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Prevalence, Incidence and Mortality Rates of Cervical Cancer in India: based on Global Burden

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ABSTRACT

Background: According to the latest GLOBOCAN statistics, cervical cancer ranks as the fourth most common cancer in terms of incidence and mortality among women worldwide, following only breast cancer, colorectal cancer, and lung cancer. In low-income countries, cervical cancer is the second most common fatal malignant tumor . Evidently, cervical cancer causes a substantial burden on women's public health globally. Cervical cancer incidence and mortality rates in the United States have substantially declined over recent decades, primarily driven by reductions in squamous cell carcinoma cases. However, the trend in recent years remains unclear.

This study was aimed to explore the trends in cervical cancer incidence, prevalence and mortality, stratified by demographic, particularly age- related incidence, death rates, rural and urban population, screening programme and tumor characteristics from 2000 to 2030 in India, in Global context.

Among the selected countries, India exhibited the lowest incidence and mortality rates for all-cause cancer among women, with rates of 100.83 and 62.61 per 100,000 person-years, respectively. However, the ASIR and ASMR of cervical cancer were the second highest in India (17.71 and 11.15 per 100,000 person-years) after South Africa (33.18 and 19.03 per 100,000 person-years). The incidence rates in India are below the global median for all cancers (157.66), breast cancer (46.21), and corpus uteri cancer (7.03), but they are above the global median for cervix uteri cancer (14.10). A similar trend was observed concerning cancer-related mortality rates among Indian women. Nearly 54% of cancer incidence and 50% of cancer mortality among women in India are attributed to these six female-specific cancers.

Conclusions: India contributed significantly to the global burden of female-specific cancers, the ASIR and ASMR for these cancers were lower than those in many other countries. It was essential to study how sociodemographic transitions influenced the patterns of female-specific cervical cancer in high, low, and middle-income countries to inform the implementation of effective cancer control strategies by health systems in India as compared to other countries.

Keywords: *Incidence, mortality, Global Burden, Cervical Cancer, India.*

1. INTRODUCTION

Cervical cancer ranks as the fourth most common cancer among women worldwide. However, its impact was disproportionately severe in developing countries such as India. In these regions, the burden of the disease was notably high, which highlighted a critical need for effective public health interventions to improve healthcare systems [1-4].In 2023, the global incidence of cervical cancer, which predominantly affects women, was estimated at 661,044 new cases, resulting in 348,186 reported deaths [5,6].Cervical cancer leads as the most frequently occurring cancer in 23 out of 185 countries and the second most common in 67 countries. In terms of cancer-related deaths, cervical cancer tops the list as the primary cause in 36 countries and was the second most common cause of cancer-related deaths in 49 countries [3-8]. Nearly 90% of these fatalities occurred in low and middle-income countries (LMICs), with higher incidence and mortality rates observed in sub-Saharan Africa, Central America, and Southeast Asia [4,9].Cervical cancer remains a significant public health problem in the United States, (US) with a higher incidence than other gynecologic cancers globally. Despite advancements in screening and diagnostic modalities, the incidence of cervical cancer remains substantial in the US, with approximately 13,800 new cases and 4290 fatalities reported in 2020[5-10]. Even with progress in promoting cervical cancer screening and vaccination, the worldwide rates of incidence and mortality for cervical cancer are still unacceptably high[6]. This is particularly common in developing countries and regions with limited resources, where cervical cancer remains a major cause of cancer-related deaths among women[11-14]. Recent estimates for 2023 show that annually 669847 new cervical cancer cases were diagnosed worldwide. However, these rates are quite higher among Indian women in comparison to global estimates. In India, the age-standardized incidence rate is 14.7 per 100,000 women, and the age-standardized mortality rate is 9.2 per 100,000 women [3,15].Current data indicated that the cervical cancer was the second most common cancer among females in India [16-21]. Low age at marriage, early age at first intercourse, higher parity raises the risk of HPV acquisition among Indian women [6,22-25]. Although the burden of cervical cancer is decreasing slowly in the India, deaths can also be prevented if it is screened at early stages [7, 26-28]. Cervical cancer mostly affects women from rural areas with poor socioeconomic status [8,29-31]. Poor screening is associated with poverty. Lack of screening and treatment has been identified as a factor leading to the development of invasive cancer, which leads to death [9, 10,32-36]. Although the improvement in the living standard and awareness among women has resulted in a decline in the incidence of cervical cancer in India, the situation is alarming in the rural settings where the majorities of women are illiterate and have poor hygienic conditions [37-41]. Additionally, access to medical facilities and poor socioeconomic status contribute to the spread of carcinoma cervix in rural areas. As India is on the way to universalizing the national level screening programme of cervical cancer, it is crucial to investigate the areas vulnerable to poor screening and trends and patterns in its prevalence. Screening and associated social determinants are vital to understanding the need for intervention in a heterogeneous population like India. There has been substantial progress in primary prevention strategies, and it certainly affected incidence and mortality due to cervical cancer 42-49]. However, screening for precancerous and cancerous cervical lesions among women over 30 years will be critical in developing countries like India to ensure that women receive appropriate diagnostic and treatment services [50-55].

Figure-1: Incidence of cervical cancer from 1990 to 2019 per 100,000 women in India.

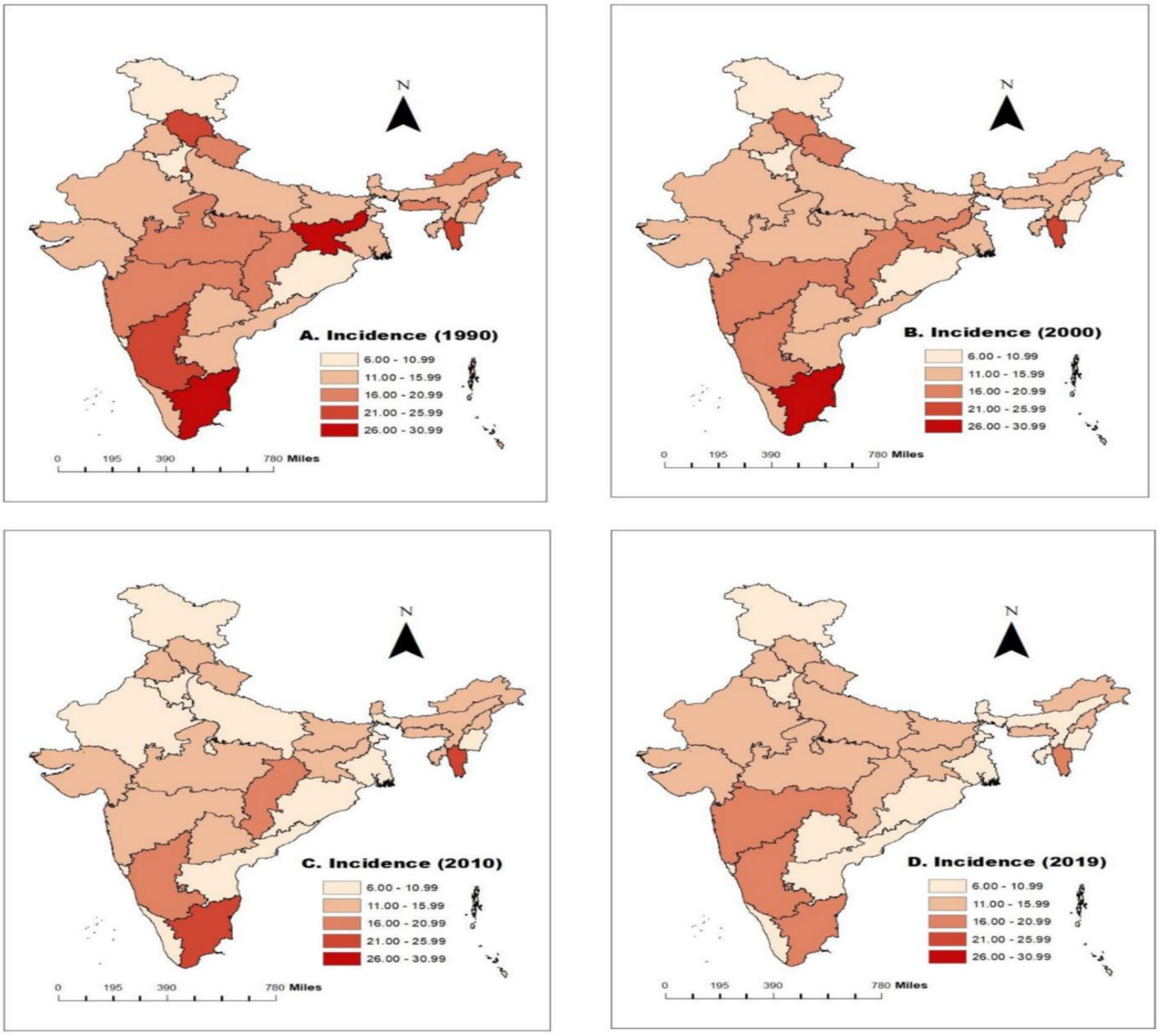


Figure-1, illustrating the A) Incidence of cervical cancer per 100,000 women in 1990. B) Incidence of cervical cancer per 100,000 women in 2000. C) Incidence of cervical cancer per 100,000 women in 2010. D) Incidence of cervical cancer per 100,000 women in 2019

Figure-2: Mortality of cervical cancer from 1990 to 2019 per 100,000 women in India.

