

Sociodemographic and Behavioral Determinants of Cervical Cancer Screening among Adult Women in the United States

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Abstract

Cervical cancer poses a significant burden on women worldwide, with particularly devastating impacts in developing nations, despite the availability of established prevention methods. This study aims to determine the socio-demographic and behavioral determinants of cervical cancer screening among adult women in the United States. This study is a cross-sectional study, and it employed the use and analysis of the 2022 behavioral risk factor surveillance system data. Descriptive statistics for all the variables were obtained, and chi-square test was used to determine statistical significance of observed differences in cross tabulated variables. Statistical significance level was taken at p -value < 0.05 and confidence interval at 95%. Bivariate and multivariate analysis was done to ascertain any statistical significant between socio-demographic variables and uptake rate of cervical screening. Among the 204,540 respondents, about 60% had previously undergone cervical cancer screening and the determinants of cervical cancer screening include age, single marital status, education, race, health insurance status, general health, veteran status, smoking, alcohol use, and income. In conclusion, the screening rate for cervical cancer found by this study is still low for a developed nation like the United States and sociodemographic factors associated with screening rate were age, single marital status, education, race, health insurance status, general health, veteran status, smoking, alcohol use, and income. It is therefore recommended that targeted interventions, policy initiatives, and community engagement be instituted to increase screening uptake among citizens of the United States.

Keywords: Adult Women, Cervical Cancer, Determinants, Screening, United States.

Introduction

Cervical Cancer is highly preventable yet, the mortality rate is still alarming. Despite improvements in screening and prevention, including Pap smear testing and HPV vaccinations, cervical cancer is still a major

public health concern in the United States considering the disease burden year in, year out [1-3].

Cervical cancer is caused by persistent infection with the human papillomavirus (HPV) and it is leading cause of death among

women. It is the fourth most common cancer in women globally with around 660 000 new cases and around 350 000 deaths in 2022 [4]. Women living with HIV are 6 times more likely to develop cervical cancer compared to women without HIV. However, Prophylactic vaccination against HPV and screening and treatment of pre-cancer lesions are effective strategies to prevent cervical cancer and are very cost-effective. Cervical cancer can be cured if diagnosed at an early stage and treated promptly [4].

Though the highest rates of cervical cancer incidence and mortality are in low- and middle-income countries, which reflect major inequities driven by lack of access to national HPV vaccination, cervical screening and treatment services and social and economic determinants; cervical incidence is still an important public health issue in United States [4, 5]. Annually, approximately over ten of thousands of new cases of cervical cancer are diagnosed among women in the United States, with an estimated 13,820 new cases of cervical cancer in the year 2024 and 4,360 premature deaths. This translates to seven new cases and two fatalities per 100,000 women. The prevalence of cervical cancer in the United State in 2021 was estimated at 295,748 women [4]. In Tennessee alone, around 250 cases of cervical cancer are reported each year [1-3]. The 2025 projection by the American Cancer Society suggested that an estimated 13,360 new cases of invasive cervical cancer will be diagnosed and about 4,320 women will die from cervical cancer in 2025, showing no significant reduction in the disease occurrence compared to 2024 [5].

Cervical cancer prevention and population health improves with screening tools like PAP and HPV testing; however, coverage gaps still exist. The disparity of access to care constitutes a major barrier and this affects underserved communities more. The primary objectives of cervical cancer screening are to prevent and detect disease at its early stages,

thereby enhancing the overall quality and duration of women's lives. Therefore, increasing access to screening is sacrosanct for a good outcome [1, 3, 4].

Various factors, including socioeconomic status, healthcare accessibility, cultural norms, and health policy initiatives, influence the uptake of cervical cancer screening practices in the United States. Sociodemographic variables such as race, income, education, geography, and access to healthcare all have a significant impact on screening uptake; discrepancies are most noticeable among Black, Hispanic, uninsured, and rural women. Even though 84% of women between the ages of 21 and 65 report having recently had a Pap test, equal access is hampered by issues like cost, insurance, transportation, cultural attitudes, and health literacy [2-4].

