3,255 respondents; Cycle 2 had a total of 3,504 respondents and cycle 3 had a total of 5, 438 respondents. However, the final analytic samples were limited to those who meet the age criteria in each of specific cancer screening guidelines (see the Dependent Variables section for more details). These three cycles of data were combined as a large cross-sectional data. The final

sample size was a total of 12,227 respondents. HINTS provide the complex sampling weights and replicate weights to estimate nationally representative descriptive summary and statistical models.[37,38]

Dependent Variables

Cervical and Breast Cancer Screening were the dependent variables for this study. Per the guideline, women should stop cervical cancer screening after the age of 65 years, especially those who have had at least three consecutive negative Pap smear results or two consecutive negative Pap smears with negative HPV in the previous 10 years.[3,39,40] In HINTS, Pap testing was assessed by asking how long-ago participants had their most recent pap test. Adherence to the guideline was evaluated based on whether they had received screening within the last 3 years and whether they were 21 – 65 years. It should be noted that the ACS updated the guideline in 2020. [22] However, this study adopted the 2012 guideline given the data from 2017-2019.

The second dependent variable was breast cancer screening. Per the guideline, the analytic sample was women aged 40 – 75 years.[21] In HINTS, breast cancer screening was assessed by asking when the respondents had the most recent mammogram. Adherence to the guidelines was evaluated based on whether they were 40 – 55 years and had their test performed a year ago or less, and whether they were 55 – 75 years and had their test performed within last 2 years.[21]

Independent Variable

All analysis included the same independent variables for both breast and cervical cancer screening. Independent variable, routine health checkup was recorded in a dichotomous measure of having vs. not having routine health checkup within the last 2 years.

Covariates

Predisposing Factors. Race/ethnicity was categorized into non- Hispanic Black (Black: reference group), non – Hispanic white (white), Hispanic, non – Hispanic Asian and non – Hispanic Others (others). Age was recoded in years as a continuous variable. Marital Status was recoded as married versus not married (reference group). Education was recoded as a college degree or higher versus less than college (reference group).

Enabling Factors. Insurance status was a dichotomous measure indicating uninsured versus insured (reference group), Income (5-levels) was coded as less than $20,000; $20, 000 to < $35, 000; $35, 000 to < $50, 000; $50,000 to < $75,000; and $75,000 or more. Emotional Support was the indicator of social support system and was recorded as having emotional support from family and friends versus not having emotional support (reference group), History of Family Cancer was recorded as having history of family cancer versus having no history of family cancer (reference group) and Health Information Seeking was recorded as having sought health information versus no seeking of health information (reference group).

Needs Factors. Obesity was dichotomized as obese versus non-obese (reference group).

Statistical Analyses

Unweighted descriptive summary and bivariate significance tests (both two-sample t-test and chi-square test) were conducted in the preliminary analysis. Subsequently, binary logistic regression was used to examine the associations between the adherence to cancer screening guidelines (separately for cervical and breast cancer screening) and routine health checkup, while adjusting for the covariates.[41] Regression models were also evaluated by all women, as well as by race/ethnicity (white, Black, Hispanic and Others). Unconditional models were tested first, and conditional models were constructed next in case of statistically significant associations in unconditional models. The fully conditional models adjusted for all the covariates. All

respondents (7.2%) with any missing values in the dependent, independent and covariates, were excluded from this study. Possible interactions between race/ethnicity and routine checkups were examined in our preliminary analysis but none of them was statistically significant. And therefore, we did not include them in the final models. SAS statistical software. version 9.2. Cary, NC: SAS Institute Inc; 2014 was used for all analyses. The sampling weights and replicate weights (provided in the HINTS data set) were used in all regression analyses to account for the complex sampling design of the HINTS data and to generate nationally representative findings. The area under the Receiver Operating Characteristics (ROC) curve was reported to test for the quality of the model for each analysis. The ROC curve depicts the model predictive accuracy, which is the combination of the sensitivity (i.e., true positive rate) and 1-specificity (i.e., true negative rate). The area under the ROC curve of around 0.70, 0.80 and 0.90 are considered acceptable, excellent, and outstanding predictive accuracy.[44]

