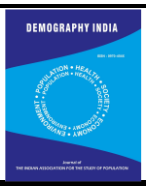
Demography India

A Journal of Indian Association of Study of Population

Journal Homepage: https://demographyindia.iasp.ac.in/



Prevalence and determinants of cervical cancer among reproductive aged women in India

Tashika[1], Dharmendra Kumar Yadav[2]*, Mayank Kumar Singh[3], Ananya Singh[4], Rohit Yadav[5] and Raj Narayan[6]*

Abstract

Cervical cancer remains a significant public health crisis in India, ranking as the second leading cause of cancer-related deaths among women. The country bears a disproportionate global burden, accounting for approximately 25% of all cervical cancer fatalities. This study examines the prevalence of cervical cancer screening among women aged 30 to 49 years. It also explores the relationship between screening rates and sociodemographic, economic factors, as well as identified risk factors for cervical cancer. For this study, secondary data from the National Family Health Survey was utilized. Odds ratios were employed to assess determinants of cervical cancer screening. Geographic disparities persisted, with Tamil Nadu demonstrating higher screening rates compared to West Bengal and Assam. Cervical cancer screening is more prevalent among women who are educated, older, Christian, from Scheduled Castes, urban residents, employed, wealthier, have lower parity, and have a history of HIV. Additionally, women who never had sexual partners, initiated sexual activity later in life, and use IUDs are also more likely to undergo screening. Conversely, cervical cancer screening prevalence was significantly lower among Muslim women, women from Scheduled Tribes, women from general castes, women with higher parity, and those using oral contraceptive pills or with a history of sexually transmitted infections. Coverage of health insurance and tobacco consumption did not significantly influence screening rates. The prevalence of cervical cancer screening in India is notably low, with only 1.6% of women undergoing the procedure. The extremely low rate of cervical cancer screening in India, particularly among disadvantaged women, presents a significant public health challenge. Urgent action is required to increase screening rates and reduce preventable morbidity and mortality.

Keywords

Cervical Cancer, Health Insurance, India, Public health, Screening, Women

*Corresponding Authors

[1] *Department of Statistics, University of Delhi. Email-Id: tashika.stats@gmail.com*

[2] *Assistant Professor, Department of Statistics, The NIHFW, New Delhi. Email-Id: drdkyadav@nihfw.org*

[3] Consultant -Survey Research & Evaluation, Population Council Consulting Pvt. Ltd. *Email-Id: singhmkgeobhu@gmail.com*

[4] ICSSR Post Doctoral Fellow, *Email-Id: sananya31@gmail.com*

[5] *Project Associate, (SAKSHAM LMIS), The NIHFW, New Delhi. Email-Id: rohitiips05@gmail.com*

[6] *Assistant Professor, Department of Community Medicine, Dr. R.M.L.I.M.S. Lucknow. Email- Id: drrajrml@gmail.com and rajiips2008@gmail.com*

Introduction

Globally, cause of death from cancer among women with incidence rate 14.1% (662,301 cases) and mortality rate 7.1% (348,874 deaths) was observed in 2022 (Bray et al.,2024). The highest rates of cervical cancer incidence and mortality were observed in low and middle-income countries, reflecting significant inequities in access to healthcare. Disparities in healthcare resources and infrastructure hinder early detection and effective management. In India, cervical cancer is the second most common cancer with an incidence rate of 17.7% (127,526 cases) and the second leading cause of death with a mortality rate of 11.2% (79,906 deaths) as per GLOBOCAN 2022 (Ferlay et al.,2021). About 22.9% of all global deaths due to cervical cancer occur in India(Mathur et al.,2020). The reason for this difference is lack of effective screening and access to timely treatment. The age standardized incidence rate per 100,000 population was 17.7 while the 5-year prevalence rate was 339,589 per 1, 00,000 population (Ferlay et al.,2021). India has a population of 511.4 million women ages 15 years and older who are at risk of developing cervical cancer (references?). Cervical cancer ranks as the second most frequent cancer among women between 15 and 44 years of age (references?). India is accounted for 19.3% new cases of cervical cancer among all countries in World (Mathur et al.,2020).

The spectra of cervical cancer looms large over India's future. With the country's population steadily growing, the absolute number of new cases is projected to reach a staggering 229,056 by 2050, a staggering 79.6% increase from 2022 (Aswathy et al.,2015). This translates to a potential health care crisis, with an estimated 153,862 deaths due to cervical cancer which is a 92.6% rise from current figures (Aswathy et al.,2015). These projections paint a grim picture, highlighting the urgent need for a multi-pronged approach. Several factors contribute to this alarming rise. The sheer population growth means a larger pool of women will be susceptible to cervical cancer. However, the most critical factor lies in the current challenges surrounding early Detection programs. Late-stage diagnoses, where the cancer has already spread beyond the cervix, are far too common in India. This not only reduces treatment success rates but also significantly increases healthcare costs. Studies have shown that a staggering 32.8% of patient shave localized disease, while a concerning67.2% are diagnosed when the cancer has already spread beyond the uterine cervix (International Agency for Research on Cancer, 2024) (Krishnamoorthy et al.). This highlights the crucial role early detection plays in successful treatment and improved patient outcomes.