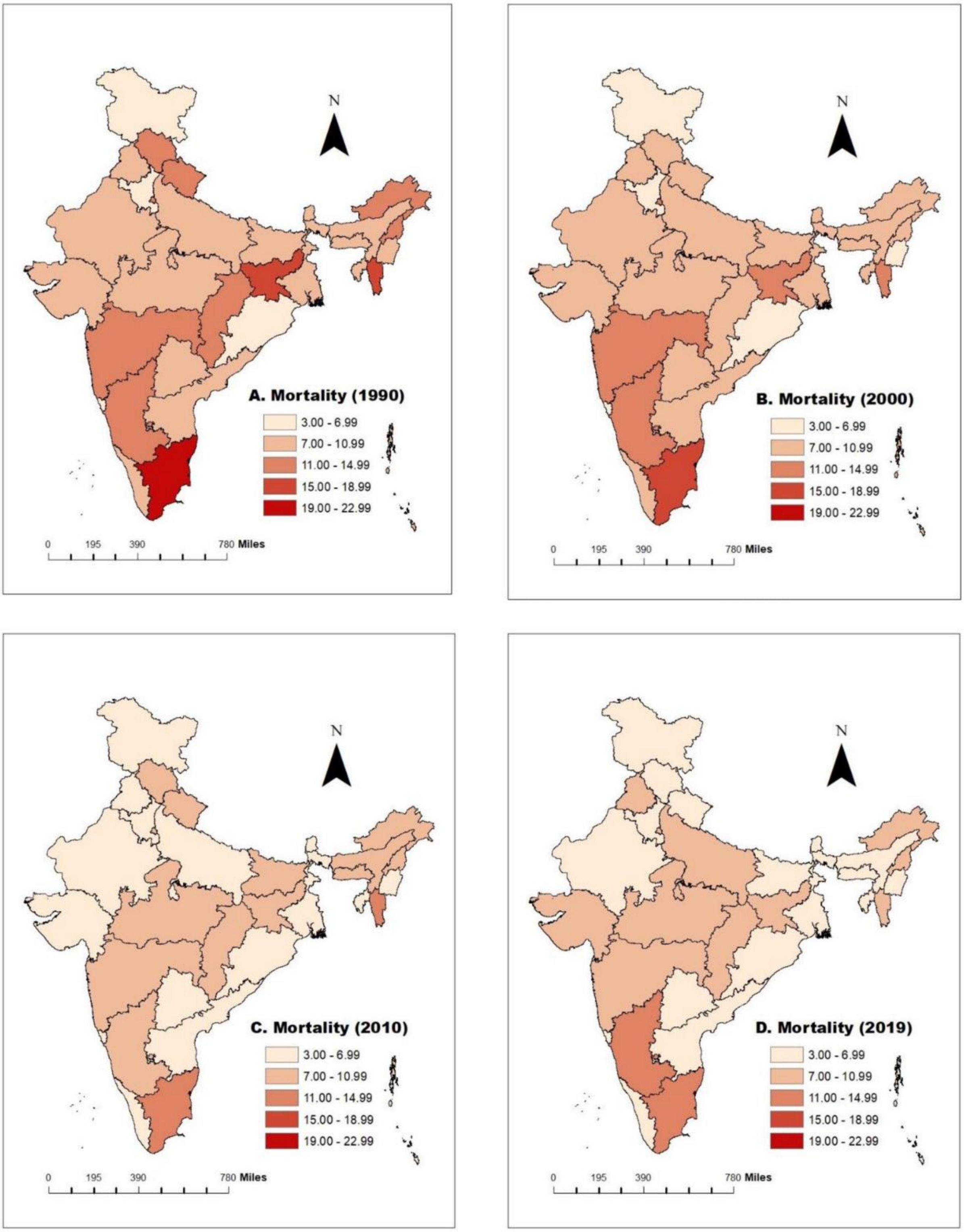


Figure-2, illustrating the A) Mortality of cervical cancer per 100,000 women in 1990. B) Mortality of cervical cancer per 100,000 women in 2000. C) Mortality of cervical cancer per 100,000 women in 2010. D) Mortality of cervical cancer per 100,000 women in 2019

Table-1: Age-standardized incidence and death rates of cervical cancer for India and its states in 2019 and their Average Annual Percentage Change (AAPC) from 1990 to 2019

State	Incidence		Death	
	Rates in 2019, 95% UI (per 100 000 females)	AAPC, 95% CI (%, 1990-2019)	Rates in 2019, 95% UI (per 100 000 females)	AAPC, 95% CI (%, 1990-2019)
India	13.10 (10.18,17.09)	-0.82* (-1.39, -0.25)	7.38 (5.71,10.13)	-1.35* (-1.96, -0.75)
Andhra Pradesh	9.81 (6.34,16.96)	-1.26* (-1.42, -1.09)	5.34 (3.50,9.67)	-1.75* (-1.88, -1.61)
Arunachal Pradesh	14.01 (9.20,20.68)	-1.05* (-1.16, -0.93)	7.99 (5.52,10.95)	-1.51* (-1.63, -1.39)
Assam	10.68 (7.49,19.26)	-0.50 (-1.23, 0.24)	6.39 (4.63,12.52)	-1.19* (-1.73, -0.64)
Bihar	11.46 (7.79,18.89)	-0.49* (-0.55, -0.43)	6.55 (4.49,11.13)	-1.01* (-1.12, -0.89)
Chhattisgarh	14.81 (10.36,20.30)	-0.92* (-1.43, -0.41)	8.71 (6.30,12.97)	-1.14* (-1.64, -0.64)
Delhi	11.87 (8.50,15.78)	-2.07* (-2.51, -1.62)	7.11 (4.81,9.26)	-2.63* (-3.42, -1.82)
Goa	7.02 (4.55,11.46)	-1.31* (-1.67, -0.96)	3.58 (2.35,6.27)	-1.99* (-2.05, -1.93)
Gujarat	13.26 (9.31,18.80)	-0.53 (-1.47, 0.42)	7.12 (5.04,10.56)	-1.29* (-2.10, -0.47)
Haryana	7.85 (5.20,15.03)	-0.62 (-1.65, 0.42)	4.32 (2.85,9.54)	-1.07 (-2.21, 0.10)
Himachal Pradesh	11.66 (8.05,16.25)	-2.30* (-2.82, -1.77)	6.49 (4.70,8.81)	-2.59* (-3.33, -1.85)
Jammu & Kashmir and Ladakh	6.13 (3.95,15.71)	-0.62* (-0.76, -0.48)	3.39 (2.21,8.78)	-1.06* (-1.17, -0.94)
Jharkhand	13.18 (9.84,18.37)	-2.21* (-2.57, -1.85)	7.87 (5.84,10.94)	-2.74* (-3.06, -2.42)
Karnataka	19.83 (11.86,27.51)	-0.31 (-1.00, 0.39)	11.14 (6.67,15.10)	-0.77 (-1.61, 0.07)
Kerala	9.35 (6.57,12.92)	-1.07 (-2.21, 0.08)	4.77 (3.29,6.49)	-1.88* (-2.41, -1.34)
Madhya Pradesh	13.41 (9.77,17.92)	-0.64* (-0.85, -0.44)	7.88 (5.85,10.47)	-1.05* (-1.25, -0.86)
Maharashtra	16.75 (11.08,22.65)	-0.41 (-0.94, 0.13)	9.26 (6.22,12.29)	-1.04* (-1.59, -0.49)
Manipur	9.25 (5.90,14.93)	-0.87* (-1.13, -0.61)	5.59 (3.78,8.86)	-1.10* (-1.68, -0.51)
Meghalaya	11.40 (7.59,16.99)	-1.14* (-1.56, -0.71)	6.84 (4.86,9.84)	-1.42* (-1.61, -1.24)
Mizoram	18.99 (9.50,29.21)	-0.72* (-1.26, -0.18)	10.90 (5.64,16.15)	-1.11* (-1.72, -0.50)
Nagaland	12.95 (7.59,19.42)	-1.23* (-1.36, -1.10)	7.57 (4.81,10.93)	-1.55* (-1.67, -1.42)
Odisha	7.10 (4.42,17.34)	-1.32* (-1.96, -0.67)	4.22 (2.64,10.63)	-1.66* (-1.88, -1.44)
Other Union Territories	9.50 (6.34,14.04)	-1.44* (-1.74, -1.14)	5.14 (3.56,7.72)	-1.85* (-2.01, -1.68)
Punjab	13.00 (9.65,17.82)	-0.43* (-0.83, -0.02)	7.14 (5.10,9.72)	-0.95* (-1.46, -0.44)
Rajasthan	11.77 (8.32,17.92)	0.05 (-0.71, 0.82)	6.26 (4.25,10.45)	-0.65 (-1.53, 0.25)
Sikkim	9.72 (6.61,14.78)	-1.35* (-1.78, -0.93)	5.47 (3.90,7.88)	-1.85* (-2.05, -1.65)
Tamil Nadu	19.91 (11.27,26.83)	-1.49* (-1.94, -1.04)	11.57 (6.31,15.59)	-1.98* (-2.29, -1.67)
Telangana	9.76 (6.03,16.26)	-1.47* (-1.52, -1.41)	5.07 (3.23,9.03)	-2.08* (-2.18, -1.98)
Tripura	10.64 (7.00,15.99)	-1.36* (-1.51, -1.21)	6.25 (4.36,9.15)	-1.70* (-1.82, -1.57)
Uttar Pradesh	13.48 (9.21,21.21)	-0.26 (-0.74, 0.22)	7.79 (5.43,13.89)	-0.72* (-1.15, -0.30)
Uttarakhand	12.32 (8.80,19.28)	-1.22* (-1.33, -1.11)	6.83 (4.94,11.45)	-1.74* (-1.83, -1.66)
West Bengal	9.67 (7.06,13.94)	-1.11* (-1.87, -0.35)	5.24 (3.89,7.89)	-1.83* (-3.02, -0.62)

Table-1, illustrated that the Age-standardized rates and AAPC of Cervical Cancer incidence and Death in India and its states in 1990 - 2019. The age-standardized incidence and death rates of cervical cancer in India is found to be 13.10 (95% UI 10.18,17.09) and 7.38 (95% UI 5.71,10.13) per 100,000 females, respectively. For Incidence, all of the states have shown a significant declining trend except Gujarat (AAPC: −0.53; 95%CI: −1.47 to 0.42; $p > 0.05$), Assam (AAPC: −0.50; 95%CI: −1.23 to 0.24; $p > 0.05$) , Haryana (AAPC: −0.62; 95%CI: −1.65 to 0.42; $p > 0.05$), Karnataka (AAPC: − (AAPC: 0.31; 95%CI: −0.41; 95%CI: -0.94 to 0.13; −1.00 to 0.39; $p > 0.05$) , Maharashtra $p > 0.05$) , Uttar Pradesh (AAPC: −0.26; 95%CI: −0.74 to 0.22; $p > 0.05$) and Kerala (AAPC: −1.07; 95%CI: −2.21 to 0.08; $p > 0.05$) where non-significant declining trend was observed and Rajasthan (AAPC: 0.05; 95%CI: −0.71 to 0.82; $p > 0.05$) where non-significant increasing trend is observed . All of the states have shown a significant declining trend in mortality except Haryana (AAPC: −1.07; 95%CI: −2.21 to 0.10; $p > 0.05$), Karnataka (AAPC: −0.77; 95%CI: −1.61 to 0.07; $p > 0.05$) and Rajasthan (AAPC: −0.65; 95%CI: −1.53 to 0.25; $p > 0.05$), where non-significant declining trend is observed.

The above mentioned data and figures are primarily showing the incidence and death rates of cervical cancer in India, which developed the author's interest to assess trends in incidence and mortality of cervical cancer in India and its states over the past three decades and up-to 2030, to track the progress of strategies, screening programme and Government policies for preventing and controlling cervical cancer as compared to other developed and developing countries and its states.

Hence, this study was aimed to determine the extent of the cervical cancer burden across different states in India, with a specific focus on estimating the years of life lost (YLLs), years lived with disability (YLDs), and disability-adjusted life years (DALYs). Additionally, this review was also aimed to project this burden for the year 2025-2030 to provide a more comprehensive understanding of the current and future impact of cervical cancer on the rural and urban population as compare to other countries. Published data from different articles/ sources were presented in this review.