Although, advocacy groups and community-based organizations raise awareness to promote fairness in healthcare access, offer insights into the obstacles faced by underprivileged people and the political dynamics of the community, some gap still exist that needs to be filled. Therefore, continuous partnership by all stakeholders is needed to guarantees a thorough strategy to address inequalities in adopting cervical cancer screenings. The need for focused, inclusive initiatives to increase screening rates and lessen inequities is highlighted by the persistence of research gaps, especially in understanding the interaction of sociodemographic factors and issues unique to rural areas.

The objectives of this study is to examine the association between cervical cancer screening uptake and sociodemographic characteristics among United State adult women, determine the potential differences in screening rates among various socioeconomic and racial groups and to evaluate the impact of educational attainment on the rate of cervical cancer screening among the study group.

Methods

The 2022 Behavioral Risk Factor Surveillance System (BRFSS) data and a national health survey were used for the study (https://www.cdc.gov/brfss/annual_data/annual_2022.html). The study design was a cross-sectional study. The analytical sample size was 204,540 women. The data was cleaned and recoded as considered necessary. The data was weighted (_LLCPWT) to evaluate its complex nature to make it a good representative of the US population.

The main outcome variable was the cervical screening rate, and the major independent determinant variables included: age, education, race, income, marital status, urban/rural dwelling, health insurance, general health, veteran status, smoking, and alcohol use. Age was categorized into 3 groups, education was grouped into 4 categories, race was grouped into 6 groups, marital status was grouped into 3, and income was grouped into 3. Other variables were classified into 2 groups.

Descriptive statistics were done to see how all variables were distributed, the output was then tabulated. A test of association was done using Chi-square. The bivariate logistic regression analysis for each predictor variable was done using SAS 9.4 to determine a strong association and direction. This is the basis for the unadjusted full model. Finally, a multivariable logistic regression model was built putting into perspective the independent association of all predictor variables with cervical cancer screening accounting for confounders using the backward stepwise selection at $p\text{-value} = 0.20$. This model was repeated using the backward stepwise selection after removing the predictor with a $P\text{-value} > 0.2$ from the new model until all predictors in the reduced multivariate analysis

model had a $p\text{-value} \leq 0.05$. This became the final model. The analysis used the survey design variables, sampling weights, stratification (_STSTR), and clustering (_PSU) variables to correct data complexity. Data statistical significance was set at $p \leq 0.05$, and 95% confidence intervals for all associations. We scored models that fit against the orthodox diagnostic such as the Akaike Information Criterion (AIC), and model discrimination against the C-statistic. The final model was acceptable in fit ($C\text{-statistic} = 0.602$), which was a moderate discriminative capacity.

Results

Sociodemographic and Risk Behavior Characteristics of Respondents

Majority of this study respondents were aged 18-34 years (43.65%), married (53.24%), had tertiary education (63.26%) and were White, non-Hispanic. About three quarters of the respondents were low to middle income earner, majority live in urban centres, majority has poor health and respondents were largely insured (Table 1).

Prevalence of Cervical Cancer Screening

About 60% of the respondents had been screened before for cervical cancer (Table 2).

Factors Affecting Cervical Cancer Screening

Bivariate analysis showed age, marital status, education, race, income, general health, health insurance, veteran status, smoking, and alcohol consumption were found to be highly associated with cervical cancer screening. However, the urbanization or rurality of where a person stays did not appear to have any association with cervical screening. (Tables 3, 4 and 5).