In the past three to four decades, the natural history of cervical cancer has been well studied, and persistent infection of the cervix with certainty pes of HPV has been reported as a necessary causative factor for its occurrence (Bobdey et al.,2016). Globally, 70.8% of cervical cancers are attributed to human papillomavirus (HPV), mainly genotypes 16 and 18 (Reichheld et al.,2020). About 50% to 80% of sexually active females will be infected with HPV during their lifetime (International Institute for Population Sciences [IIPS], 2021). According to the World Health Organization (WHO), persistent infection with high-risk HPV types causes approximately 95% of cervical cancers worldwide (Di Donato et al.,2023). The majority of the patients with cancer were diagnosed at the locally advanced stage for breast (57.0%), cervix uteri (60.0%), head and neck (66.6%), and stomach (50.8%) cancer, whereas in lung cancer, distant meta stasis was predominant among males (44.0%) and females (47.6%) (International Agency for Research on Cancer, 2024). This highlights the gap in screening and early diagnosis. Nearly, 80% of

invasive cervical cancers can be prevented by screening programs. Late diagnosis is a major contributing factor to the high disease mortality rates in India. World Health Organization (WHO) in 1992 devised the cervical cancer screening recommendations for women living in low-resource settings with the motive to screen every woman at least once over their life time at the age of 40, with priority on ages 30-49 years who should be screened every 5 years (Walboomers et al.,1999).

Cervical cancer is frightening, but catching it early makes a world of difference. Regular screening allows doctors to spot precancerous changes in the cervix, called CIN (Cervical Intraepithelial Neoplasia), before they turn into cancer. These pre-cancerous lesions can be treated effectively, leading to very high cure rates. CIN is graded into Low Grade Squamous Intraepithelial Lesion (LSIL) also called CIN I and High grade Squamous Intraepithelial Lesion (HSIL). HSIL is sub divided into CIN II and CIN III. CIN II is a moderate cervical dysplasia with high rate of regression to normal. CIN III is marked full thickness atypia and loss of maturation which carries highest risk of progression to invasive squamous cell carcinoma (De Martel et al.,2017) (Koutsky.,1997). A patient with lesions diagnosed and treated at stage CIN III is at significantly higher hazard risk (4.88) for persistence / recurrence than a patient with lesions that are diagnosed and treated during CIN II (WHO.,2024). Early-stage cervical cancer is a men able to treatment, resulting in 95% disease-free survival and 98% overall survival at ten years (Miller.,1992).

Strengthening existing screening programs and ensuring wider accessibility, particularly in rural areas, the Government of India has commenced a program to screen all women aged 30-64 years for cervical cancer every 5 years using visual inspection by acetic acid under the National Program for Prevention and Control of Cancer, Diabetes, CVD and Stroke of the National Health Mission (Kashyap, V. H., & Shivaswamy, M. S. (2019). The Operational Framework of Management of Common Cancers has provided broad programmatic guidelines as well as screening and management algorithm. This is consistent with the WHO-recommended strategy for secondary prevention with treatment of pre-cancerous lesions (WHO.,2024). While this is a positive step, there's a need to bridge the gap between existing programs and ensuring widespread access across the country. This could involve implementing more efficient screening methods like HPV testing alongside VIA, along with improving public awareness about the importance of early detection, particularly among women from lower socioeconomic backgrounds and those with lower education levels. Statistics show a clear link between these factors and a higher risk of cervical cancer (Khieu and Butler.,2022). The peak age of incidence for cervical cancer in India is 50–59 years, compared to 35–44 years in developed countries (Muthuramalingam and Muraleedharan.,2023). This high age group is partially attributable to the considerable proportion of women in India who are diagnosed with cervical cancer when they are already in the advanced and late stages of the disease: 32.8% of patient shave localized disease and for 67.2% of patients, the disease has spread beyond the uterine cervix at the time of initial diagnosis (International Agency for Research on Cancer, 2024) (Krishnamoorthy et al.). This makes treatment costly and provides a poor prognosis, resulting in higher mortality rates.

However, there is a beacon of hope in the fight against cervical cancer. The increased focus on HPV vaccination for young girls holds immense potential. Human papillomavirus (HPV), particularly strains 16 and 18, is responsible for a large portion of cervical cancer cases in India. Vaccinating against these most common HPV strains can significantly reduce future cases.

Studies have shown that HPV vaccination programs in other countries have led to a dramatic decrease in cervical cancer rates. By taking decisive action now, India can avert this looming public health crisis. Investing in HPV vaccination programs for young girls can significantly reduce the pool of susceptible women in the future.

Rationale of Study

Cervical cancer is a major public health concern in India. It represents a leading cause of death among women, causing significant national health issues. Fortunately, effective screening methods exist to detect cervical cancer early. However, a disturbing trend shows a very low prevalence of these screenings being conducted in India. This study addresses this critical public health issue by examining two interrelated aspects. First, we aim to quantify the current state of cervical cancer screening in India. This involves determining the percentage of women within the target age range who have undergone the recommended screening procedures. This will provide valuable data on the current screening landscape and identify areas for improvement. Secondly, the study will explore the risk factors associated with an increased risk of developing cervical cancer. This may involve investigating factors such as sociodemographic characteristics, sexual history, and lifestyle habits. By identifying these risk factors, we can develop more targeted preventive strategies specifically tailored to address the vulnerabilities of high-risk populations in India. This comprehensive approach, examining both screening prevalence and associated risk factors, will provide valuable information for policymakers and healthcare professionals. The findings can be used to develop targeted interventions that can increase awareness about cervical cancer screening, address barriers to accessing these services, and ultimately contribute to a reduction in the burden of cervical cancer in India.

The objective of the Study is to assess the prevalence of cervical cancer screening among women of reproductive age in India and identify the associated factors influencing screening uptake.