Back ground:

2. INCIDENCE OF CERVICAL CANCER IN USA

Table-2: Annual Percentage Change in Incidence of cervical cancer, 2000–2019 In US.[Y.-y. Ou et al.Clinical Epidemiology and Global Health. 2025; 33: 102002].[7]

	Trend 1		Trend 2		Trend 3	
	Years	APC (95 %CI)	Years	APC (95 %CI)	Years	APC (95 %CI)
Overall	2000–2003	−4.1a(-6.4 to −1.6)	2003–2013	−1.4[a](-1.9 to −0.9)	2013–2019	0.3(-0.7 to 1.4)
Age						
20-24	2000–2002	−8.0(-27.5 to 16.8)	2002–2012	−1.6(-4.1 to 0.9)	2012–2019	−14.5[a](-20.3to 8.3)
25-29	2000–2002	−14.9(-33.8 to 9.5)	2002–2019	−1.3[a](-2.5 to −0.1)		
30-34	2000–2013	−2.1[a](-2.9 to −1.2)	2013–2019	4.3[a](1.5–7.3)		
35-39	2000–2019	−0.4[a](-0.9 to 0.2)				
40-44	2000–2005	−2.4[a](-1.4 to −0.3)	2005–2013	−0.4(-1.8 to 1.1)	2013–2019	0.4(-1.4 to 2.3)
45-49	2000–2019	−0.8[a](-1.4 to −0.3)				
50-54	2000–2006	−3.1[a](-5.8 to −0.3)	2006–2019	−0.6(-1.5 to 0.2)		
55-59	2000–2006	−4.8[a](-6.8 to −2.7)	2006–2019	−0.3(-0.9 to 0.3)		
60-64	2000–2004	−5.8(-12.4 to 1.2)	2004–2017	−1.5[a](-2.7 to −0.3)	2017–2019	−3.6(-21.2 to 17.8)
65-69	2000–2019	−3.4[a](-4.3 to 2.5)	2004–2017	−0.3(-15.0 to 16.9)	2017–2019	−7.1(-22.2 to 11.1)
70-74	2000–2009	−1.1(-3.1 to 0.8)	2009–2019	−3.7[a](-5.3 to −2.1)		
75-79	2000–2009	−3.9[a](-6.5 to −1.2)	2009–2019	−0.3(-2.7 to 2.1)		
80-84	2000–2002	−15.5(-37.6to14.4)	2002–2014	−2.6[a](-4.7 to-0.4)	2014–2019	−0.9(-8.0 to 6.8)
Race						
White	2000–2004	−3.8[a](-6.6 to −1.1)	2004–2019	−0.5[a](-0.9 to −0.1)		
Black	2000–2006	−3.9[a](-6.7 to −1.1)	2006–2015	−2.5[a](-4.2 to-0.8)	2015–2019	0.9(-4.9 to 7.1)
American Indian/AK Native	2000–2012	−0.8(-3.8 to 2.1)	2012–2015	9.5(-28.8 to 68.4)	2015–2019	−14.9[a](-26.5 to −1.7)
Asian/Pacific Islander	2000–2011	−3.1[a](-4.3 to −1.9)	2011–2019	−0.3(-1.9 to 1.4)		
Seer stage						
Localized	2004–2007	−0.1(-5.9 to 6.1)	2007–2019	−1.5[a](-3.7 to −2.4)		
Regional	2004–2013	−2.4[a](-3.5 to −1.2)	2013–2019	1.9(-0.3 to 4.2)		
Distant	2004–2015	2.5[a](1.4–3.7)	2015–2019	−3.8(-8.6 to 1.1)		
Tumor size						
≤4 cm	2004–2015	−1.7[a](-2.5 to −0.8)	2015–2019	−56[a](-74.5to-26.4)		
>4 cm	2004–2006	23.4(-13.2 to75.4)	2006–2019	0.6(-0.7 to1.9)		

APC: annual percent change; CI: confidence interval. a The value is statistically different from zero (2-sided P < 0.05) based on joinpoint regression analysis.

Table-2, illustrating the Changes (APCs) at different stages of cervical cancer, revealed the significant variations among the three stages. A notable trend of decreasing incidence of localized cervical cancer was observed from 2007, with an annual percentage change (APC) of − 1.5 % (95 % CI = − 3.7 to − 2.4 %). In contrast, the incidence of distal cervical cancer exhibited fluctuations post-2015, with an APC of − 3.8 % (95 % CI = − 8.6 %–1.1 %). Conversely, regional cervical cancer incidence demonstrated a declining trend from 2004 to 2013, followed by an increase after 2013, with an APC of 1.9 % (95 % CI = − 0.3 %–4.2 %). The investigation of the correlation between tumor size and cervical cancer incidence was conducted, as outlined in Table 1 and Fig. 1E. A notable decrease in cervical cancer occurrence in 2015 was observed in tumor measuring less than 4 cm, as evidenced by the blue curve (APC = − 56 %, 95 % CI = − 74.5 % to − 26.4 %).

Table-3: Age-cycle-cohort modelling of cervical cancer incidence, 2000–2019 in US [56].

				95 % confidence interval		
Characteristic	Coefficient	SE	Z-value	P-value	lower	upper
Age						
20-24	−2.072	0.724	−2.860	0.004	−3.491	−0.654
25-29	−0.581	0.347	−1.670	0.094	−1.262	0.099
30-34	0.165	0.268	0.610	0.540	−0.361	0.690
35-39	0.448	0.251	1.780	0.075	−0.045	0.940
40-44	0.557	0.250	2.230	0.026	0.067	1.046
45-49	0.493	0.258	1.910	0.056	−0.013	0.998
50-54	0.426	0.264	1.610	0.107	−0.092	0.944
55-59	0.360	0.264	1.360	0.173	−0.158	0.877
60-64	0.291	0.257	1.130	0.257	−0.212	0.794

65-69	0.231	0.244	0.950	0.344	−0.248	0.709
70-74	0.107	0.236	0.450	0.651	−0.356	0.570
75-79	−0.029	0.238	−0.120	0.904	−0.495	0.438
80-84	−0.121	0.251	−0.480	0.629	−0.612	0.370
85-89	−0.272	0.305	−0.890	0.373	−0.870	0.327
Period						
2000–2004	0.091	0.104	0.870	0.382	−0.113	0.294
2005–2009	0.009	0.105	0.080	0.933	−0.197	0.214
2010–2014	−0.062	0.109	−0.570	0.571	−0.274	0.151
2015–2019	−0.038	0.110	−0.350	0.729	−0.253	0.177
Cohort						
1915–1919	0.479	0.478	1.000	0.317	−0.458	1.415
1920–1924	0.438	0.345	1.270	0.204	−0.238	1.113
1925–1929	0.301	0.295	1.020	0.308	−0.278	0.880
1930–1934	0.191	0.266	0.720	0.472	−0.330	0.713
1935–1939	0.188	0.268	0.700	0.483	−0.337	0.713
1940–1944	0.111	0.282	0.390	0.695	−0.442	0.663
1945–1949	−0.014	0.298	−0.050	0.963	−0.599	0.571
1950–1954	−0.087	0.309	−0.280	0.779	−0.692	0.518
1955–1959	−0.094	0.311	−0.300	0.762	−0.704	0.515
1960–1964	−0.106	0.308	−0.340	0.732	−0.709	0.498
1965–1969	−0.114	0.304	−0.370	0.708	−0.710	0.483
1970–1974	−0.042	0.298	−0.140	0.888	−0.626	0.542
1975–1979	−0.057	0.305	−0.190	0.852	−0.656	0.541
1980–1984	−0.054	0.331	−0.160	0.870	−0.702	0.594
1985–1989	−0.009	0.400	−0.020	0.982	−0.792	0.775
1990–1994	−0.189	0.636	−0.300	0.766	−1.436	1.057
1995–1999	−0.942	2.210	−0.430	0.670	−5.273	3.389
Cons	1.443					
AIC	4.497					
BIC	−96.426					

AIC= Information Criterion, BIC= Bayesian Information Criterion.

Table-3, indicated that, individuals aged 20–24 and 25–29 have the lowest risk of developing cervical cancer compared to other age groups. As age increases, the likelihood of developing cervical cancer also increases. The highest risk is seen in the 40–44 age group, with a gradual decrease in incidence after the age of 45. Specifically, the incidence of cervical cancer decreases by approximately 2.07 % per year for individuals aged 20–24, while those in the 40–44 and 45–49 age groups see a reduction of 0.56 % and 0.49 % per year, respectively. The peak risk period was identified as occurring between 2000 and 2004, characterized by a cycle effect. Subsequently, the strength of the cycle effect gradually diminished from 2004 to 2019; however, no statistically significant findings were observed, suggesting that the cycle effect was not significant over the past two decades. This suggests that there was no significant cycle effect present in the last two decades. The examination of cohort effects indicated a negative impact across all birth cohorts, with the exception of those born between 1915- 1919 and 1920–1924. This finding implies a decreasing trend in cervical cancer incidence among individuals born in these years, with a reduced risk observed in later birth cohorts. The model shows a strong fit, supported by the negative values of both the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). The prevalence of cervical cancer in the US has shown a fluctuating pattern over the last two decades, with significant differences noted among various age brackets [56-61].

Table-4: Estimated number of new cancer cases and deaths by sex, United States, 2025 [56, 62].

	Estimated new cases			Estimated deaths		
	Both sexes	Male	Female	Both sexes	Male	Female
All sites	2,041,910	1,053,250	988,660	618,120	323,900	294,220
Oral cavity & pharynx	59,660	42,500	17,160	12,770	9130	3640
Tongue	20,040	14,120	5920	3270	2210	1060
Mouth	15,730	9090	6640	3360	2090	1270
Pharynx	21,640	17,800	3840	4590	3,630	960
Other oral cavity	2250	1490	760	1550	1200	350
Digestive system	362,200	201,190	161,010	174,520	100,250	74,270
Esophagus	22,070	17,430	4640	16,250	12,940	3310
Stomach	30,300	17,720	12,580	10,780	6400	4380

Small intestine	13,920	7190	6730	2060	1190	870
Colon & rectum[a]	154,270	82,460	71,810	52,900	28,900	24,000
Colon	107,320	54,510	52,810			
Rectum	46,950	27,950	19,000			
Anus, anal canal, & anorectum	10,930	3560	7370	2030	780	1250
Liver & intrahepatic bile duct	42,240	28,220	14,020	30,090	19,250	10,840
Gallbladder & other biliary	12,610	6040	6570	4400	1950	2450
Pancreas	67,440	34,950	32,490	51,980	27,050	24,930
Other digestive organs	8420	3620	4800	4030	1790	2240
Respiratory system	245,700	124,700	121,000	130,200	68,340	61,860
Larynx	13,020	10,110	2910	3910	3140	770
Lung & bronchus	226,650	110,680	115,970	124,730	64,190	60,540
Other respiratory organs	6030	3910	2120	1560	1010	550
Bones & joints	3770	2150	1620	2190	1240	950
Soft tissue (including heart)	13,520	7600	5920	5410	2960	2450
Skin (excluding basal & squamous)	112,690	65,740	46,950	14,110	9550	4560
Melanoma of the skin	104,960	60,550	44,410	8430	5470	2960
Other nonepithelial skin	7730	5190	2540	5680	4080	1600
Breast	319,750	2800	316,950	42,680	510	42,170
Genital system	444,610	325,690	118,920	71,510	36,880	34,630
Uterine cervix	13,360		13,360	4320		4320
Uterine corpus	69,120		69,120	13,860		13,860
Ovary	20,890		20,890	12,730		12,730
Vulva	7480		7480	1770		1770
Vagina & other genital, female	8070		8070	1950		1950
Prostate	313,780	313,780		35,770	35,770	
Testis	9720	9720		600	600	
Penis & other genital, male	2190	2190		510	510	
Urinary system	170,470	120,320	50,150	33,140	22,840	10,300
Urinary bladder	84,870	65,080	19,790	17,420	12,640	4780
Kidney & renal pelvis	80,980	52,410	28,570	14,510	9550	4960