Table 1. Sociodemographic and Risk Behavior Characteristics of Respondents

Characteristics	Categories	Frequency(n)	Weighted Percentage (%)
Age	18-34yrs	56,503	43.65
	35-64yrs	69,656	31.65
	65+	78,381	24.70
Marital Status	Married/Couple	106,913	53.24
	Divorced/Widowed	63,954	24.06
	Never Married	32,029	22.69
Education	Did not graduate high school	11,126	11.11
	Graduated high school	46,849	25.62
	Attended college	58,291	31.67
	Graduated college	87,592	31.59
Race	White, non-Hispanic	152,528	59.53
	Black, non-Hispanic	17,993	12.16
	Asian, non-Hispanic	5,294	5.72
	A. Indian/Alaskan Native	3,232	1.10
	Hispanic	19,954	17.82
	Other race, non-Hispanic	5,539	3.64
Income	Low	52,054	33.47
	Middle	72,473	41.91
	High	39,549	26.08
Rural / Urban	Rural	25,945	6.28
	Urban	173,503	93.72
General Health	Good	165,933	18.94
	Poor	38,154	81.05
Health Insurance	Insured	189,048	93.22
	Not insured	8,456	6.77
Veteran status	No	198,904	97.48
	Yes	5,401	2.52
Smoking	No	127,557	67.50
	Yes	73,152	32.50
Alcohol Use	No	101,428	52.36
	Yes	94,157	47.63

Footnotes: Table showing the descriptive statistics of the study population. $\Sigma N=204,540$.

Table 2. Cervical Cancer Screening Rate

Ever screened for cervical cancer.	Weighted Percentage (%)
Yes	59.99 (59.51 – 60.48)
No	40.0 (39.52 – 40.48)

Footnotes: Prevalence rate in the USA.

Table 3. Bivariate Logistic Regression of Sociodemographic and Behavioral Factors Cervical Cancer Screening among Adult Women in the United States, BRFSS 2022

Characteristics	Categories	Crude Odds ratio(95% CI)	P Value
Age	18-34yrs	Ref	
	35-64yrs	2.96 (2.8 – 3.11)	<0.0001
	65+	1.60 (1.53 – 1.68)	<0.0001
Marital Status	Married/Couple	Ref	
	Divorced/Widowed	0.78 (0.75 – 0.83)	<0.0001
	Never Married	0.33 (0.31 – 0.35)	<0.0001
Education	Did not graduate high school	Ref	
	Graduated high school	1.31 (1.20 – 1.43)	<0.0001
	Attended college	2.27 (2.08 – 2.48)	<0.0001
	Graduated college	3.72 (3.41 – 4.06)	<0.0001
Race	White, non-Hispanic	Ref	
	Black, non-Hispanic	0.62 (0.58 – 0.65)	<0.0001
	Asian, non-Hispanic	0.38 (0.34 – 0.43)	<0.0001
	A. Indian/Alaskan Native	0.60 (0.51 – 0.72)	<0.0001
	Hispanic	0.54 (0.51 – 0.57)	<0.0001
	Other race, non-Hispanic	0.77 (0.68 – 0.87)	<0.0001
Income	Low	Ref	
	Middle	1.64 (1.56 – 1.73)	<0.0001
	High	2.86 (2.68 – 3.05)	<0.0001
General Health	Poor	Ref	
	Good	1.12 (1.07 – 1.18)	<0.0001
Health Insurance	Not Insured	Ref	
	Insured	2.2 (2.02 – 2.41)	<0.0001
Veteran status	No	Ref	
	Yes	1.36 (1.20 – 1.53)	<0.0001
Smoking	No	Ref	
	Yes	1.53 (1.47 – 1.60)	<0.0001
Alcohol Use	No	Ref	
	Yes	0.63 (0.60 – 0.66)	<.0001

Footnotes: Analysis weighted using BRFSS survey weights

- *ref* = reference category
- *OR* = Odds Ratio for Unadjusted variables in the model

Table 4. Multivariate Logistic Regression of Sociodemographic and Behavioral factors Cervical Cancer Screening among Adult Women in the United States, BRFSS 2022