Results

Table 1 shows the descriptive summary by the type of cancer screening and by adherence to the guidelines. There were 6, 941 respondents eligible to be included in the cervical cancer screening analysis (pap test guidelines; women aged ≥ 21 years and < 65 years) and 8,005 respondents eligible for breast cancer screening (mammography screening guidelines; women aged ≥ 40 years and ≤ 75 years). Overall, about 72% and 49% of women met the cervical cancer and breast cancer screening guidelines, respectively. A large proportion of women who had routine health checkups adhered to the cervical cancer screening (91.02% vs. 83.57%) and breast cancer screening (93.96% vs. 80.49%) guidelines, respectively. Women who received the cervical cancer screening were more likely to be younger, racially diverse, wealthier, more educated, married, and insured, compared to those who did not. Also, women who met the

cervical cancer screening guideline were more likely to seek health information and have emotional support. While the difference between women who met and did not meet the breast cancer screening guidelines were similar to the findings in cervical cancer screening, there was no significant difference in marital status. Also, women who met the breast cancer screening guideline were more likely to have the family members with cancer history and be obese.

With regard to the first research question, results of logistic regression are presented in Table 2 (cervical cancer) and Table 3 (breast cancer). Women who had received routine health checkup in the past 2 years had 3.48 times odds *($p < 0.05$)* of having received a Pap testing, and 3.70 times odds *($p < 0.05$)* of having received a mammography screening in the unconditional models. After adjusting for the covariates, women who had received routine health checkup in the past 2 years had 3.24 times odds of having received a Pap testing *($p < 0.05$)* and 5.86 times odds of having received a mammography screening *($p < 0.05$).* There were statistically significant associations between routine health checkup and cervical cancer screening as well as breast cancer screening among women.

Regarding the cervical cancer screening in the second research question, results of logistic regression are presented in the Supplemental Table 4, 5, 6 and 7, Black, white, Hispanic, and Other women, respectively. Among Black women (Table 4) and women in other racial groups (Table 7), having had routine health checkup in the past 2 years was associated with 3.59 times odds and 3.93 times odds of having received Pap testing respectively (both $p < 0.05$) in the unconditional models. Results were consistent even after adjusting for the covariates. Among White women, having had routine health checkups in the past 2 years was associated with 4.62 times odds ($p < 0.05$) of having received a Pap test. The result was consistent even after adjusting for the covariates. Routine health checkup was not significantly associated with Pap

testing among Hispanic women. Routine health checkup was significantly associated with Pap testing among Black, white, and Other women, but Hispanic was an exception.

Regarding the breast cancer screening in the second research question, results of logistic regression for unconditional and conditional models are presented in Supplemental Table 8, 9, 10 and 11 for Black, white, Hispanic, and other women, respectively. Among Black women and Hispanic women, having received routine health checkup in the past 2 years was associated with 3.79 times odds and 2.92 times odds of having received a guideline mammography screening respectively (both $p < 0.05$). Results were consistent even after adjusting for the covariates. Among white women. Having received routine health checkup in the past 2 years was associated with 5.53 times odds $(p < 0.05)$ of having received a guideline mammography screening. Results were consistent even after adjusting for the covariates. Routine health checkup was not significantly associated with mammography screening women in the "other" racial group. Routine health checkup was significantly associated with mammography among Black, white, and Hispanic women, but women in the "other" racial group were an exception. Overall, the model predictive accuracy was acceptable (around 0.70 of the area under the ROC curve), except for the model of cervical cancer screening among Other women (0.64).

Discussion

The Pap test and mammography screening is critical for early detection of cervical and breast cancer, yet it is greatly underutilized among racial/ethnic minority women compared to white women.[17,18] Overall, routine health checkup was positively associated with meeting the guideline of cervical cancer screening as well as breast cancer screening among women. However, when analyzed by race/ethnicity, there was variation in the findings. Routine checkup was associated with cervical cancer screening among white, Black, and other women. Also,

routine checkup was associated with breast cancer screening only among white, Black, and Hispanic women. That is, Hispanic women and Other women did not benefit from routine health checkup for cervical cancer and breast cancer screening, respectively.

The Andersen behavioral model posits that there are several factors that could facilitate the utilization of health care services and our study has shown that routine health checkup is a significant factor that is associated with cancer screening among women. Our results suggest that women who undergo routine health checkup will evidently adhere to cancer screening guidelines. This might be due to health care providers' recommendation on cancer screening process and disease prevention during their routine checkups.[9] This is consistent with a study showing that women who received recommendation from a clinician to get cancer screening were more likely to, compared to women who received no recommendation.[42] Additionally, previous studies reported that recommendations from primary care physicians as well as increased awareness of their own risk (high risk group due to the family history) in routine checkup promote cervical cancer, colorectal cancer and prostate cancer screening.[42,45-46] The finding in our study has important implications for public health, as routine health checkup could reduce the incidence rate and cancer related mortality among women, as well as encourage positive health behavior among them. This study thus provides insight into the need for health care providers, policy makers and the government to encourage routine health checkup among women to increase their chances of being diagnosed early and reducing the rates of cancer mortality.