Continued- 4

	Estimated new cases			Estimated deaths		
	Both sexes	Male	Female	Both sexes	Male	Female
Ureter & other urinary organs	4620	2830	1790	1210	650	560
Eye & orbit	3140	1620	1520	490	270	220
Brain & other nervous system	24,820	14,040	10,780	18,330	10,170	8160
Endocrine system	52,140	16,450	35,690	3440	1680	1760
Thyroid	44,020	12,670	31,350	2290	1090	1200
Other endocrine	8120	3780	4340	1150	590	560
Lymphoma	89,070	49,980	39,090	20,540	11,780	8760
Hodgkin lymphoma	8720	4840	3880	1150	720	430
Non-Hodgkin lymphoma	80,350	45,140	35,210	19,390	11,060	8330
Myeloma	36,110	20,030	16,080	12,030	6540	5490
Leukemia	66,890	38,720	28,170	23,540	13,500	10,040
Acute lymphocytic leukemia	6100	3450	2650	1400	720	680
Chronic lymphocytic leukemia	23,690	14,340	9350	4460	2810	1650
Acute myeloid leukemia	22,010	12,060	9950	11,090	6130	4960
Chronic myeloid leukemia	9560	5610	3950	1290	740	550
Other leukemia	5530	3260	2270	5300	3100	2200
Other & unspecified primary sites[b]	37,370	19,720	17,650	53,220	28,260	24,960

Table-5: Estimated number of new cases for selected cancers by state, United States, 2025 [56, 63-68].

State	All sites	Female breast	Colon & rectum	Leukemia	Lung & bronchus	Melanoma of the skin	Non-Hodgkin lymphoma	Prostate	Urinary bladder	Uterine cervix	Uterine corpus
Alabama	30,030	4960	2630	860	4050	1470	980	5440	1240	230	920
Alaska	3670	550	350	110	430	90	150	710	170	–[a]	110
Arizona	42,560	6950	3220	1440	4250	3790	1700	5380	2090	270	1450
Arkansas	19,700	2690	1560	590	2660	970	690	2930	780	150	480
California	199,980	32,860	16,050	6000	16,330	11,140	8280	29,600	7220	1490	7480
Colorado	29,020	5250	2130	1030	2520	2060	1210	4400	1220	190	910
Connecticut	23,920	3790	1630	770	2740	780	990	3570	1150	110	860
Delaware	7680	1210	500	220	920	410	290	1460	350	–[a]	260
District of Columbia	3140	580	230	80	330	100	110	380	80	–[a]	140
Florida	171,960	23,920	12,330	6980	18,530	10,290	7550	26,920	8070	1160	5720
Georgia	66,210	10,180	5160	1980	6810	3520	2150	10,360	2390	460	2000
Hawaii	9040	1510	820	270	880	570	330	1160	290	60	440
Idaho	11,820	1820	860	430	1120	960	500	1970	580	70	310
Illinois	78,870	12,160	6110	2430	9270	4220	3090	12,350	3220	490	2780
Indiana	42,150	6470	3410	1330	6120	2300	1600	6160	1870	290	1400
Iowa	21,340	3010	1580	810	2490	1660	860	3150	920	120	710
Kansas	15,810	2620	1430	510	2010	670	680	2520	670	120	550
Kentucky	30,420	4290	2580	1010	4950	1590	1150	4140	1270	220	960
Louisiana	29,980	4230	2490	890	3290	1270	1030	4650	1050	210	780
Maine	11,080	1520	710	370	1460	500	440	1620	610	–[a]	340
Maryland	37,200	6270	2620	1090	3940	1780	1380	6680	1380	220	1320
Massachusetts	44,000	7240	2770	1380	5300	1370	1820	6690	1870	180	1600
Michigan	66,040	9900	4710	2100	8460	3040	2590	10,230	2970	380	2110
Minnesota	37,650	5620	2600	1300	4110	2900	1590	5700	1510	160	1200
Mississippi	17,820	2710	1710	510	2460	700	590	2940	710	150	550
Missouri	39,220	6090	3010	1310	5650	2070	1520	5320	1600	250	1230
Montana	7560	1080	550	230	750	560	280	1230	360	–[a]	210
Nebraska	12,390	1790	940	380	1260	780	460	2030	490	60	390
Nevada	17,540	2760	1480	560	1800	1050	670	2680	800	140	560
New Hampshire	10,290	1470	640	340	1330	460	430	1820	530	–[a]	370
New Jersey	59,840	9290	4430	2090	5420	2340	2470	10,740	2630	360	2270
New Mexico	11,540	1850	960	400	940	670	450	1720	450	90	410
New York	123,430	19,170	8920	4020	12,770	4030	5100	20,490	5210	790	4440
North Carolina	71,320	11,320	4890	2270	8810	3850	2550	11,210	2860	420	2260
North Dakota	4510	640	360	160	520	330	190	800	190	–[a]	130
Ohio	77,010	11,800	5760	2220	9950	4440	2900	10,820	3450	490	2620
Oklahoma	24,120	3460	1970	790	3100	1180	860	2930	960	190	700
Oregon	26,980	4440	1850	800	2950	1420	1070	3570	1220	140	950

Continued-5

State	All sites	Female breast	Colon & rectum	Leukemia	Lung & bronchus	Melanoma of the skin	Non-Hodgkin lymphoma	Prostate	Urinary bladder	Uterine cervix	Uterine corpus
Pennsylvania	90,240	13,650	6500	2900	10,250	3710	3540	13,400	4150	540	3330
Rhode Island	7480	1140	480	270	930	270	300	1060	350	–[a]	260
South Carolina	35,300	5870	2640	1030	4710	1850	1220	6280	1460	240	1110
South Dakota	5870	830	450	200	630	440	240	950	260	–[a]	160
Tennessee	42,750	6960	3450	1300	6400	1880	1560	6630	1860	300	1310
Texas	150,870	23,880	12,710	5660	14,030	5700	5940	21,070	5160	1420	5270
Utah	14,120	2290	990	540	790	1700	600	2700	530	100	510
Vermont	4670	740	290	150	590	220	200	760	220	–[a]	170
Virginia	50,510	8250	3670	1350	6100	2410	1910	9040	1970	290	1750
Washington	46,500	7680	3240	1470	4860	2440	1920	6730	1970	280	1350
West Virginia	13,250	1690	1020	410	2050	530	470	1620	590	70	500
Wisconsin	39,940	5920	2,630	1460	4320	2230	1660	6500	1750	170	1380
Wyoming	3580	530	270	100	340	230	120	550	170	–[a]	100
United States	2,041,910	316,950	154,270	66,890	226,650	104,960	80,350	313,780	84,870	13,360	69,120

Table-6: Estimated cases and deaths, and age-standardized incidence and mortality rates of cervical cancer by UN region and HDI in 2022 [56. 69-73].

World regions	Incidence						Mortality					
	All ages		0–39 years		40–85+ years		All ages		0–39 years		40–85+ years	
	Numbers	ASR	Numbers	ASR	Numbers	ASR	Numbers	ASR	Numbers	ASR	Numbers	ASR
World	662,044	14.12	105,794	3.52	556,250	36.66	348,709	7.08	32,593	1.07	316,116	19.84
Region												
Northern America	15,654	6.35	3988	3.05	11,666	13.35	6692	2.18	594	0.44	6098	5.9
Eastern Asia	167,528	13.43	18,124	2.99	149,404	35.63	62,094	4.29	2888	0.47	59,206	12.42
Eastern Africa	58,145	40.42	11,884	7.26	46,261	110.91	39,476	28.87	5548	3.4	33,928	83.01
Middle Africa	16,268	31.12	2682	4.43	13,586	87.83	11,293	22.86	1102	1.83	10,191	67.55
Northern Africa	7686	6.5	572	0.56	7114	19.12	4425	3.8	79	0.08	4346	11.71
Southern Africa	12,351	34.89	2559	8.16	9792	91.69	7114	20.36	1211	3.87	5903	55.38
Western Africa	31,249	26.7	4102	2.97	27,147	77.12	18,306	16.29	1767	1.28	16,539	48.2
Caribbean	4012	14.01	813	4.94	3199	33.29	2397	7.68	200	1.21	2197	21.42
Central America	15,119	14.34	3453	4.6	11,666	35.04	7646	7.19	876	1.15	6770	20.02
South-Eastern Asia	69,886	17.4	14,101	5.2	55,785	43.33	38,703	9.51	4044	1.47	34,659	26.58
South Central Asia	153,944	15.1	19,921	2.33	134,023	42.23	95,962	9.51	8434	0.99	87,528	27.61
Western Asia	5724	4.1	913	0.79	4811	11.14	3036	2.19	234	0.2	2802	6.42
Eastern Europe	35,052	15.74	7835	7.34	27,217	33.61	16,669	6.27	1721	1.45	14,948	16.53
Northern Europe	5659	8.17	1917	5.48	3742	13.91	2145	2.17	214	0.6	1931	5.5
Southern Europe	7792	6.43	1178	2.58	6614	14.62	3740	2.21	171	0.36	3569	6.13
Western Europe	9716	6.64	1899	2.98	7817	14.44	4396	2.14	241	0.37	4155	5.89
Australia-New Zealand	1047	5.2	338	2.96	709	9.94	386	1.44	37	0.31	349	3.83
Melanesia	1340	27.59	423	10.04	917	64.88	873	19.33	209	4.95	664	49.88
South America	44,040	15.55	9109	5.14	34,931	37.69	23,471	7.84	3031	1.66	20,440	20.97
Micronesia	54	18.6	16	7.88	38	41.4	33	10.92	0	0	33	34.11
Polynesia	35	9.59	8	3.22	27	23.11	17	4.63	0	0	17	14.47
HDI												
Very HDI country	107,148	9.26	23,237	4.11	83,911	20.2	48,363	3.33	4024	0.67	44,339	8.97
High HDI country	265,503	14.08	37,826	3.47	227,677	36.64	118,418	5.87	9558	0.86	108,860	16.49
Medium HDI country	200,389	18.02	28,858	3.14	171,531	49.65	123,222	11.21	11,477	1.24	111,745	32.39
Low HDI country	89,004	23.76	15,873	3.83	73,131	66.12	58,706	16.29	7534	1.82	51,172	47.03

3. COMPARTATIVE DATA ON PREVALENCE/ INCIDENCE MORTALITY RATES OF CERVICAL CANCER IN INDIA AND OTHER COUNTRIES

Cervical cancer is the second most prevalent cancer among women in India. An estimated 511.4 million women aged 15 years and older are potentially susceptible to developing cervical cancer.[71-73] Women from lower socioeconomic backgrounds face a relatively higher risk. Recent estimates indicate that, annually, 123,907 women are diagnosed with cervical cancer, and 77,348 women lost their lives to the disease in 2020.[74] Notably, the average age of cervical cancer incidence in India is 50-59 years,[75] which is comparatively later compared to developed countries, where early diagnosis below 40 years of age is more common due to robust screening practices.[76,77] The five-year survival of patients with cervical cancer in India is only 51.7%[78] compared to 62.8% in the United States,[79] emphasizing the importance of early screening, diagnosis, and timely initiation of treatment in reducing disease-associated mortality.