Characteristics	Categories	Crude Odds ratio(95% CI)	P Value
Age	18-34yrs	Ref	
	35-64yrs	2.06 (1.93– 2.19)	<0.0001
	65+	1.19 (1.11 – 1.27)	<0.0001
Marital Status	Married/Couple	Ref	
	Divorced/Widowed	0.94 (0.88 – 1.01)	0.0789
	Never Married	0.54 (0.50 – 0.58)	<0.0001
Education	Did not graduate high school	Ref	
	Graduated high school	1.12 (0.99 – 1.26)	0.0693
	Attended college	1.73 (1.53 – 1.95)	<0.0001
	Graduated college	2.63 (2.31– 2.98)	<0.0001
Race	White, non-Hispanic	Ref	
	Black, non-Hispanic	0.79 (0.74 – 0.86)	<0.0001
	Asian, non-Hispanic	0.37 (0.08 – 12.27)	<0.0001
	A. Indian/Alaskan Native	0.76 (0.61 – 0.94)	0.0136
	Hispanic	0.85 (0.78 – 0.93)	0.0004
	Other race, non-Hispanic	0.93 (0.79 – 1.09)	0.3696
Income	Low	Ref	
	Middle	1.23 (1.15 – 1.31)	<0.0001
	High	1.68 (1.54 – 1.83)	<0.0001
General Health	Poor	Ref	
	Good	0.90 (0.84 – 0.96)	<0.0032
Health Insurance	Not Insured	Ref	
	Insured	1.39 (1.24 – 1.55)	<0.0001
Veteran status	No	Ref	
	Yes	1.17 (1.01 – 1.36)	<0.0415
Smoking	No	Ref	
	Yes	1.36 (1.28 – 1.44)	<0.0001
Alcohol Use	No	Ref	
	Yes	1.18 (1.12 – 1.25)	<0.0001

Footnotes:

- Analysis weighted using BRFSS survey weights
- Model adjusted for all variables shown above
- In multivariate analysis, age, marital status for never married, education, race, income, general health, health insurance, veteran status, smoking, and alcohol consumption were found to be highly associated with cervical cancer screening.
- Model fit statistics: c-statistics = 0.684
- ref = reference category

Table 5. Bivariate and Multivariate Logistic Regression of Sociodemographic and Behavioral Factors for Cervical Cancer Screening among Adult Women in the United States, BRFSS 2022

Characteristics	Categories	Crude Odds ratio(95% CI)	P Value	Adjusted Odds ratio(95% CI)	P Value
Age	18-34yrs	Ref		Ref	
	35-64yrs	2.96 (2.8 – 3.11)	<0.0001	2.06 (1.93– 2.19)	<0.0001
	65+	1.60 (1.53 – 1.68)	<0.0001	1.19 (1.11 – 1.27)	<0.0001
Marital Status	Married/Couple	Ref		Ref	
	Divorced/Widowed	0.78 (0.75 – 0.83)	<0.0001	0.94 (0.88 – 1.01)	0.0789
	Never Married	0.33 (0.31 – 0.35)	<0.0001	0.54 (0.50 – 0.58)	<0.0001
Education	Did not graduate high school	Ref		Ref	
	Graduated high school	1.31 (1.20 – 1.43)	<0.0001	1.12 (0.99 – 1.26)	0.0693
	Attended college	2.27 (2.08 – 2.48)	<0.0001	1.73 (1.53 – 1.95)	<0.0001
	Graduated college	3.72 (3.41 – 4.06)	<0.0001	2.63 (2.31– 2.98)	<0.0001
Race	White, non-Hispanic	Ref		Ref	
	Black, non-Hispanic	0.62 (0.58 – 0.65)	<0.0001	0.79 (0.74 – 0.86)	<0.0001
	Asian, non-Hispanic	0.38 (0.34 – 0.43)	<0.0001	0.37 (0.08 – 12.27)	<0.0001
	A. Indian/Alaskan Native	0.60 (0.51 – 0.72)	<0.0001	0.76 (0.61 – 0.94)	0.0136
	Hispanic	0.54 (0.51 – 0.57)	<0.0001	0.85 (0.78 – 0.93)	0.0004
	Other race, non-Hispanic	0.77 (0.68 – 0.87)	<0.0001	0.93 (0.79 – 1.09)	0.3696
Income	Low	Ref		Ref	
	Middle	1.64 (1.56 – 1.73)	<0.0001	1.23 (1.15 – 1.31)	<0.0001
	High	2.86 (2.68 – 3.05)	<0.0001	1.68 (1.54 – 1.83)	<0.0001
General Health	Poor	Ref		Ref	
	Good	1.12 (1.07 – 1.18)	<0.0001	0.90 (0.84 – 0.96)	0.0032
Health Insurance	Not Insured	Ref		Ref	
	Insured	2.2 (2.02 – 2.41)	<0.0001	1.39 (1.24 – 1.55)	<0.0001
Veteran status	No	Ref		Ref	
	Yes	1.36 (1.20 – 1.53)	<0.0001	1.17 (1.01 – 1.36)	0.0415
Smoking	No	Ref		Ref	
	Yes	1.53 (1.47 – 1.60)	<0.0001	1.36 (1.28 – 1.44)	<0.0001
Alcohol Use	No	Ref		Ref	
	Yes	0.63 (0.60 – 0.66)	<.0001	1.18 (1.12 – 1.25)	<0.0001