Yet, the relationship between routine health checkup and cancer screening differed by race\ethnicity. Routine health checkup was however not statistically significant with cervical cancer for Hispanic women and was not significant with breast cancer for other women. This

may be due to a combination of reasons such as poor access to health care, language and financial barriers, lack of ability in navigating the complex health care system (e.g., finding appropriate health care providers, communication with health professionals) in the United States. Importantly, Hispanic women are less likely to receive routine health checkup and more likely to be diagnosed with cervical cancer, than White women.[3] Our findings of the racial/ethnic differences in the predisposing and enabling factors are worth further investigations in future research. Specifically, White women might have benefited more from the predisposing factor (i.e., marital status) and enabling factors (i.e., insurance, emotional support, and family history) for the cancer screening, compared to racial/ethnic minorities (see the predisposing and enabling factors in Tables 4-11). Taken together, the findings from this study suggest that routine health checkup is an important strategy to promote cancer screening among women although specific race/ethnic groups --- Hispanic women and Other women should receive additional support to promote their cancer screening.

This study had a few strengths in view of the current literature. First, the use of a large nationally representative HINTS data made an extensive exploration of subgroups --- racial/ethnic groups --- possible in the context of cancer screening. Also, this study added novel empirical evidence on the associations between routine health checkup and cancer screening among women by racial/ethnic groups. Finally, the HINTS data provide detailed cancer related information and health care utilization, and thus, this study used the rigorous cancer screening measures that precisely reflected the existing guideline by age group.

Several limitations of this study should be noted. First, omitted variable bias could not be ruled out. Given this study combined three cycles of HINTS data, some of the potentially relevant variables (e.g., Cancer information seeking, Access to transportation support for medical

purposes and Knowledge of HPV) were not available across the cycles. This decision was a tradeoff to larger sample sizes in each of race/ethnic subgroups. Although self-rated health is known as a predictor of cancer screening, this study did not include it in the analysis because of the large sample of women with a wide range of age and of the fact that older women tend to report overly positive self-rated health. This is often referred to as the response shift.[43] Future research also should develop a more comprehensive theoretical framework to include other potential need factors such as comorbidity. Furthermore, the observed differences in the relationship between routine health checkup and cancer screening by race/ethnicity should only be discussed separately for each group. The findings should not be treated as the statistically significant differences in the effects of routine checkup on cancer screening by race/ethnicity. Finally, the use of secondary cross-sectional data necessarily limits the scope of this study, examination, and discussion of causations. Future research should address these aforementioned limitations of this study to confirm the findings.

Conclusion

This study added new nationally representative empirical evidence of routine health checkup, cervical and breast cancer screening by racial/ethnic groups in the U.S. Assessing the racial disparities in routine health checkup and cancer screening among Black and minority women in the U.S. could help improve compliance with routine health checkup, cervical and breast cancer screening. Such efforts should lead to early diagnosis of cancers and timely treatment. The findings of this study can be the basis for the change in the U.S health care systems by enhancing routine health checkup and addressing the racial differences in cancer screening rates among women. The findings of this study could also inform public health practitioners, policy makers and other governmental agencies in revising the health policy and

guidelines to ultimately improve compliance with cancer screening. Furthermore, the knowledge of racial/ethnic differences in the routine health checkup and cancer screening could be beneficial for health educators and researchers to develop culturally sensitive interventions not only to increase the overall screening rate but also to outreach disadvantaged sub-group of women (i.e., cervical cancer screening among Hispanic women; and breast cancer screening among Other women).

Author Disclosure Statement

No competing financial interests exist.