As per National Cancer Registry Program data of Indian Council of Medical Research (ICMR), the estimated number of incidence of Cervical cancer for the country during the last three year is given below: [80-93]

Table-7: Estimated Incidence of cancer cases in India - State / UT – Cervix Uteri- (2016-2018)

States	2016	2017	2018
Jammu & Kashmir	1060	1079	1098
Himachal Pradesh	603	606	610
Punjab	**2157**	**2173**	**2189**
Chandigarh	66	67	68
Uttaranchal	866	877	890
Haryana	2018	2043	2070
Delhi	1073	1088	1103
Rajasthan	5791	5861	5933
Uttar Pradesh	17156	17420	17687
Bihar	9454	9638	9824
Sikkim	24	24	24
Arunachal Pradesh	70	71	72
Nagaland	88	89	90
Manipur	138	142	147
Mizoram	119	122	125
Tripura	159	160	163
Meghalaya	119	122	124
Assam	1438	1456	1474
West Bengal	7450	7509	7568
Jharkhand	2907	2958	3009
Orissa	3662	3693	3723
Chhattisgarh	2303	2343	2383
Madhya Pradesh	6222	6322	6423
Gujarat	4810	4868	4928
Daman & Diu	17	18	19
Dadra & Nagar Haveli	29	30	32
Maharashtra	8741	8811	8882
Telangana	2870	2893	2916
Andhra Pradesh	4124	4149	4173
Karnataka	5020	5074	5130
Goa	108	109	110
Lakshadweep	5	6	6
Kerala	2849	2908	2975
Tamil Nadu	5452	5443	5432
Pondicherry	103	106	108
Andaman & Nicobar Islands	28	28	28
Total	**99099**	**100306**	**101536**

Table-8: Burden of cervical cancer (Incidence, Mortality, YLLs, YLDs, DALYs per 100,000) among women in India in 2016 by Population Based Cancer Registries

Region	Incidence		Mortality		YLLs		YLDs		DALYs	
	CR	ASR	CR	ASR	CR	ASR	CR	ASR	CR	ASR
Bangalore	15.5	19.7	8.2	10.8	281.6	350.1	7.3	9.0	288.9	359.1
Mumbai	8.4	8.9	4.4	4.8	147.3	153.2	3.7	3.9	151.0	157.1
Chennai	15.7	15.9	8.2	8.5	275.8	273.4	6.8	6.9	282.6	280.3
Hyderabad District	8.4	11.3	4.4	5.9	163.7	200.8	5.6	7.7	169.3	208.4
Bhopal	10.6	13.8	5.6	7.0	226.3	269.2	6.0	7.7	232.3	276.9
Delhi	11.9	14.6	6.2	7.8	243.8	285.1	5.4	6.6	249.2	291.7
Barshi Rural	17.0	16.5	13.1	11.9	393.4	374.5	7.3	7.1	400.7	381.6
Kollam District	9.0	7.2	4.7	3.7	134.3	107.5	4.1	3.3	138.3	110.8
Aurangabad	11.8	15.3	6.2	9.2	178.6	245.3	7.2	8.7	185.8	254.1
Nagpur	11.8	12.2	6.2	6.5	232.6	230.3	5.9	6.0	238.5	236.4
Pune	8.8	10.7	4.6	5.8	161.9	190.3	3.8	4.6	165.7	194.9
Thiruvananthapuram District	9.1	7.4	4.8	3.9	144.8	116.3	4.0	3.3	148.8	119.6
Kolkata	9.9	8.9	5.2	4.8	168.4	152.1	4.5	4.1	173.0	156.1
Dibrugarh District	4.1	5.1	2.2	2.6	93.3	103.1	7.2	11.4	100.5	114.5
Kamrup Urban	13.0	15.4	6.8	8.2	256.3	281.4	6.6	7.8	262.9	289.3
Cachar District	13.4	16.7	7.0	9.7	282.0	361.1	9.9	12.1	291.9	373.2
Manipur State	5.5	7.3	2.9	4.1	105.3	136.0	2.8	3.5	108.1	139.5
Mizoram State	19.7	25.2	10.3	14.4	421.9	548.3	8.9	11.3	430.8	559.6
Sikkim State	7.7	10.5	4.1	5.6	161.8	211.8	4.1	5.8	165.9	217.6
Ahmedabad Urban	6.9	7.5	3.6	4.1	138.4	146.3	3.1	3.3	141.5	149.6
Wardha District	9.3	8.9	5.8	5.6	197.7	189.1	4.3	4.1	202.0	193.2
Tripura State	8.6	10.2	4.5	5.4	183.3	209.6	3.7	4.4	187.0	214.0
Nagaland	9.3	14.3	4.9	7.3	220.5	303.5	6.3	11.3	226.8	314.8
Meghalaya	5.6	9.5	2.9	5.4	118.1	202.1	3.6	5.6	121.6	207.7
West Arunachal	6.5	10.7	3.4	5.4	160.8	241.5	6.2	13.9	166.9	255.3
Osmanabad & Beed	13.7	13.8	7.2	7.2	252.0	261.2	6.2	6.3	258.2	267.5
Pasighat	16.3	22.2	8.5	13.0	327.3	423.3	50.5	82.0	377.8	505.3
Patiala District	14.1	14.8	7.4	7.8	244.4	251.4	9.3	10.3	253.7	261.7
All Registries	10.7	12.1	5.6	6.6	196.5	218.3	4.9	5.5	201.4	223.8

Abbreviations: CR Crude Rate, ASR Age-Standardised Rate, YLLs Years of Life Lost, YLDs Years Lived with Disability, DALYs Disability Adjusted Life Years

Table-9: Estimated prevalence of cancer cases in India by different State/UT - Cervix Cancer [National Cancer Registry Programme Report-2023]

State	2023
Jammu & Kashmir	2887
Ladakh UT	71
Himachal pradesh	2135
Punjab	10377
Chandigarh	266
Uttaranchal	2768
Haryana	7081
Delhi	5883
Rajasthan	17023
Uttar pradesh	45682
Bihar	23164
Sikkim	122
Arunachal pradesh	329
Nagaland	536
Manipur	494
Mizoram	646
Tripura	861
Meghalaya	519
Assam	8237
West bengal	25822
Jharkhand	8128
Orissa	12002
Chattisgarh	6862
Madhya pradesh	18475
Gujarat	17083

Daman	51
Dadra & Nagar Haveli	72
Maharashtra	30414
Telangana	11525
Andhra pradesh	17146
Karnataka	20678
Goa	460
Lakshadweep	25
Kerala	7765
Tamil nadu	36014
Pondicherry	624
Andaman & Nicobar Islands	106
Total	**342333**

Table-10: Estimation of YLLs, YLDs, and DALYs for cervical cancer in India for 2021, 2023, and 2025[Ramamoorthy et al. Reproductive Health (2024) 21:111]

Cancer burden measures	2021	2023	2025
YLLs	1,475,075	1,444,555	1,414,665
YLDs	86,058	87,410	88,782
DALYs	1,558,395	1,531,965	1,505,472

Above tables illustrated the variations in survival rates/ death / age relations of different GCs in India and other countries. A study conducted among older women aged 65 years or above using the Surveillance, Epidemiology, and End Results (SEER) population data demonstrated that the five-year survival rates for women diagnosed with corpus uteri, vulva, and cervix uteri cancers were 76%, 69.7%, and 56%, respectively [93]. In contrast, the five year survival rates for women with cancers diagnosed in the fallopian tube (47.8%), vagina (44.8%), ovary (31%), and other female organ cancers (24.6%) were lower [93, 94-98]. Disparities in social development status, lifestyle, and the availability of diagnostic as well as healthcare resources contributed to the differences in the female organ cancer burden across countries and regions [92, 94-100]. A temporal trend analysis using the World Health Organization (WHO) mortality database for countries such as Japan, the Republic of Korea, and Singapore indicated that age, period, and cohort effects influenced the risk of mortality from these cancers [95-103]. Additionally, the cancer burden was associated with the human development index (HDI)[104]. The relationship between HDI and the incidence and mortality of GCs was multifaceted [96-106]. Countries with very high HDI have lower mortality rates despite higher incidence rates of GCs. This could be due to well-established and advanced healthcare systems, high socioeconomic status, and comprehensive cancer screening programs [107-113]. Conversely, low HDI countries exhibited the highest incidence rates for GCs, which may be attributed to inadequate or inaccessible healthcare, low socioeconomic status, and a lack of vaccination strategies, along with other co-factors such as a higher prevalence of human immunodeficiency virus (HIV) and human papilloma virus (HPV) infections and/or coinfections [106-114]. Most cancer cases occur in low- and middle-income countries [107-115-121]. In terms of incident cases, India ranked third after China and the United States of America (USA), respectively, contributed the second-largest number of cancer deaths after China [88]. The leading cancers among women in India were those arising from the breast, cervix, and ovary [99- 106,112-119], which indicated that the screening coverage was low, despite various schemes and programs. According to the national family health survey (NFHS-5) data, the percentage of women who underwent cervical cancer screening in India was as low as 1.9%, while the percentage of those who ever participated in breast cancer screening practices was merely 0.9%. Lack of awareness about cancer screening, socioeconomic inequalities, stigma around screening outcomes and cancer, and limited health system resources may all contribute to inadequate screening practices among Indian women [122-130]. The challenge of addressing the cancer burden persisted worldwide despite the availability of early detection and preventive measures. Breast cancer and other GCs substantially contributed to this burden, with notable disparities in their impact across regions and countries due to various factors [131-138]. As a highly populated country, India witnesses a large number of cancer cases and deaths, adding to the global burden of cancers in general, and breast cancer and other GCs in particular [139-141]. In this review, it was aimed to assess the burden of female organ cancers, cervix uteri, ovary, corpus uteri, vagina, and vulva in India and compare it to a global context, using the latest age-standardized incidence and mortality estimates from GLOBOCAN reports 2025/ 2030. These estimates will facilitate valid comparisons of cancer burden between regions and countries. Such comparisons will yield a clearer understanding of the cancer burden in India relative to other countries and help assess the adequacy of cancer control measures in India.

Table-11:. Age-standardized incidence and mortality rates of all cancers among women along with the six female-specific cancers in different continents (GLOBOCAN 2025 estimates).