Methods and materials

Source of Data

This analysis leverages data from the fifth round of the National Family Health Survey (NFHS- 5), conducted by the Ministry of Health and Family Welfare (MoHFW), Government of India. The Ministry of Health and Family Welfare (MoHFW), designated the International Institute for Population Sciences (IIPS), Mumbai, as the nodal agency to conduct NFHS-5. NFHS-5 field work for India was conducted in two phases-Phase-I from 17 June 2019 to 30 January 2020 covering 17 states and 5 UTs and Phase-II from2 January 2020 to 30 April 2021 covering 11 states and 3 UTs (International Institute for Population Sciences [IIPS], 2021). The survey employed a stratified two-stage sampling design based on the 2011 census, ensuring national representativeness and the ability to generate estimates at the state/union territory and district levels. Detailed information regarding the sampling design can be found in the NFHS-5 national report.

The NFHS-5 offers a comprehensive resource for researchers and policymakers seeking to understand the landscape of women's health and family welfare in India. This large-scale, multi-round survey provides high-quality data on a vast array of topics, including marriage patterns, fertility rates, contraceptive use, and healthcare utilization. The NFHS-5's Woman's Schedule stands out for its in-depth exploration of women's experiences. Beyond traditional health indicators, the survey delves into critical areas

like reproductive health, sexual behaviour, and decision-making power within households. Additionally, the inclusion of data on domestic violence sheds light on the social determinants of women's health. NFHS-5 boasts an impressive sample size, encompassing data from over 636,699 households and 7,24,115 women, and 101,839 men (International Institute for Population Sciences [IIPS], 2021). This vast pool of participants strengthens the validity and generalizability of the findings derived from the survey. The data underscores the significance of screening of cervical cancer. By identifying precancerous lesions (CIN) before they progress to cancer, screening programs offer a vital tool for prevention and successful treatment. Early-stage detection of cervical cancer boasts a high survival rate, making early intervention through screening crucial.

Using the publicly available and anonymized NFHS-5 data enables efficient analysis of cervical cancer screening prevalence in India.

Sample Size and Sampling Technique

The National Family Health Survey-5 (NFHS-5) employed a robust two-stage sampling methodology to ensure a representative sample of women for its nationwide health survey. This approach involved the selection of villages and census enumeration blocks, with the intricacies of household selection and data collection procedures documented in a separate investigation. The survey achieved a remarkably high response rate, with 97.7% among 724,115 women at reproductive age between 15 to 49 years. This robust response rate strengthens the generalizability of the findings derived from the women's data, suggesting a strong representation of the target population (International Institute for Population Sciences [IIPS], 2021). While data collection encompassed a broader range of women aged 15-49 years, this particular study only incorporates information from women aged 30-49 years (364,556) age group may have been chosen due to its alignment with the primary target population for cervical cancer screening programs.

Dependent variable

The NFHS-5 surveyed women between15-49 years old, a demographic group most susceptible to cervical cancer. The data set for responses to a specific question: "Have you ever undergone a screening test for cervical cancer? (International Institute for Population Sciences [IIPS], 2021).This question, serving as the dependent variable, provided the foundation for analysing cervical cancer screening rates and potential influencing factors among this age group.

Independent variables

Socio demographic characteristics like age (grouped into 5-year bands), education level, marital status, religion, caste, wealth index, occupation, type of residence and coverage of health insurance were considered. These factors paint a picture of a woman's social and economic background. They can influence how easily she can access health care information and resources, potentially impacting her awareness of cervical cancer and her ability to get screened. For example, a woman with higher education and financial resources might be more likely to know about screening options and have the means to access them.

Secondly, the analysis looked at potential risk factors of cervical cancer. These include reproductive factors like a woman's age at first sexual intercourse, the number of children she has delivered, the number of sexual partners in last 12 months and her history of using contraception like IUDs and pills, tobacco use and any history of sexually transmitted infections and HIV. These factors can affect a woman's susceptibility to the Human Papillomavirus (HPV), the primary cause of cervical cancer.

Analysis

Data analysis was conducted using SPSS software to investigate factors associated with cervical cancer screening. Descriptive statistics provided a foundational understanding of socio-demographic characteristics and risk factors associated to cervical cancer. Chi-square tests were employed to assess the relationship between these factors and cervical cancer screening status. Geographic disparities in screening rates were visualized using Arc GIS software, providing a spatial representation of cervical cancer screening prevalence across India's states and union territories. To ensure the reliability of subsequent analyses, multicollinearity was examined. Three binary logistic regression models were constructed to identify predictors of cervical cancer screening, in which first model incorporates socio-demographic factors, second incorporates cervical cancer risk factors, and third model incorporates combination of both the model. Odds ratios with 95% confidence interval were calculated from these models, quantified the association between each predictor and screening status while accounting for other variables.

Socio-Demographic characteristics of the Study population

The socio-demographic condition of women at reproductive age in India is presented in Table 1. The findings offered a balanced proportion across age groups, with 27.7% falling within the 30-34year group, 26.9% in 35–39-year group, 22.3% and 23.1% in 40-44 years and 45-49-year group, respectively. Marital status data of women revealed a predominantly married population with 90.6%, and a small proportion of widowed/divorced and never-married women with 7.3% and 2.1%, respectively.

Highest educational attainment statistics demonstrated significant heterogeneity, with 36.4% lacking formal education,15.4% attained primary education, 39% and 9.2% attained secondary and higher education, respectively. Hinduism emerged as the most prevalent religion with 75.9%, followed by Islam with 11.3%, Christianity with 7.4% and other religion with 5.3%. Regarding social background, Other Backward Classes (OBCs) constituted the largest caste group with 40%, followed by Scheduled Castes and Scheduled Tribes forming substantial cohorts with 19.5% each, and General caste comprised 21%.