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Table 1. Descriptive characteristics of women who had cancer screening tests in the Health Information National Trends Survey (Cycle 1 2 3)

Variables	Cervical Cancer Screening		p	Breast Cancer Screening		p
	Yes (n = 4965) %	No (n = 1976) %		Yes (n=3884) %	No (n=4121) %	
Routine Health Checkup			*			*
Yes	91.02%	83.57%		93.96%	80.49%	
No	8.98%	16.43%		6.04%	19.51%	
Age, Years			*			*
Mean (SD)	52.8 (15.5)	64.3 (17.7)		63.0 (11.0)	43.3 (18.1	
Race			*			*
White	59.56%	66.07%		63.33%	58.83%	
Black	17.35%	12.45%		18.09%	12.69%	
Hispanic	15.26%	13.09%		12.59%	17.74%	
Others	7.83%	8.40%		35.99%	10.75%	
Income			*			*
< $20,000	18.32%	28.22%		20.13%	19.79%	
$20, 000 - < $35,000	12.66 %	20.69 %		15.72 %	12.90%	
$35, 000 - $50,000	12.84 %	15.06 %		12.83 %	13.78 %	
$50,000 - < $75, 000	17.96 %	16.48 %		18.63 %	17.32 %	
$75, 000 +	38.21 %	19.56 %		32.70%	36.21 %	
Education			*			*
College or higher	49.30%	30.98%		41.44%	49.61%	
Less than College	50.70%	69.02%		58.56%	50.39%	
Marital Status			*			NS
Married	52.52%	33.76%		47.31%	48.65%	
Not married	47.48%	66.24%		52.69%	51.35%	
Health Insurance			*			*
Insured	95.93%	92.52%		97.71%	91.22%	
Uninsured	4.07%	7.48%		2.29%	8.78%	
Health Information Seeking			*			*
Yes	84.34%	76.69%		82.72%	80.97%	
No	15.66%	23.31%		17.28%	19.03%	
Emotional Support			*			*
Yes	88.33%	84.32%		88.14%	85.43%	
No	11.67%	15.68%		11.86%	14.57%	
History of Family Cancer			NS			*
Yes	78.60%	79.84%		81.14%	75.34%	
No	21.40%	20.16%		18.86%	24.66%	
Obese			NS			*
≥ 30.00	33.65%	34.85%		36.62%	29.22%	
≤ 30.00	66.35%	65.15%		63.38%	70.78%	

Notes: * indicates the statistically significant associations with Cervical cancer screening and Breast Cancer Screening ($p < 0.05$)
NS indicated not statistically significant association with Cervical cancer screening and Breast Cancer Screening ($p > 0.05$)
N shows the unweighted sample sizes
Women aged ≥21 years and ≤65 years within all predictor variables for cervical cancer screening and ≥ 40 years and ≤ 75 years for breast cancer screening.

Table 2. Estimated Odds Ratios from Binary Logistic Regression Models of Women within the age of 21 to 65 years who had recent Cervical Cancer Screening within the last 3 years in the Health Information National Trends Survey 5 (Cycle 1, 2 and 3)

Variables	Unconditional Model 1 OR (95% CI)	Conditional Model 2 OR (95% CI)
Predisposing factors		
Age, years (>21 and <65)		0.98 (0.97, 1.00) *
College or higher (vs. less than College)		1.27 (0.89, 1.82)
Married (vs not married)		1.81 (1.23, 2.65) *
White (vs. Black)		0.51 (0.31, 0.84) *
Hispanic (vs. Black)		0.46 (0.26, 0.82) *
Others (vs. Black)		0.33 (0.17, 0.64) *
Enabling factors		
Routine Health Checkup (yes vs. no)	3.48 (2.50, 4.84) *	3.24 (2.13, 4.93) *
Income (< 20, 000 and ≥ $75, 000)		1.06 (0.93, 1.20) *
Health Information Seeking (yes vs. no)		0.79 (0.53, 1.17)
Health insurance (insured vs. uninsured)		1.78 (1.14, 2.79) *
Emotional Support (having support vs. not having support)		1.51 (1.05, 2.15) *
History of Family Cancer (yes vs. no)		1.06 (0.73, 1.55)
Need factors		
Obese (vs. not obese)		0.79 (0.57, 1.11)
Area under the ROC	0.58	0.70

Note: The unconditional and conditional models predicted the odds of getting screened for cervical cancer
* indicates the statistically significant associations with the cervical cancer screening ($p < 0.05$)
Area under the Receiver Operating Characteristics Curve = 0.70
OR = Odds ratio [obtained by exp.(the estimated regression coefficient)]; CI = 95% Confidence Interval (associated with the estimated regression coefficient) is in parenthesis.
N = 4622 (women); Adjusted by age group, education, income, marital status, race, obese, health insurance, history of cancer, emotional support, health information seeking and routine health checkup. Outcome variable: cervical cancer screening.
The HINTS final sampling weights and replicate weights were applied.