ASR among females (Per 100,000 female population)	Africa		Latin America and the Caribbean		North America		Europe		Oceania		Asia		Global	
	Inc	Mort	Inc	Mort	Inc	Mort	Inc	Mort	Inc	Mort	Inc	Mort	Inc	Mort
*All cancers	140.7	89.8	177.4	77.6	340.7	74.9	253.4	84.4	371.3	82.9	157.7	70.5	196.9	91.7
Breast	40.5	19.2	52.0	13.2	95.1	12.3	75.6	14.6	91.5	15.4	34.3	10.5	46.8	12.7
Cervix uteri	26.4	17.6	15.1	7.7	6.4	2.2	10.6	3.9	9.6	4.5	13.9	6.7	14.1	7.1
Ovary	5.3	4.0	5.7	3.6	7.5	3.8	9.3	5.0	8.1	4.5	6.2	3.7	6.7	4.0
Corpus uteri	3.5	1.1	8.1	2.0	22.3	3.2	15.5	2.8	13.8	2.5	5.7	1.2	8.4	1.7
Vaginal	0.4	0.2	0.4	0.1	0.4	0.1	0.3	0.1	0.5	0.2	0.3	0.2	0.4	0.2
Vulva	1.2	0.6	0.8	0.3	1.9	0.4	1.7	0.5	1.3	0.3	0.4	0.2	0.8	0.3
**GCs	36.8	23.5	30.1	13.7	38.5	9.7	37.4	12.3	33.3	12.0	26.5	12.0	30.4	13.3
Breast cancer and GCs	77.3	42.7	82	26.8	133.6	21.9	112.9	26.8	124.7	27.4	61	22.4	77.2	26.0

**Gcs: cancers of cervix uteri, ovary, corpus uteri, vagina, and vulva. ASR, age-standardized rate;

Table-12: Age-standardized incidence and mortality rates of all cancers among women along with the female-specific cancers–A comparison between selected countries and India (GLOBOCAN 2025 estimates)

Countries	Incidence per 100,000 person-years						
	*All cancers among women	Breast cancer	Cervix uteri	Ovary	Corpus uteri	Vagina/Vulva	**GCs
Australia	415.21	101.47	5.25	7.84	14.61	1.95	29.65
The USA	341.74	95.91	6.32	7.32	22.47	2.25	38.36
The UK	292.54	94.03	7.51	9.2	14.76	2.27	33.74
China	197.03	33.04	13.83	5.68	6.84	0.55	26.9
South Africa	190.35	47.8	33.18	5.11	6.17	2.72	47.18
El Salvador	128.37	39.65	15.19	4.29	2.91	0.65	23.04
India	100.83	26.6	17.71	6.57	2.46	1.13	27.87
Median of 185 countries	157.66	46.21	14.10	6.26	7.03	0.00	31.54
Min	34.71	4.56	2.14	0.69	0.06	1.10	5.83
Max	415.21	105.42	95.89	15.33	26.22	5.87	105.38
Countries	Mortality per 100,000 person-years						
	*All cancers among women	Breast cancer	Cervix uteri	Ovary	Corpus uteri	Vagina/Vulva	**GCs
South Africa	110.58	16.96	19.03	4.44	2.66	1.05	27.18
The UK	87.63	13.98	1.96	4.75	2.71	0.63	10.05
The USA	73.61	12.19	2.17	3.67	3.13	0.46	9.43
Australia	71.21	12.28	1.43	3.92	2.16	0.36	7.87
China	67.81	6.1	4.54	2.64	1.05	0.22	8.45
El Salvador	64.6	7.79	8.43	2.68	0.81	0.33	12.25
India	62.61	13.7	11.15	4.64	0.96	0.56	17.31
Median of 185 countries	80.85	14.53	6.97	4.07	1.88	0.00	14.16
Min	24.67	2.33	1.07	0.78	0.00	0.41	4.42
Max	150.93	38.85	64.33	9.29	9.53	4.30	71.13

Table-13: Global incidence and mortality rates due to Cervical and GCs—proportionate representation from all cancers among women. Selected sociodemographic indicators of the countries included in the study (2024)

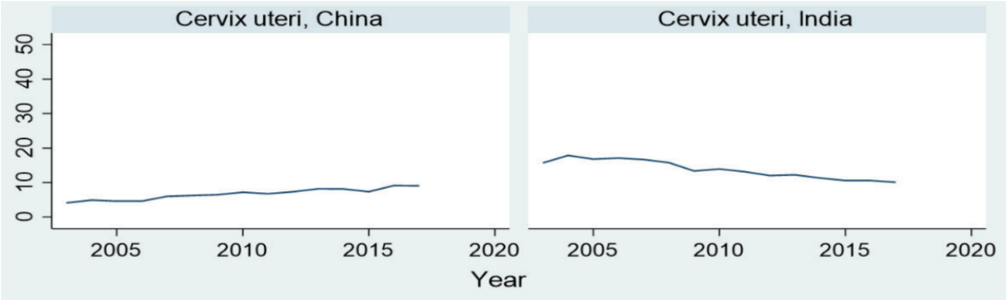
Countries	HDI 2022	Current health expenditure per capita (current USA$) 2021	Current health expenditure (% of GDP) 2021	Population density (people per sq. km of land area) 2021	Rural population (% of total population) 2023	Adolescent fertility rate (births per 1000 women ages 15–19) 2022
Australia	0.95	7055.37	10.54	3.34	13.38	7.73
United States	0.93	12,012.24	17.36	36.30	16.70	15.12
United Kingdom	0.94	5738.48	12.36	277.05	15.36	9.99
China	0.79	670.51	5.38	150.44	35.43	11.15
South Africa	0.72	583.67	8.27	48.96	31.18	60.89
El Salvador	0.67	442.21	9.72	304.74	24.61	54.55
India	0.64	74.00	3.28	473.42	63.64	16.30

Table-14: Contribution of Cervical and other reproductive cancers to all cancer incidence and mortality among women—A comparison between selected countries. Spearman rank correlation coefficient between ASIR (incidence) and sociodemographic indicators of the countries included in the study

ASIR	HDI 2022	Current health expenditure per capita (current USA$) 2021	Current health expenditure (% of GDP) 2021	Population density (people per sq. km of land area) 2021	Rural population (% of total population) 2023	Adolescent fertility rate (births per 1000 women ages 15–19) 2022
All cancers among women	0.96	0.96	0.75	–0.86	–0.82	–0.75
Breast cancer	0.86	0.86	0.86	–0.82	–0.93	–0.50
Cervix uteri	–0.86	–0.86	–0.71	0.61	0.79	0.86
Ovary	0.75	0.64	0.54	–0.32	–0.61	–0.82
Corpus uteri	0.86	0.96	0.86	–0.68	–0.71	–0.61
Vagina/Vulva	0.32	0.32	0.46	–0.36	–0.39	0.11

ASIR, age-standardized incidence rates

Figure-3: Cervix uteri cancer incidence trends in India and China from 2005 to 2020.



Of 185 countries, China ranked 58th and 145th in ASIR and ASMR, respectively, for all cancers among women, where as India ranked 170th and 162nd [130-139]. However, the ASIR and ASMR show different patterns when considered Cervical cancer and other GCs. The Cervical cancer mortality rate was only half in China compared to India (6.1 vs. 13.7 per 100,000 person-years). Similarly, China maintains a better mortality rate compared to India for other GCs. Although, when considered the contribution of the six female organ cancers, China falls behind India with a lower proportion of female organ cancer incidence and mortality; conversely, other cancers contributed significantly to all cancer incidence and mortality among Chinese women. Trends from 2010 to 2020 in the incidence and mortality rates of cancers affected the female genital organs in China suggested that most of these cancers increased during this period, particularly cervical cancer incidence and mortality across both rural and urban areas, despite a historical reduction in cervical cancer rates in China [115-123]. A comparison of cervical cancer incidence rates between China and India in the first two decades of this century clearly illustrated a slight but consistent increased in its incidence in China, contrasting with the notable reduction in incidence among many other low- and middle-income countries, such as India. Sociodemographic advancement positively influences a population by reducing infection related cancers, including cervical and vaginal cancer incidence and mortality. Conversely, such transitions may increase the incidence of cancers like ovary, and corpus uteri [116-126]. At this point, the finding of this increased, cervical cancer incidence in China warranted global attention. While socioeconomic improvements could reduced sociodemographic risk factors for cervical or other HPV-infection related cancers in one direction, The factors could also contributed the behavioral risk factors that expand the possibility of acquiring persistent HPV infections, thus increased, cancer incidence in the other direction [127-136]. The findings from China suggested that comprehensive and sustainable cancer control strategies are warranted, considering the diverse socioeconomic development levels across China's regions [136-141]. This served as an example for low- and middle-income countries like India, where sociodemographic improvements alone could not effectively reduce the cervical cancer burden, and highlights the need for more effective strategies to control the burden of HPV-related cancers. Compared to India, the age-standardized incidence rates for all cancers among women, as well as cervical cancer incidence rates, were three to four times higher in Australia, the UK, and the USA. However, all-cause mortality rates and mortality due to breast cancer show only minimal variations in the comparison. At the same time, the incidence and mortality rates of cervical cancer were relatively low in these countries. Factors such as the availability of conventional and well-placed healthcare services, public health initiatives, and extensive cancer screening programs in such regions may contribute to improved cancer control[142-148].

In Australia, GCs constituted almost 9.2% of cancers and nearly 10% of mortality rates due to cancer among women. Between 1994 and 2004, a gradual decrease in the incidence and mortality of cervical cancer was observed [149]. This could be attributed to the National Cervical Cancer Screening Program introduced in 1991. However, in 2024, the overall incidence of GCs gradually progressed to 49 per 100,000 women, up from 43 per 100,000 in 2003, with the increase in uterine cancer largely influencing this progression. The mortality of uterine cancer progressed from 3.3 deaths per 100,000 women in 2000 to 4.8 deaths per 100,000 women in 2024 [141-144].

In the case of El Salvador from the Latin American region, the breast cancer incidence rate was higher compared to India, but the cervical cancer rate was slightly reduced; however, the mortality rates for both cancers were lower than in India. Cervical cancer was the principal cause of cancer-related deaths among women in El Salvador [150-156].

The success of countries such as Australia, the USA, and the UK in reducing mortality due to cervical cancer could be attributed to organized screening and efficient healthcare systems [136-141, 151-156]. For example, Australia, which ranked in the top ten countries globally for healthcare efficiency, has a government-funded universal health system that ensured equity in access to healthcare services at the population level. The country has also established effective national programs for delivering HPV vaccinations and screening for cervical cancer. However, socioeconomic disparities exist in the participation observed within these programs [112-118]. While Australia demonstrated the benefits of a universal healthcare model, implementing a similar system in India, possessed challenges due to the large population and limited government resources [112, 134, 144]. Nonetheless, India could take incremental steps toward equity in healthcare by initiating universal screening programs at the primary healthcare level and involving community health workers to promote these programs within local communities. Such ground-level initiatives could facilitated early detection of female cancers without imposing a significant financial burden on families and the healthcare system [6-9,128-130].