Footnotes: Bivariate and Multivariate analysis for ease of comparison in the context of confounders.

Discussion

This study focused on crude and adjusted odds ratios to analyze the association between sociodemographic and health-related

characteristics and access to healthcare services to find important predictors. The results mostly align with previous research, validating established correlations while exposing subtleties in how age, education,

race, wealth, and insurance status affect access to healthcare [1-3]. In the National Healthcare Quality and Disparities Report 2021 and another study done to explore cervical cancer screening uptake among women in the United States and the impact of social determinants of health and psychosocial determinants, it was posited that access to healthcare is significantly influenced by sociodemographic factors, including race, ethnicity, socioeconomic level, education, geography, and handicap status. They stressed that racial and ethnic minorities, those with lower incomes, those who live in rural areas, and those with less education frequently have poorer healthcare results and less access to services [1, 2]. These factors as documented by these studies are in line with findings by our study.

Higher education levels, for instance, were highly associated with greater access to healthcare, consistent with other research that links socioeconomic stability and health literacy to improved use of preventative care [6-8]. In a similar vein, people with insurance and higher incomes showed improved access, which is consistent with the well-established obstacles that low-income and uninsured groups must overcome [9, 10]. Nonetheless, variations among racial and ethnic groupings highlight enduring inequalities, with Black and Hispanic people exhibiting decreased odds even when confounders were taken into account [11-13]. The National Healthcare Quality and Research (NHQR) report and a study on understanding and addressing social determinants to advance cancer health equity in the United States acknowledged the enduring racial and ethnic inequities that still impede fair healthcare access while highlighting the crucial role that socioeconomic factors like income, insurance status, and education play in determining access to healthcare [1, 6].

Addressing these gaps necessitates addressing systemic injustices that

disproportionately impact Black, Hispanic, and other marginalized racial and ethnic groups in addition to expanding access to services for lower-income and uninsured communities. In the same vein, a systematic analysis on social determinants of health and US cancer screening interventions and another study on uptake of cervical cancer screening among women in Portland, Jamaica. North American showed that social and demographic determinants of health had a major impact on the efficacy of cancer screening programs in the United States, exposing inequalities in screening outcomes and access [7, 14]. It is worth noting that studies done in low-and-middle-income to determine barriers to uptake of cervical cancer screening services found many obstacles to cervical cancer screening such as age, marital status, gender of provider, cultural considerations, a lack of knowledge, poor awareness, fear of procedure, distance from health facilities, non-availability of healthcare facilities low risk perception, financial constrain [8, 15-18].

Other studies in the United States highlighted the influence of insurance status on access to preventive treatment by revealing that health insurance is a key factor in boosting the use of Pap smears among immigrants in the United States [6-9]. This was in keeping with the findings of this study.

This study deviated from previous research in a few areas [3, 6, 19, 20]. The non-significant adjusted odds for people who are divorced or widowed and those who are in good overall health, for example, point to possible moderating factors that need more research [1, 2, 11]. These results reveal limitations in addressing intersectionality in healthcare access and emphasize the interaction of sociodemographic factors. It is hoped that these findings will buttress the need for policy change and advocacy on behavioral and cultural adjustments to overcome the scourge of cervical cancer among our women

as this disease is highly preventable. With all hands on deck, it is very possible.