Notably, majority of the participants (about 73.8%) resided in rural areas and 26.2% in urban areas. Wealth distribution is classified into five economic categories, 20.1% belonged to the poorest quintile, 21.3% to the poorer, 20.8% were in the middle quintile, 19.5% in the richer quintile, and 18.4% were from the richest quintile. While 40.9% participants were employed. Health insurance coverage was available to 36.2% of the participants and 63.8% lacked health insurance. The survey yielded valuable insights into reproductive health. About 49.6% of participants gave birth to more than two children. 23.8% of women reported initiating sexual activity before reaching legal adulthood (18 years) whereas 54.9% of women had sex at first union and 1.8% never had sex yet. Majority of women (about 83.2%) had one sexual partner in last 12 months, 16.2% had zero partner and 0.6% had two partners. A small proportion of women about 4.7% had a history of sexually transmitted infections (STIs) in last 12months, while 22.6% of women had a history of HIV in last 12 months. IUDs were used by 5.8% of participants as the method of contraception, while 15% have used pills.

Table1 Socio-demographic Characteristics of women aged 30-49 years, India, 2019-21

Characteristics	Sample Frequency	Unweighted Proportion
Age Group (in years)		
30-34	101049	27.7
35-39	98068	26.9
40-44	81380	22.3
45-49	84059	23.1
Marital status		
Never Married	7663	02.1
Currently Married	330345	90.6
Formerly Married	26543	07.3
Highest Education		
No education	132584	36.4
Primary	56110	15.4
Secondary	142288	39.0
Higher	33574	09.2
Religion		
Hindu	276745	75.9
Muslim	41361	11.3
Christian	27152	7.40
Other	19298	5.30
Caste		
Schedule caste	67813	19.5
Schedule tribe	67559	19.5
OBC	138994	40.0
General	72911	21.0
Residence		
Urban	95547	26.2
Rural	269009	73.8
Wealth Index		
Poorest	73151	20.1
Poorer	77543	21.3
Middle	75769	20.8
Richer	71194	19.5
Richest	66899	18.4
Occupation		
Employed	22457	40.9
Unemployed	32397	59.1
Coverage of Health Insurance		
No	232532	63.8
Yes	132024	36.2
Parity		
0-2childbirth	183772	50.4
>2childbirths	180784	49.6
Age at first sexual intercourse		
lessthan18	86675	54.9
More than 18	71127	45.1
Number of Sexual Partner		
0	8426	16.2
1	43292	83.2
2	307	0.6
History of STI		
No	52255	95.3
Yes	2599	04.7
History of HIV		
No	42470	77.4
Yes	12384	22.6
Tobacco use		
No	360923	99.0
Yes	3633	01.0
Have used: Pill		
No	303971	85.0
Yes	53825	15.0
Have used: IUD		
No	336982	94.2
Yes	20814	05.8
Total	364556	100

Prevalence of cervical cancer screening

Cervical cancer screening in India is a complex issue, profoundly influenced by a confluence of demographic, socioeconomic, geographical, and reproductive factors. Table 2 represents the prevalence of cervical cancer screening across various selected background characteristics. Women aged 40-44 and 45-49 exhibited higher screening prevalence rate of 1.7% and 1.9%, respectively compared to younger counterparts in the 30-34 and 35-39 age groups with 1.2% and 1.5%, respectively. Never-married women had a significantly lower cervical cancer screening rate (0.8%) compared to currently married (1.6%) and formerly married women (1.7%). Screening rates were higher among women with some level of education: 1.5% for primary, 1.8% for secondary, and 2.1% for higher education, compared to 1.2% among women with no formal education. Christians had significantly higher screening rate with 2.1% compared to Hindus with 1.6% and Muslims with 1%, while women follow other religion reported a rate of 1.9%. Scheduled Caste and OBC (Other Backward Classes) women had screening rates with 1.9% each followed by General category women with 1.3% and Scheduled Tribe women with 1%. Urban women exhibited a higher prevalence of cervical cancer screening with 2.1% than their rural counterparts with 1.4%. In association to wealth, screening rates increased with wealth, from 0.8% in the poorest group to 2% in the richest, while1.3% in poorer, 1.8% in middle and 1.9% in richer group. Employed women had higher screening rates with 1.8% than unemployed women with 1.4%. Women with health insurance coverage had 1.6% screening rates and those without had 1.5%.

Women with at most 2 children had 1.8% screening rates and those with more than 2 children had 1.3%. There was a minimal difference in screening rates between women who had sex before 18 with 1.3% and after 18 with 1.4%. Screening rates of women with no partner, one partner and two partners from the last 12 months are 2%, 1.5% and 1.3%, respectively.

Women with no history of STI and HIV had 1.6% and 1.2% screening rates, respectively while women with history of STI and HIV, had 0.7% and 2.9%, respectively. Tobacco users and non-users had 1.2% and 1.1% screening rates, respectively. Women using pills had a lower screening rate of 0.9% compared to those not using pills with 1.7%. IUD users had a slightly higher rate with 1.8% than non-users with 1.6%.

State-wise prevalence of cervical cancer screening

Figure 1 represents the state-wise prevalence of cervical cancer screening among women aged 30-49 years. A wide disparity in screening rates is evident across states, with Tamil Nadu exhibiting the highest prevalence at 10.3% and West Bengal and Assam reporting the lowest at 0.2%. Among union territories, Andaman & Nicobar Islands recorded the highest prevalence of 5.1%, while Ladakh reported the lowest of 0.3%. Notably, Tamil Nadu, Puducherry, Mizoram, Andhra Pradesh, Kerala, Telangana, and Punjab demonstrated higher screening rates compared to the national average.

Determinants of Cervical Cancer Screening

Three logistic regression model, incorporating socio-demographic factors, risk factors and combination of both are shows in Table3. The initial model, which incorporated socio-demographic factors, yielded the following results. With reference to women aged 30-34, those in the 35-39 age group are 28.1% more likely to be screened, while women aged 40-44 and 45-49 are 50.5% and 51.9% more likely, respectively, to have received cervical cancer screening. Currently married and formerly married women being 104.5% and 80.6% more likely to be screened than never married women, respectively. Education level significantly impacts cervical cancer screening rates.