In this analytical review, it was found that the HDI, health expenditure percapita, and current health expenditure (% of GDP) positively correlated with overall cancer rates among women, as well as with cervical, ovarian, and corpus uteri cancers; however, a negative correlation was observed with cervical cancer. Conversely, population density, the proportion of the rural population, and adolescent fertility rates showed a positive correlation with cervical cancer but a negative correlation with other cancers . Socioeconomic inequality was a global issue, and the role of socioeconomic status in cancer outcomes has been extensively studied. A recent umbrella review of socioeconomic status and cancer outcomes reiterated the worst health outcomes in the poorest populations; this disparity existed both between countries and within countries of diverse socioeconomic statuses [10-14, 123-128]. Incidence, prognosis, screening, and treatment accessibility were all influenced by socioeconomic status. Even when the incidence of certain cancers (for example, cervical cancer) was high in countries with very high HDI, the mortality rates were observed to be very low. Conversely, countries with lower incidence rates for certain cancers might have very high mortality rates. Well-organized screening, healthcare accessibility, and resource allocation to healthcare contributed these variations among countries [123-131].

Several factors, such as improved literacy rates, delayed age at marriage, first sexual intercourse and first childbirth, low parity, increased use of contraception, improved menstrual hygiene, and decreased tobacco use among women, have played a significant role in the decline of cervical cancer burden in India [77-81]. Screening for cervical cancer in India has been implemented through the National Programme for Prevention and Control of Non-Communicable Diseases [NP-NCD] since 2010 [88]. However, the coverage has been extremely poor, with only 1.2% of women aged 15–49 ever having been screened for cervical cancer [99]. Another nationally representative study found that 2.2% of women between the ages of 30–69 reported having undergone cervical cancer screening, with a 3.0% difference between women who were screened in urban (4.0%) and rural (1.3%) areas [100]. India is directing efforts toward the elimination of cervical cancer (a threshold of 4 per 100,000 women-year) by 2030, by focusing on the World Health Organisation strategy of Human Papillomavirus (HPV) vaccination for 90% of adolescent girls, screening 70% of women aged 35 and 45, and treating 90% of pre-cancerous and cancerous women [111]. Furthermore, while several national and state-specific public health insurance schemes were available, they were limited in coverage and failed to protect patients from catastrophic health expenditures [122-129].

The efforts to estimate the burden of cancer in India, utilizing reliable Population Based Cancer Registry (PBCR) data through simple and replicable methods, were undertaken [131-133, 144]. The burden of cancer in India was estimated to be 26.7 million DALYs in 2021, with cervical cancer contributing 8.2% to this estimate [133].

The Age standardized incidence rate per 100 000 population, in India was 18 while the 5 year prevalence rate across all ages was 42.82 per 1 lakh population. As per the National Cancer Registry Programme, cancer of breast and cervix uteri was the most common cancers among females. Cervical cancer accounted for 6-29% of all cancers among women in India. Papumpare district in the state of Arunachal Pradesh, India had the highest incidence rate of cervical cancer (27.7) in Asia. 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 metastasis was predominant among males (44.0%) and females (47.6%) [123-129]

Table-15: Cervical Cancer in India : National Policy [145]

National health policy

The National health Policy of India which was first drawn up in 1983 and subsequently revised in 2002 and 2017 provides the overall guidelines for the health sector in the country. Its primary aim is to inform, clarify, strengthen and prioritize the role of the Government in shaping health systems in all its dimensions-investments in health, organization of healthcare services, prevention of diseases and promotion of good health.

National cancer registry program

Cancer registry is an organization of systematic collection, storage, analysis, interpretation and reporting of data on patients with cancer (IARC). A proper analysis and interpretation of data provides insights with inputs for its prevention, control and management.

Cervical cancer policy/strategy

At present, there does not appear to be a single comprehensive cervical cancer program at the national level in India. Some provisions for cervical cancer prevention and treatment are included within the documents related to the aforementioned policies and strategies.

Cervical cancer screening policy/strategy

There is no comprehensive national screening program in India at present. A lifetime screening prevalence of 29.8% among women aged 30-49 has been reported from a nationally representative survey. The Ministry of Health and Family Welfare has 4 recommended the Visual Inspection with Acetic Acid (VIA) screening method for women aged 30-65 with a 5-year interval since 2016 as per the operational framework.

HPV immunization policy/strategy

Although there is no national human papillomavirus (HPV) immunization program in India, there are several efforts, including one state-wide program in Sikkim, another program in two districts of Punjab and an opportunistic program based in Delhi.

Figure-4: Ranks of Age-Standardized cervical cancer incidence rate per 100,000 women population for all ages in 1990 and 2022 in India [Singh et al. BMC Cancer (2022) 22:149].

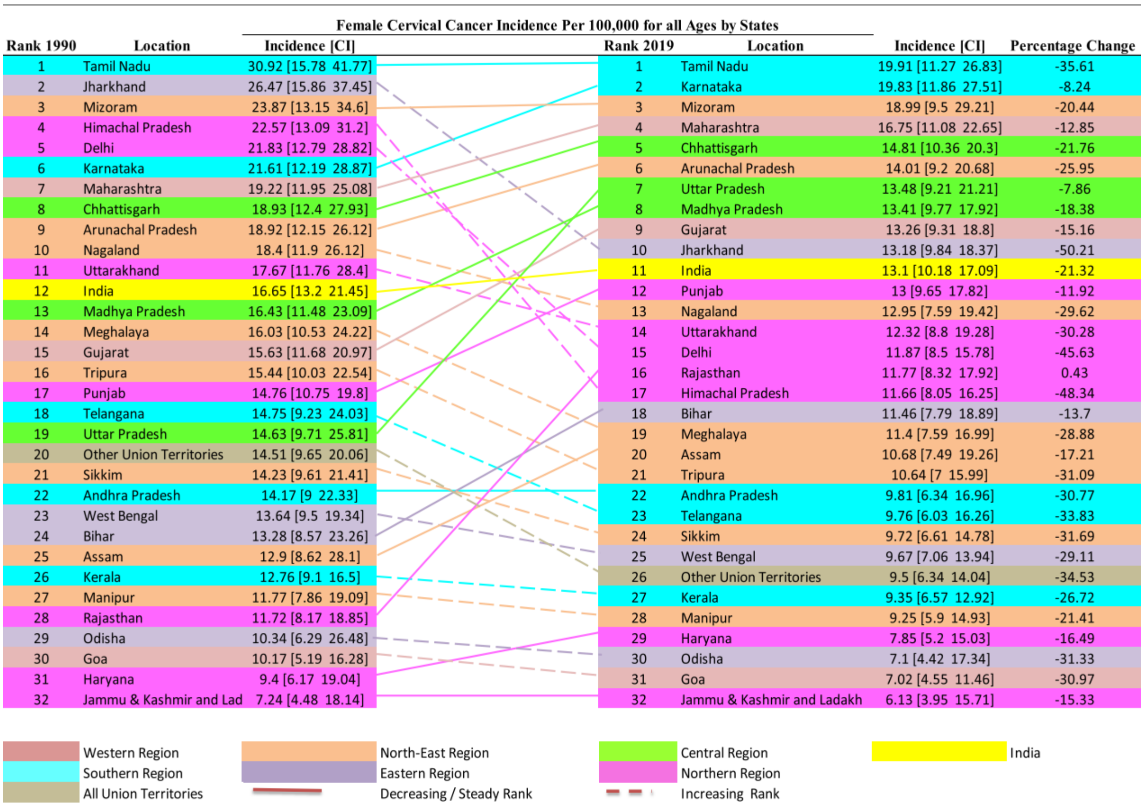


Figure-4, indicated that the overall variation in the ranks of age-standardized cervical cancer incidence over the three decades (1990 to 2022). Among all the states and Unionterritories, the percentage change was negative, i.e. all the states and union territories have witnessed a declined in the incidence rate over time. Percentage decrement in incidence was not uniform across the states, which further leaded to variation in states rank. Over the thirty years, ranks of only four states, namely Tamil Nadu (1st rank, -35.61 percentage change), Mizoram (3rd rank, -20.44 percentage change), Andhra Pradesh (22nd rank, -30.77 percentage change), and Jammu & Kashmir &Ladakh (32nd rank, -15.33 percentage change) have remained same, and the ranks of remaining states have changed. The first rank indicated the highest incidence of cervical cancer, and the last (32nd) rank indicated the lowest value in age-standardized cervical cancer incidence. The highest percentage change in age-standardized incidence was found in Jharkhand (-50.21%, 2nd rank)

in 1990 to 10th rank in 2022) followed by Himachal Pradesh (-48.34%, 4th rank in 1990 to 17th rank in 2022) in contrast to the lowest change in incidence was observed in the state Uttar Pradesh (-7.86%, 19th rank in 1990 to 7th rank in 2022) followed by Karnataka (-8.24%, 6th rank in 1990 to 2nd rank in 2022). Only a single state, namely Rajasthan,have shown an increase in the incidence value over time (0.43%, 28th rank in 1990 to 16th rank in 2022). In 1990, 11 states ranked lower than the national average (India 12th rank, incidence 16.65 per 100000), but in 2022 a total of 10 states rank lower than the national average (India 10th rank, incidence 13.1 per 100000). Among seven northern states, half of the states (Himachal Pradesh, Delhi, Uttarakhand) have moved upward in their rank and other states like Punjab, Rajasthan, Haryana) have (Jammu & Kashmir and Ladakh) remained the same in their rank. In the country's north-eastern region, two states, i.e. Arunachala Pradesh and Assam ranks, have decreased; however, Mizoram has remained the same in their positional rank and ranks of these five states, i.e. Nagaland, Meghalaya, Tripura, Sikkim, Manipur have increased.

Figure-5: Ranks of age-standardized cervical cancer mortality rate per 100,000 women population for all ages in 1990 and 2022 in India[Singh et al. BMC Cancer (2022) 22:149].