Table 3. Estimated Odds Ratios from Binary Logistic Regression Models of Women within the age of 40 to 75 years who had recent Breast Cancer Screening within the last 2 years in the Health Information National Trends Survey 5 (Cycle 1, 2 and 3)

Variables	Unconditional Model 1 OR (95% CI)	Conditional Model 2 OR (95% CI)
Predisposing factors		
Age, years (>21 and <65)		1.09 (1.07, 1.10) *
College or higher (vs. less than College)		1.10 (0.84, 1.44)
Married (vs not married)		1.29 (0.97, 1.73)
White (vs. Black)		0.60 (0.17, 2.13)
Hispanic (vs. Black)		0.45 (0.10, 2.00)
Others (vs. Black)		0.13 (0.02, 0.81) *
Enabling factors		
Routine Health Checkup (yes vs. no)	3.70 (2.59, 5.28) *	5.86 (1.70, 20.15) *
Income (< 20, 000 and ≥ $75, 000)		1.09 (0.98, 1.21)
Health Information Seeking (yes vs. no)		1.12 (0.76, 1.65)
Health insurance (insured vs. uninsured)		2.95 (1.69, 5.14) *
Emotional Support (having support vs. not having support)		1.55 (1.06, 2.28) *
History of Family Cancer (yes vs. no)		1.22 (0.91, 1.64)
Need factors		
Obese (vs. not obese)		1.09 (0.81, 1.45)
Area under the ROC	0.58	0.74

Note: The unconditional and conditional models predicted the odds of getting screened for breast cancer
* indicates the statistically significant associations with the cervical cancer screening ($p < 0.05$)
Area under the Receiver Operating Characteristics Curve = 0.74
OR = Odds ratio [obtained by exp.(the estimated regression coefficient)]; CI = 95% Confidence Interval (associated with the estimated regression coefficient) is in parenthesis.
N = 4525 (Women)
Adjusted by age group, education, income, marital status, race, obese, health insurance, history of cancer, emotional support, health information seeking and routine health checkup. Outcome variable: breast cancer screening.
The HINTS final sampling weights and replicate weights were applied.

Table 4. Estimated Odds Ratios from Binary Logistic Regression Models of Black Women within the age of 21 to 65 years who had recent Cervical Cancer Screening within the last 3 years in the Health Information National Trends Survey 5 (Cycle 1, 2 and 3)

Variables	Unconditional Model 1 OR (95% CI)	Conditional Model 2 OR (95% CI)
Predisposing factors		
Age, years (>21 and <65)		0.96 (0.92, 0.99) *
College or higher (vs. less than College)		0.92 (0.33, 2.56)
Married (vs not married)		0.73 (0.29, 1.82)
Enabling factors		
Routine Health Checkup (yes vs. no)	3.59 (1.51, 8.53) *	3.48 (1.08, 11.3) *
Income (< 20, 000 and ≥ $75, 000)		1.31 (0.99, 1.73)
Health Information Seeking (yes vs. no)		1.06 (0.42, 2.67)
Health insurance (insured vs. uninsured)		0.85 (0.30, 2.46)
Emotional Support (having support vs. not having support)		0.80 (0.31, 2.08)
History of Family Cancer (yes vs. no)		0.96 (0.22, 4.04)
Need factors		
Obese (vs. not obese)		1.31 (0.61, 2.78)
Area under the ROC	0.57	0.68

Note: The unconditional and conditional models predicted the odds of getting screened for cervical cancer
* indicates the statistically significant associations with the cervical cancer screening ($p < 0.05$)
N = 755 (Black women)
Area under the Receiver Operating Characteristics Curve = 0.68
OR = Odds ratio [obtained by exp.(the estimated regression coefficient)]; CI = 95% Confidence Interval (associated with the estimated regression coefficient) is in parenthesis.
Adjusted by age group, education, income, marital status, obese, health insurance, history of cancer, emotional support, health information seeking and routine health checkup. Outcome variable: cervical cancer screening.
The HINTS final sampling weights and replicate weights were applied.