Strengths and Limitations of the Study

A large sample size of over 200,000 offers great statistical power, enhancing the dependability of findings and enabling the identification of subtle variations or patterns within subgroups. Also, generalizability is more likely to apply to the larger population as the sample is representative of the target population. Cross-sectional investigations are more economical in terms of time and resources because they gather data at a single point in time.

The snapshot of prevalence study design is especially helpful in figuring out how common certain habits, exposures, or health issues are in a community at a specific time. Finally, helpful for finding Associations considering its large sample size even while it is impossible to determine causality.

One limitation of the study is that no causality relationship can be established since cross-sectional studies only record information at one moment in time, they are unable to determine the causes of different variables. Also, potential for confounding variables, that makes it more difficult to draw reliable findings by distorting the influence of one variable by another that isn't examined. Furthermore, it is challenging to comprehend patterns or the influence of temporal elements because the data only depicts a single point in time and does not take changes over time into account. The risk of misclassification in large samples, and mistakes in data collection or classification such as incorrectly identifying individuals according to their health state may compromise the overall accuracy of the findings. Finally, novel research cannot be done using secondary data like in this case.

Conclusion

The screening rate for cervical cancer found by this study is still low for a developed nation like United States. This study also found that sociodemographic factors associated with screening rate were age, single marital status, education, race, health insurance status, general health, veteran status, smoking, alcohol use, and income.

Recommendations/Public Health Implications

To increase the uptake of cervical cancer screening and to mitigate the effects of factors preventing uptake in other alleviate the burden of cervical cancer across various communities in the United States, it is imperative to institute targeted interventions, policy initiatives, and community engagement endeavors.

Public health practitioners can create focused initiatives to raise screening rates in high-risk or underrepresented communities by having a better understanding of these issues.

Therefore, the results can direct the creation of tailored interventions for populations, such as minority women, low-income women, or women living in rural areas, who may encounter difficulties in obtaining screening services. To make screening more accessible, this can involve educational campaigns, outreach initiatives, and mobile health services. Also, Policies targeted at reducing disparities in cervical cancer screening can be informed by this initiative's adoption. Public health initiatives can concentrate on enhancing healthcare access for underserved groups and assisting in the reduction of the equity gap by identifying sociodemographic factors (such as income, insurance status, and ethnicity) that affect participation.

In the same vein, the findings can be utilized to help develop educational campaigns that raise awareness of the risks of cervical cancer, the value of early detection, and the many screening alternatives. Especially in

areas with reduced health literacy, these programs help dispel myths, lessen anxiety, and promote proactive health practices. The project can offer evidence in support of policy advocacy to increase health insurance coverage for cervical cancer screening, particularly for women who are underinsured or uninsured. This can entail promoting state and federal legislation modifications to guarantee that screening is extensively accessible without monetary restrictions. Integration of screening services into primary care can promote cervical cancer screening as a standard component of preventive health services for women by encouraging stakeholders, including public health organizations, legislators, and healthcare providers, to incorporate it into routine primary care visits.

Monitoring and Evaluation using the data from the project can set up continuous monitoring and evaluation systems for cervical

cancer screening programs, guaranteeing that interventions continue to be successful and that advancements in screening uptake are monitored and modified as necessary. The results can guide the allocation of resources such as funds, staff, and outreach initiatives, making certain that they are focused on regions that have the most need or where screening rates are disproportionately low.

Conflict of Interest

Nil.

Acknowledgement

The authors acknowledged the support and contributions of Noah Gideon Ugbeyo, Mohammed Oladele Suleiman, Ibrahim Boateng, Oluwayemisi E. Ayo-Bali, Obasuyi Oghogho, Bamidele Tolani Akinyemi, Rofiat Temitope Lemboye-Bello, Oladayo Ogunlaja and Oluwale Olutola Ojo to the success of this work.

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