Table 2 Prevalence of cervical cancer screening among women aged 30-49 years, India, 2019-21

Characteristics	Prevalence (%)	Significance Value
Age Group (in years)		
30-34	1.23	
35-39	1.45	<0.001
40-44	1.75	
45-49	1.92	
Marital status		
Never Married	0.84	<0.001
Currently Married	1.57	
Formerly Married	1.75	
Highest Education		
No education	1.19	
Primary	1.52	<0.001
Secondary	1.81	
Higher	2.07	
Religion		
Hindu	1.59	
Muslim	1.01	<0.001
Christian	2.09	
Other	1.60	
Caste		
Schedule caste	1.91	
Schedule tribe	1.02	<0.001
OBC	1.90	
General	1.33	
Residence		
Urban	2.09	<0.001
Rural	1.38	
Wealth Index		
Poorest	0.82	
Poorer	1.26	
Middle	1.84	<0.001
Richer	1.95	
Richest	2.02	
Occupation		
Employed	1.84	<0.001
Unemployed	1.43	
Coverage of Health Insurance		
No	1.54	0.096
Yes	1.61	
Parity		
0-2childbirth	1.81	<0.001
>2childbirths	1.32	
Age at first sexual intercourse		
lessthan18	1.27	0.005
More than 18	1.43	
Number of Sexual Partner		
0	1.96	
1	1.52	0.012
2	1.33	
History of STI		
No	1.64	<0.001
Yes	0.67	
History of HIV		
No	1.21	<0.001
Yes	2.93	
Tobacco use		
No	1.56	0.959
Yes	1.55	
Have used: Pill		
No	1.70	<0.001
Yes	0.90	
Have used: IUD		
No	1.56	0.002
Yes	1.84	

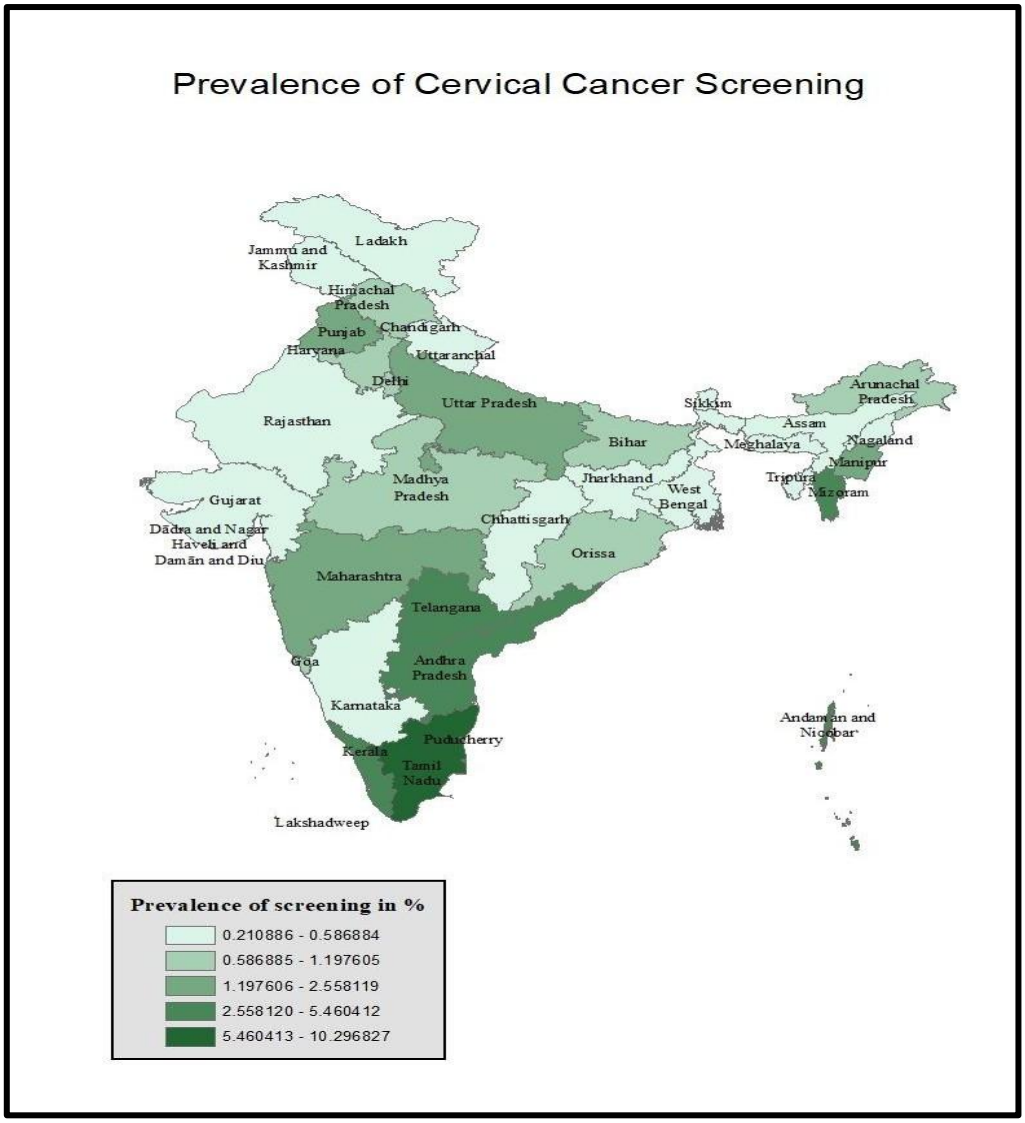


Figure 1 State-wise representation of Prevalence of Cervical Cancer Screening among women aged 30-49 years, India, 2019-21