Table 5. Estimated Odds Ratios from Binary Logistic Regression Models of White Women within the age of 21 to 65 years who had recent Cervical Cancer Screening within the last 3 years in the Health Information National Trends Survey 5 (Cycle 1, 2 and 3)

Variables	Unconditional Model 1 OR (95% CI)	Conditional Model 2 OR (95% CI)
Predisposing factors		
Age, years (>21 and <65)		0.98 (0.96, 0.99) *
College or higher (vs. less than College)		1.18 (0.79, 1.76)
Married (vs not married)		1.70 (1.09, 2.65) *
Enabling factors		
Routine Health Checkup (yes vs. no)	4.62 (2.84, 7.52) *	3.88 (2.09, 7.19) *
Income (< 20, 000 and ≥ $75, 000)		1.08 (0.93, 1.25)
Health Information Seeking (yes vs. no)		0.83 (0.44, 1.58)
Health insurance (insured vs. uninsured)		2.73 (1.44, 5.17) *
Emotional Support (having support vs. not having support)		1.98 (1.19, 3.29) *
History of Family Cancer (yes vs. no)		1.06 (0.67, 1.66)
Need factors		
Obese (vs. not obese)		0.57 (0.37, 0.88) *
Area under the ROC	0.59	0.73

Note: The unconditional and conditional models predicted the odds of getting screened for cervical cancer
* indicates the statistically significant associations with the cervical cancer screening ($p < 0.05$)
Area under the Receiver Operating Characteristics Curve = 0.73
OR = Odds ratio [obtained by exp.(the estimated regression coefficient)]; CI = 95% Confidence Interval (associated with the estimated regression coefficient) is in parenthesis.
N = 2525 (White women)
Adjusted by age group, education, income, marital status, obese, health insurance, history of cancer, emotional support, health information seeking and routine health checkup. Outcome variable: cervical cancer screening.
The HINTS final sampling weights and replicate weights were applied.

Table 6. Estimated Odds Ratios from Binary Logistic Regression Models of Hispanic Women within the age of 21 to 65 years who had recent Cervical Cancer Screening within the last 3 years in the Health Information National Trends Survey 5 (Cycle 1, 2 and 3)

Variables	Unconditional Model 1 OR (95% CI)	Conditional Model 2 OR (95% CI)
Predisposing factors		
Age, years (>21 and <65)		1.01 (0.97, 1.05)
College or higher (vs. less than College)		2.82 (0.89, 8.91)
Married (vs not married)		3.32 (1.40, 7.89) *
Enabling factors		
Routine Health Checkup (yes vs. no)	1.79 (0.89, 3.58)	1.90 (0.73, 4.95)
Income (< 20, 000 and ≥ $75, 000)		0.98 (0.69, 1.40)
Health Information Seeking (yes vs. no)		0.71 (0.31, 1.66)
Health insurance (insured vs. uninsured)		1.94 (0.70, 5.37)
Emotional Support (having support vs. not having support)		1.22 (0.47, 3.14)
History of Family Cancer (yes vs. no)		1.06 (0.43, 2.64)
Need factors		
Obese (vs. not obese)		1.47 (0.73, 2.93)
Area under the ROC	0.57	0.68

Note: The unconditional and conditional models predicted the odds of getting screened for cervical cancer
* indicates the statistically significant associations with the cervical cancer screening ($p < 0.05$)
Area under the Receiver Operating Characteristics Curve = 0.68
OR = Odds ratio [obtained by exp.(the estimated regression coefficient)]; CI = 95% Confidence Interval (associated with the estimated regression coefficient) is in parenthesis.
N = 755 (Hispanic women) Adjusted by age group, education, income, marital status, obese, health insurance, history of cancer, emotional support, health information seeking and routine health checkup. Outcome variable: cervical cancer screening.
The HINTS final sampling weights and replicate weights were applied.

Table 7. Estimated Odds Ratios from Binary Logistic Regression Models of Other Women within the age of 21 to 65 years who had recent Cervical Cancer Screening within the last 3 years in the Health Information National Trends Survey 5 (Cycle 1, 2 and 3)

Variables	Unconditional Model 1 OR (95% CI)	Conditional Model 2 OR (95% CI)
Predisposing factors		
Age, years (>21 and <65)		0.99 (0.95, 1.03)
College or higher (vs. less than College)		0.55 (0.18, 1.70)
Married (vs not married)		1.89 (0.71, 5.08)
Enabling factors		
Routine Health Checkup (yes vs. no)	3.93 (1.39, 11.09) *	5.76 (1.29, 25.82) *
Income (< 20, 000 and ≥ $75, 000)		1.08 (0.72, 1.62)
Health Information Seeking (yes vs. no)		0.67 (0.20, 2.20)
Health insurance (insured vs. uninsured)		2.24 (0.15, 34.18)
Emotional Support (having support vs. not having support)		0.52 (0.07, 4.03)
History of Family Cancer (yes vs. no)		1.54 (0.52, 4.60)
Need factors		
Obese (vs. not obese)		0.92 (0.28, 2.96)
Area under the ROC	0.56	0.64