Women with primary, secondary, and higher education are 15.7%, 30.6%, and 42.4% more likely to be screened, when compared to women with no education, respectively. Women following Christianity other religions are 110.6% and 29.1%, respectively more likely to be screened than Hindu women. Conversely, Muslim women are 25.8% less likely to be screened for cervical cancer compared to Hindu women. Scheduled tribe and general category women are 57.5% and 38.8% less likely to be screened, respectively while women from other backward castes are 4.2% more likely, compared to scheduled caste women. Rural women are 19.8% less likely of being screened compared to urban women. Women in the middle wealth quintile are 118.9% more likely to be screened for cervical cancer, followed by those in the richer, richest, and poorer quintiles, who are 96.2%, 94.1%, and 58.6% more likely, respectively, compared to women in the poorest quintile. Unemployed women being 25.9% less likely to be screened than employed women. Women having health insurance being 6.4% more likely to undergo screening compared to those without coverage.

The second model, incorporating cervical cancer risk factors, produced the following results. Women with more than two children are 8.9% less likely to undergo cervical cancer screening compared to those with at most two children.

Table 3 Binary logistic analysis of socio-demographic characteristics, risk factors of cervical cancer and combination of both, among women aged 30-49 years, India, 2019-21

Independent Variables	Model1		Model2		Model3	
	Odds Ratio (95% CI)	P-Value	Odds Ratio (95% CI)	P-Value	Odds Ratio (95% CI)	P-Value
Age Group (in years)						
30-34®	1.000				1.000	
35-39	1.281 (1.051-1.562)	0.014			1.069 (0.768-1.488)	0.691
40-44	1.505 (1.229-1.843)	<0.001			1.276 (0.91-1.788)	0.158
45-49	1.519 (1.237-1.867)	<0.001			1.18 (0.828-1.680)	0.359
Marital status						
Never Married®	1.000				1.000	
Currently Married	2.045 (1.051-3.981)	0.035			0.899 (0.211-3.825)	0.885
Formerly Married	1.806 (0.889-3.672)	0.102			0.737 (0.165-3.290)	0.689
Highest Education						
No education®	1.000				1.000	0.181
Primary	1.157 (0.929-1.442)	0.192			0.728 (0.495-1.071)	0.107
Secondary	1.306 (1.089-1.565)	0.004			0.814 (0.593-1.117)	0.203
Higher	1.424 (1.078-1.88)	0.013			1.088 (0.661-1.790)	0.74
Religion						
Hindu®	1.000				1.000	
Muslim	0.742 (0.559-0.986)	0.039			0.762 (0.478-1.214)	0.253
Christian	2.206 (1.676-2.905)	<0.001			2.514 (1.619-3.904)	<0.001
Other	1.291 (0.952-1.75)	0.1			1.205 (0.709-2.047)	0.491
Caste						
Schedule caste®	1.000				1.000	
Schedule tribe	0.425 (0.321-0.562)	<0.001			0.650 (0.428-0.989)	0.044
OBC	1.042 (0.872-1.247)	0.65			0.960 (0.695-1.325)	0.805
General	0.612 (0.485-0.772)	<0.001			0.847 (0.573-1.251)	0.404
Residence						
Urban®	1.000				1.000	
Rural	0.802 (0.68-0.946)	0.009			1.023 (0.757-1.383)	0.881
Wealth Index						
Poorest®	1.000				1.000	
Poorer	1.586 (1.203-2.092)	0.001			1.346 (0.904-2.002)	0.143
Middle	2.189 (1.672-2.867)	<0.001			1.488 (0.986-2.247)	0.059
Richer	1.962 (1.473-2.614)	<0.001			1.583 (1.012-2.475)	0.044
Richest	1.941 (1.415-2.662)	<0.001			2.148 (1.305-3.533)	0.003
Occupation						
Employed®	1.000				1.000	
Unemployed	0.741 (0.644-0.854)	<0.001			1.064 (0.833-1.359)	0.621
Coverage of Health Insurance						
No®	1.000				1.000	
Yes	1.064 (0.924-1.226)	0.389			1.119 (0.876-1.429)	0.369

Parity				
0-2childbirth®	1.000		1.000	
>2childbirths	0.911 (0.718-1.156)	0.441	0.983(0.758-1.276)	0.900
Age at first sexual intercourse				
lessthan18®	1.000		1.000	
More than 18	0.849 (0.666-1.082)	0.185	0.784 (0.603-1.021)	0.071
Number of Sexual Partner				
0®	1.000		1.000	
1	0.738 (0.552-0.986)	0.040	0.702 (0.495-0.997)	0.048
2	1.139 (0.352-3.69)	0.828	1.164 (0.352-3.844)	0.803
History of STI				
No®	1.000		1.000	
Yes	0.360 (0.160-0.810)	0.014	0.367 (0.163-0.827)	0.016
History of HIV				
No®	1.000		1.000	
Yes	1.343 (1.033-1.745)	0.027	1.223 (0.927-1.612)	0.154
Smoke Tobacco				
No®	1.000		1.000	
Yes	1.527 (0.673-3.462)	0.311	1.480 (0.638-3.435)	0.361
Have used: Pill				
No®	1.000		1.000	
Yes	0.844 (0.607-1.173)	0.313	0.934 (0.667-1.308)	0.69
Have used: IUD				
No®	1.000		1.000	
Yes	1.351 (0.870-2.100)	0.181	1.236(0.784-1.949)	0.362

®indicates the reference category "CI"indicates to Confidence Interval

Women who initiated sexual activity after age 18 are 15.1% less likely to be screened than those who began before 18. Women with one partner are 26.2% less likely to be screened compared to those with no partners. Conversely, women with two partners are 13.9% more likely to be screened. Women with a history of STIs are 64% less likely to undergo cervical cancer screening compared to those without a history. Women with history of HIV are 34.3% more likely to be screened compared to those without history of HIV. Women who consume tobacco are 52.7% more likely to be screened than non-smokers. Women who have used the pill are 15.6% less likely to be screened compared to non-users. However, women who have used IUDs are 35.1% more likely to be screened.

The third model, which considered a combination of socio-demographic characteristics and cervical cancer risk factors, produced the following outcomes. Women aged 35-39, 40-44, and 45-49 are 6.9%, 27.6%, and 18% more likely to be screened than those aged 30-34 years, respectively. Currently married and formerly married women are 10.1% and 26.3% less likely to be screened than never married women, respectively. Women with higher education are 88% more likely to be screened compared to those with no education.

Conversely, women with primary and secondary education are 27.2% and 18.6% less likely to be screened, respectively. Women following Christian and other religions are 151.4% and 20.5%, respectively more likely, while Muslim women are 23.8% less likely to be screened compared to Hindu women. Scheduled tribe, OBC, and general category women are less likely to be screened compared to scheduled caste women, with disparities of 35%,4%, and 15.3%, respectively. Rural women are 2.3% more likely to be screened compared to urban women.

Women in the richest wealth quintile are 114.8% more likely to be screened, followed by richer, middle, and poorer quintiles with increment of 58.3%, 48.8%, and 34.6%, respectively, compared to the poorest quintile. Unemployed women are slightly more likely (6.4%) to be screened compared to employed women. Women with health insurance are 11.9% more likely to undergo screening compared to those without coverage. Having more than two children has a negligible impact on cervical cancer screening rates, with a decrease of only 1.7% compared to women with at most two children. Women who initiated sexual activity after age 18 are 21.6% less likely to undergo screening compared to those who beganbefore18. Women with one partner are 29.8% less likely to be screened compared to those with no partners, while women with two partners are 16.4% more likely. Women with a history of STIs are 63.3% less likely to undergo cervical cancer screening compared to those without a history. Women with history of HIV are 22.3% more likely to be screened compared to those without history of HIV. Women who consume tobacco are 48% more likely to be screened than non-smokers. Women who have used the pill are 6.6% less likely to be screened compared to non-users. However, women who have used IUDs are 23.6% more likely to be screened.

Discussion

Cervical cancer remains a significant global health concern, particularly in developing countries like India. Effective prevention and early detection through screening are crucial for reducing morbidity and mortality. This study examines the prevalence of cervical cancer screening across India and identify associated risk factors. It examines disparities in screening rates based on demographic factors such as age, socioeconomic status, geographic location, and educational attainment. Additionally, the study explores the relationship between cervical cancer and potential risk factors including parity, sexual behaviour, sexually transmitted infections, tobacco use, and contraceptive methods. The findings of this study indicate that only 1.6% of women aged 30-49 years had undergone cervical cancer screening. An independent study conducted in July 2019 among women aged 25–65 years in a South Indian community revealed that 14.3% women had examined their pelvic in their lifetime while only 7.1% had undergone cervical cancer screening at least once in their lifetime. (International Institute for Population Sciences [IIPS], 2021)

In this study, a notable trend emerged from the study as cervical cancer screening rates increased with age. As women get older, they are more likely to undergo cervical cancer screening. Unmarried women were less likely to get screened than ever married women. Christian women were more likely to undergo cervical cancer screening compared to Hindu and Muslim women. Cervical cancer screening rates were notably higher among Scheduled Caste and OBC compared to General category and Scheduled Tribe women. Similar results were found in the study which was conducted using data from NFHS-5; older, married, Christian women from Scheduled Caste and OBC backgrounds were more likely to undergo screening.

Education level significantly impacts cervical cancer screening rates. Women with higher levels of education are more likely to undergo screening. Wealth is a significant predictor of cervical cancer screening. Women from wealthier households are more likely to undergo screening compared to those from poorer households. Geographic disparities significantly influence cervical cancer screening rates. Women in cities are more likely to get screened than women in villages. Employment status is significantly associated with cervical cancer screening rates. This study indicates that employed women are more likely to undergo screening compared to their unemployed counterparts. Health insurance coverage exhibited a minimal impact on cervical cancer screening rates, with a negligible difference of 0.1% between insured and uninsured women. These finding align with similar trends observed in the similar study based on NFHS-4 data. (Khieu and Butler.,2022)

Socio-demographic characteristics, including age, marital status, educational attainment, religion, caste, residential status and economic status are significantly associated with cervical cancer screening rates. Additionally, reproductive factors such as parity, early sexual activity, HIV status and consumption of pill and IUD impact cervical cancer screening uptake. Geographic location also plays a crucial role, with states like Tamil Nadu demonstrating higher screening rates compared to those of West Bengal and Assam.

Conclusion

The stark disparities in cervical cancer screening rates across India underscore a critical public health challenge. While factors such as age, education, and socioeconomic status, risk factors such as parity, tobacco use, early sexual activity, and history of HIV significantly influence cervical cancer screening uptake, the underlying issue is a complex interplay of systemic, societal, and individual factors. To effectively address this problem, a multi-faceted approach is imperative. Investing in robust healthcare infrastructure, particularly in rural areas, is essential to ensure equitable access to screening services. Parallel to this, targeted awareness campaigns must be launched to dispel myths, reduce stigma, and empower women to prioritize their health. Furthermore, integrating cervical cancer screening into routine maternal and child health services can optimize resource utilization and improve coverage. Addressing the root causes of health inequities, such as poverty, illiteracy, and gender discrimination, is equally crucial. Empowering women through education, economic opportunities, and decision-making autonomy can significantly enhance their ability to access and utilize healthcare services.