Note: The unconditional and conditional models predicted the odds of getting screened for cervical cancer
* indicates the statistically significant associations with the cervical cancer screening ($p < 0.05$)
Area under the Receiver Operating Characteristics Curve = 0.64
OR = Odds ratio [obtained by exp.(the estimated regression coefficient)]; CI = 95% Confidence Interval (associated with the estimated regression coefficient) is in parenthesis.
N = 402 (Other women)
Adjusted by age group, education, income, marital status, obese, health insurance, history of cancer, emotional support, health information seeking and routine health checkup. Outcome variable: cervical cancer screening.
The HINTS final sampling weights and replicate weights were applied.

Table 8. Estimated Odds Ratios from Binary Logistic Regression Models of Black Women within the age of 40 to 75 years who had recent Breast Cancer Screening within the last 2 years in the Health Information National Trends Survey 5 (Cycle 1, 2 and 3)

Variables	Unconditional Model 1 OR (95% CI)	Conditional Model 2 OR (95% CI)
Predisposing factors		
Age, years (($\geq$ 40 and $\leq$ 75)		1.13 (1.06, 1.20) *
College or higher (vs. less than College)		1.12 (0.42, 2.97)
Married (vs not married)		1.12 (0.38, 3.29)
Enabling factors		
Routine Health Checkup (yes vs. no)	3.79 (1.73, 8.28) *	7.19 (1.58, 32.76) *
Income (< 20, 000 and $\geq$ $75, 000)		1.10 (0.78, 1.54)
Health Information Seeking (yes vs. no)		1.03 (0.34, 3.13)
Health insurance (insured vs. uninsured)		2.10 (0.41, 10.72)
Emotional Support (having support vs. not having support)		1.44 (0.48, 4.31)
History of Family Cancer (yes vs. no)		1.22 (0.47, 3.15)
Need factors		
Obese (vs. not obese)		1.35 (0.58, 3.15)
Area under the ROC	0.56	0.76

Note: The unconditional and conditional models predicted the odds of getting screened for breast cancer
* indicates the statistically significant associations with the breast cancer screening ($p < 0.05$)
Area under the Receiver Operating Characteristics Curve = 0.76
OR = Odds ratio [obtained by exp.(the estimated regression coefficient)]; CI = 95% Confidence Interval (associated with the estimated regression coefficient) is in parenthesis.
N = 739 (Black women) Adjusted by age group, education, income, marital status, obese, health insurance, history of cancer, emotional support, health information seeking and routine health checkup. Outcome variable: breast cancer screening.
The HINTS final sampling weights and replicate weights were applied.

Table 9. Estimated Odds Ratios from Binary Logistic Regression Models of White Women within the age of 40 to 75 years who had recent Breast Cancer Screening within the last 2 years in the Health Information National Trends Survey 5 (Cycle 1, 2 and 3)

Variables	Unconditional Model 1 OR (95% CI)	Conditional Model 2 OR (95% CI)
Predisposing factors		
Age, years ((≥ 40 and ≤ 75)		1.08 (1.06, 1.09) *
College or higher (vs. less than College)		1.23 (0.87, 1.70)
Married (vs not married)		1.37 (0.97, 1.96)
Enabling factors		
Routine Health Checkup (yes vs. no)	5.53 (3.30, 9.25) *	3.44 (1.94, 6.08) *
Income (< 20, 000 and ≥ $75, 000)		1.09 (0.96, 1.24)
Health Information Seeking (yes vs. no)		1.03 (0.60, 1.75)
Health insurance (insured vs. uninsured)		3.31 (1.46, 7.50) *
Emotional Support (having support vs. not having support)		1.79 (1.08, 2.95) *
History of Family Cancer (yes vs. no)		1.12 (0.75, 1.66) *
Need factors		
Obese (vs. not obese)		1.11 (0.76, 1.62)
Area under the ROC	0.58	0.72

Note: The unconditional and conditional models predicted the odds of getting screened for breast cancer
* indicates the statistically significant associations with the breast cancer screening ($p < 0.05$)
Area under the Receiver Operating Characteristics Curve = 0.72
OR = Odds ratio [obtained by exp.(the estimated regression coefficient)]; CI = 95% Confidence Interval (associated with the estimated regression coefficient) is in parenthesis.
N = 2564 (White women)
Adjusted by age group, education, income, marital status, obese, health insurance, history of cancer, emotional support, health information seeking and routine health checkup. Outcome variable: breast cancer screening.
The HINTS final sampling weights and replicate weights were applied.

Table 10. Estimated Odds Ratios from Binary Logistic Regression Models of Hispanic Women within the age of 40 to 75 years who had recent Breast Cancer Screening within the last 2 years in the Health Information National Trends Survey 5 (Cycle 1, 2 and 3)

Variables	Unconditional Model 1 OR (95% CI)	Conditional Model 2 OR (95% CI)
Predisposing factors		
Age, years ((≥ 40 and ≤ 75)		1.14 (1.08, 1.20) *
College or higher (vs. less than College)		0.94 (0.44, 1.99)
Married (vs not married)		1.06 (0.51, 2.20)
Enabling factors		
Routine Health Checkup (yes vs. no)	2.92 (1.47, 5.82) *	2.77 (1.09, 7.07) *
Income (< 20, 000 and ≥ $75, 000)		1.04 (0.77, 1.40)
Health Information Seeking (yes vs. no)		1.56 (0.55, 4.43)
Health insurance (insured vs. uninsured)		4.38 (1.31, 14.63) *
Emotional Support (having support vs. not having support)		1.03 (0.33, 3.28)
History of Family Cancer (yes vs. no)		1.79 (0.83, 3.85)
Need factors		
Obese (vs. not obese)		0.78 (0.41, 1.47)
Area under the ROC	0.63	0.79

Note: The unconditional and conditional models predicted the odds of getting screened for breast cancer
* indicates the statistically significant associations with the breast cancer screening ($p < 0.05$)
Area under the Receiver Operating Characteristics Curve = 0.79
OR = Odds ratio [obtained by exp. (the estimated regression coefficient)]; CI = 95% Confidence Interval (associated with the estimated regression coefficient) is in parenthesis.
N = 558 (Hispanic women)
Adjusted by age group, education, income, marital status, obese, health insurance, history of cancer, emotional support, health information seeking and routine health checkup. Outcome variable: breast cancer screening.
The HINTS final sampling weights and replicate weights were applied.

Table 11. Estimated Odds Ratios from Binary Logistic Regression Models of Other Women within the age of 40 to 75 years who had recent Breast Cancer Screening within the last 2 years in the Health Information National Trends Survey 5 (Cycle 1, 2 and 3)

Variables	Unconditional Model 1 OR (95% CI)	Conditional Model 2 OR (95% CI)
Predisposing factors		
Age, years (($\geq$ 40 and $\leq$ 75)		1.10 (1.02, 1.18) *
College or higher (vs. less than College)		0.50 (0.17, 1.44)
Married (vs not married)		2.65 (0.75, 9.33)
Enabling factors		
Routine Health Checkup (yes vs. no)	1.08 (0.30, 3.95)	1.11 (0.22, 5.52)
Income (< 20, 000 and $\geq$ $75, 000)		1.19 (0.81, 1.75)
Health Information Seeking (yes vs. no)		0.86 (0.28, 2.60)
Health insurance (insured vs. uninsured)		0.85 (0.05, 15.42)
Emotional Support (having support vs. not having support)		0.81 (0.18, 3.72)
History of Family Cancer (yes vs. no)		1.03 (0.33, 3.18)
Need factors		
Obese (vs. not obese)		1.44 (0.44, 4.66)
Area under the ROC	0.55	0.71

Note: The unconditional and conditional models predicted the odds of getting screened for breast cancer
* indicates the statistically significant associations with the breast l cancer screening ($p < 0.05$)
OR = Odds ratio [obtained by exp.(the estimated regression coefficient)]; CI = 95% Confidence Interval (associated with the estimated regression coefficient) is in parenthesis.
Area under the Receiver Operating Characteristics Curve = 0.71
N = 302 (Other women)
Adjusted by age group, education, income, marital status, obese, health insurance, history of cancer, emotional support, health information seeking and routine health checkup. Outcome variable: breast cancer screening.
The HINTS final sampling weights and replicate weights were applied.