References

Bray, F., Laversanne, M., Sung, H., Ferlay, J., Siegel, R. L., Soerjomataram, I., & Jemal, A. (2024). Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: a cancer journal for clinicians*, *74*(3), 229-263. https://gco.iarc.who.int/media/globocan/factsheets/cancers/23-cervix-uteri-fact-sheet.pdf

Ferlay, J., Colombet, M., Soerjomataram, I., Parkin, D. M., Piñeros, M., Znaor, A., & Bray, F. (2021). Cancer statistics for the year 2020: An overview. International journal of cancer, 149(4), 778-789. https://gco.iarc.who.int/media/globocan/factsheets/populations/356-india-fact-sheet.pdf

Mathur, P., Sathishkumar, K., Chaturvedi, M., Das, P., Sudarshan, K. L., Santhappan, S., ... &Icmr-Ncdir-Ncrp Investigator Group. (2020). Cancer statistics, 2020: report from national cancer registry programme, India. *JCO global oncology*, *6*, 1063-1075..https://pubmed.ncbi.nlm.nih.gov/32673076/

International Agency for Research on Cancer. (2024). *Cancer Tomorrow*. Global Cancer Observatory. https://gco.iarc.fr/tomorrow

Sreedevi, A., Javed, R., & Dinesh, A. (2015). Epidemiology of cervical cancer with special focus on India. *International journal of women's health*, 405-414..https://pubmed.ncbi.nlm.nih.gov/25931830/

Walboomers, J. M., Jacobs, M. V., Manos, M. M., Bosch, F. X., Kummer, J. A., Shah, K. V., ... & Muñoz, N. (1999). Human papillomavirus is a necessary cause of invasive cervical cancer worldwide. *The Journal of pathology*, *189*(1), 12-19. https://pubmed.ncbi.nlm.nih.gov/10451482/

De Martel, C., Plummer, M., Vignat, J., & Franceschi, S. (2017). Worldwide burden of cancer attributable to HPV by site, country and HPV type. *International journal of cancer*, *141*(4), 664-670. http://onlinelibrary.wiley.com/doi/10.1002/ijc.30716/full

Koutsky, L. (1997). Epidemiology of genital human papillomavirus infection. *The American journal of medicine*, *102*(5), 3-8..https://pubmed.ncbi.nlm.nih.gov/9217656/

World Health Organization. (2024, March 5). Cervical cancer. WHO. Retrieved from https://www.who.int/news-room/fact-sheets/detail/cervical-cancer

Miller, A. B. (1992). Cervical cancer screening programmes: managerial guidelines. https://apps.who.int/iris/handle/10665/39478.

Khieu, M., & Butler, S. L. (2022). High grade squamous intraepithelial lesion. *Tampla, FL: StatPearlsPublishing*..https://pubmed.ncbi.nlm.nih.gov/28613479/

Muthuramalingam, M. R., &Muraleedharan, V. R. (2023). Patterns in the prevalence and wealth-based inequality of cervical cancer screening in India. *BMC Women's Health*, *23*(1), 337. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10291770/

Giannini, A., Di Donato, V., Sopracordevole, F., Ciavattini, A., Ghelardi, A., Vizza, E., ... & Bogani, G. (2023). Outcomes of high-grade cervical dysplasia with positive margins and HPV persistence after cervical conization. *Vaccines*, *11*(3), 698. https://pubmed.ncbi.nlm.nih.gov/36992282/

Di Donato, V., Bogani, G., Casarin, J., Ghezzi, F., Malzoni, M., Falcone, F., ... & Giannini, A. (2023). Ten-year outcomes following laparoscopic and open abdominal radical hysterectomy for "low-risk" early-stage cervical cancer: a propensity-score based analysis. *Gynecologic Oncology*, *174*, 49-54. https://pubmed.ncbi.nlm.nih.gov/37149905/

Krishnamoorthy, Y., Ganesh, K., & Sakthivel, M. (2022). Prevalence and determinants of breast and cervical cancer screening among women aged between 30 and 49 years in India: Secondary data analysis of National Family Health Survey–4. *Indian Journal of Cancer*, *59*(1), 54-64. https://journals.lww.com/indianjcancer/fulltext/2022/59010/prevalence_and_determinants_of_breast_and_cervical.9.aspx

Bobdey, S., Sathwara, J., Jain, A., & Balasubramaniam, G. (2016). Burden of cervical cancer and role of screening in India. *Indian journal of medical and paediatric oncology*, *37*(04), 278-285. https://pubmed.ncbi.nlm.nih.gov/28144096/

Reichheld, A., Mukherjee, P. K., Rahman, S. M., David, K. V., & Pricilla, R. A. (2020). Prevalence of cervical cancer screening and awareness among women in an urban community in South India—a cross sectional study. *Annals of global health*, *86*(1), 30. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10291770/#CR20

International Institute for Population Sciences (IIPS). (2021). *National Family Health Survey (NFHS-5), India report (2019–21)*. https://rchiips.org/nfhs/NFHS-5Reports/NFHS-5_INDIA_REPORT.pdf

International Institute for Population Sciences (IIPS), & ICF. (2021). *National Family Health Survey (NFHS-5), 2019–21: India*. Mumbai: IIPS.

Kashyap, V. H., &Shivaswamy, M. S. (2019). Assessment of implementation of the national programme for the prevention and control of cancer, diabetes, cardiovascular diseases, and stroke at subcenters of Belagavi taluka: A cross-sectional study. *Indian Journal of Health Sciences and Biomedical Research kleu*, *12*(1), 21-27.