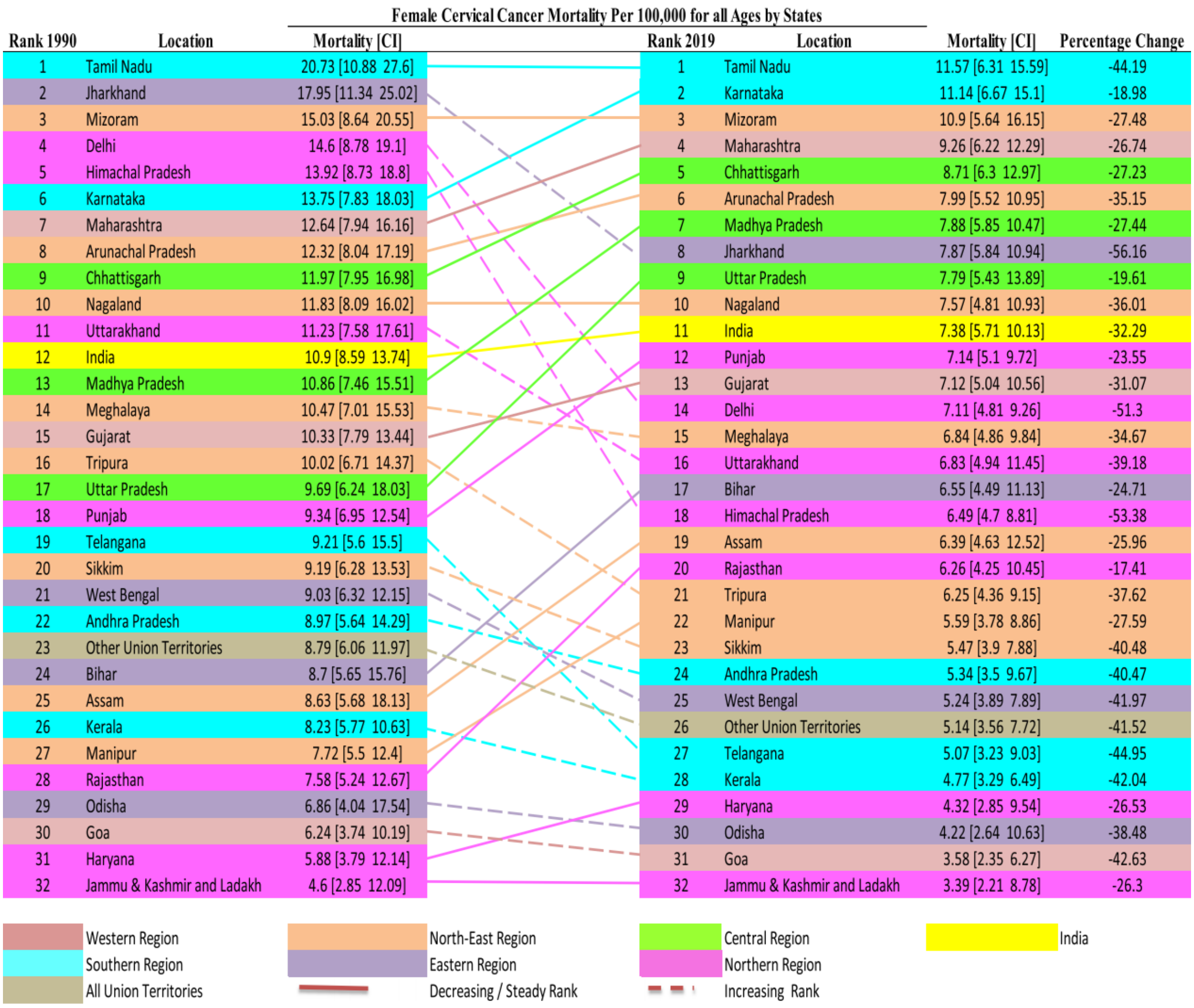


Figure-5, indicated that the variation in ranks of age-standardized cervical cancer mortality among all ages over the three decades (1990 to 2022). The percentage change was negative across all states and Union territories, indicating all the states and union territories have witnessed a decline in mortality over time. The variation in the state ranking indicated that percentage decrement in mortality was not uniform. Overall, Tamil Nadu has performed worst in case of age-standardized cervical cancer incidence 30.92 (CI: 15.78 – 41.77) in 1990 to 19.91 (CI: 11.27 – 26.83) in 2022 and mortality 20.73 (CI: 10.88 – 27.6) in 1990 to 11.57 (CI: 6.31 – 15.59)) per 100,000 females in 2022 both. Whereas Jammu & Kashmir & Ladakh performed well in terms of age-standardized cervical cancer incidence 7.24 (CI: 4.48 – 18.14) in 1990 to 6.13 (CI: 3.95 – 15.71) in 2022 and mortality 4.6 (CI: 2.85 – 12.09) in 1990 to 3.39 (CI: 2.21 – 8.78) per 100,000 females in 2022. Both the highest and lowest performing states have maintained their rank over the period. In the year 1990, 11 states had ranks lower than the national average (India 12th rank, mortality 10.9 per 100000 females). Still, in 2022 only ten states show lower rankings than the national average (India 11th rank, mortality 7.38 per 100000 females).

Table-16: Trends in incidence and mortality of cervical cancer in India from 1990 to 2019 using join-point regression analysis

Age standardised incidence rate			Age standardised mortality rate		
Segment	Year	APC* (95% C.I.)	Segment	Year	APC* (95% C.I.)
1	1990-1995	-1.24* (-2.07, -0.40)	**1**	1990-1995	-1.58* (-2.46, -0.68)
2	1995-1998	1.47 (-2.31,5.39)	**2**	1995-1998	0.95 (-3.05,5.11)
3	1998-2005	-3.22* (-3.83, -2.59)	**3**	1998-2005	-3.52* (-4.17, -2.86)
4	2005-2012	-0.84* (-1.47, -0.20)	**4**	2005-2012	-1.67* (-2.34, -0.99)
5	2012-2015	2.49 (-1.33,6.45)	**5**	2012-2015	2.11 (-1.94,6.32)
6	2015-2019	-0.16 (-1.35,1.05)	**6**	2015-2019	-0.96 (-2.22,0.31)
AAPC*	1990-2019	-0.82* (-1.39, -0.25)	**AAPC***	1990-2019	-1.35* (-1.96, -0.75)

Note: *, Indicates that the Annual Percent Change (APC) is significantly different from zero at the alpha = 0.05 level APC annual percentage change, AAPC average annual percent change, CI confidence interval

Table-16, illustrated that the APC and AAPC of incidence and mortality due to cervical cancer in India from 1990 to 2019). The regression model shows a significant declining trend in India between 1990 and 2019 for age-standardized incidence rate (AAPC: −0.82; 95%CI: −1.39 to −0.25; $p < 0.05$) with highest decline in the period 1998-2005 (AAPC: −3.22; 95%CI: −3.83 to −2.59; $p < 0.05$). Similarly, a significant declining trend has been observed in the age-standardized mortality rate India between 1990 and 2019 (AAPC: −1.35; 95%CI: −1.96 to −0.75; $p < 0.05$) with highest decline in the period 1998-2005 (AAPC: −3.52; 95%CI: −4.17 to −2.86; $p < 0.05$) [144-151].

The Government of India (GOI) has launched a nationwide cervical, breast and oral cancer prevention and control program. However, the fifth round of the National Family Health Survey (NFHS-5), a nationwide survey conducted by the Ministry of Health and Family Welfare (MoHFW), GOI, has shown concerning results on screening uptake by both men and women across India. With an estimated 10 million deaths in the year 2020 – or almost one in six – cancer remains a leading cause of death globally [131]. According to the Global Cancer Observatory, India accounted for 7.5% and 9.4%, respectively, of global cancer incidence and mortality [132]. Furthermore, it is projected that the cancer burden in India will increase by 12.8% in the year 2025 compared to the year 2020 [133]. The population-based cancer registries (PBCRs) in India reported that the preventable cancers – breast followed by cervical cancers were the most common sites among females; whereas the mouth was the leading cancer site among males [144]. Furthermore, there was a significant increase in the incidence rate of breast cancer across most of the Indian PBCRs [134]. The Cancer Incidence in Five Continents (CI5) volume XII provided cancer incidence data from India 24 high-quality PBCRs [155]. Based on the CI5 XII database [135], the female breast cancer incidence ranged from 7.2 (Meghalaya) to 45.1 (Bangalore) per 100,000 populations, and for cervix uteri cancer, it ranged from 6.5 (Manipur) to 23.0 (Mizoram) per 100,000 populations. Uttar Pradesh (UP), the most populous state of India, with a total population of 199,812,341 accounts for 16.5% of the total country population. Moreover, UP state is predominantly rural (77.7%), and has 71 districts, more than 310 sub-districts, and over 100,000 villages [126]. With regards to the cancer burden, the state-wise projected cancer cases in India based on the National Cancer Registry Program report for the year 2022 indicated that UP state has the maximum number of cases (14.4%) followed by Maharashtra (8.3%) and West Bengal (7.7%) states [147]. Similarly, compared to other states, UP state had the highest number of deaths due to cancer [77]. Furthermore, Varanasi district PBCR, the first PBCR from UP state, reported that one in 12 men and one in 15 women are at risk of developing cancer in the district. The ageadjusted incidence rate (AAIR) for men and women was 72.1 and 58.4 per 100,000 populations, respectively (year 2018–2019). As per the Varanasi PBCR report, among men, mouth, tongue, gallbladder, lung and liver were the top five leading cancer sites with AAIR of 18.4, 5.6, 4.2, 3.8 and 3.8, respectively. For women, the leading cancer site was the breast, followed by the gallbladder, cervix uteri, ovary and mouth with AAIR of 13.1, 8.2, 7.2, 3.9 and 2.5, respectively [88-91].

Table-17: Screening uptake by women aged 30–49 years in UP state and its districts, as per NFHS-5 (2019–2021). [Charurwadi P. ecancer 2024, 18:1742]

UP/Its districts	Screening uptake by women						Women population (age: 30-49), 2021
	Cervical cancer		Breast cancer		Oral cancer		
	%	n	%	n	%	n	
UP#	**1.5**	**404,794**	**0.4**	**99,133**	**0.6**	**173,483**	**27,537,000**
Agra (1)	0.3	1,757	0.3	1,757	0.4	2,343	585,732
Aligarh (2)	0.2	955	0.4	1,909	0.0	0	477,303
Allahabad (3) (Currently known as Prayagraj)	1.4	11,075	0.4	3,164	0.7	5,538	791,081
Ambedkar Nagar (4)	4.8	14,918	0.4	1,243	0.4	1,243	310,793
Auraiya (5)	1.4	2,549	0.3	546	0.7	1,275	182,102
Azamgarh (6)	4.6	28,381	1.5	9,255	0.6	3,702	616,983
Baghpat (7)	0.2	310	0.0	0	0.0	0	154,884
Bahraich (8)	0.2	961	0.0	0	1.3	6,247	480,518
Ballia (9)	0.9	3,966	0.4	1,763	0.7	3,085	440,700
Balrampur (10)	3.0	7,722	0.5	1,287	1.6	4,118	257,396
Banda (11)	3.6	8,288	1.4	3,223	1.7	3,914	230,221
Barabanki (12)	1.3	5,198	0.0	0	1.2	4,798	399,842
Bareilly (13)	0.2	1,132	0.0	0	0.0	0	566,025
Basti (14)	3.0	9,110	0.5	1,518	0.0	0	303,669
Bijnor (15)	0.0	0	0.0	0	0.2	934	467,103
Budaun (16) *	0.7	2,935	0.4	1,677	0.2	838	419,244
Bulandshahr (17)	0.0	0	0.2	917	0.0	0	458,515
Chandauli (18)	4.2	10,680	0.8	2,034	0.6	1,526	254,285
Chitrakoot (19)	1.4	1,866	0.4	533	1.3	1,732	133,257
Deoria (20)	6.8	28,428	0.8	3,344	0.5	2,090	418,062
Etah (21)	0.7	1,498	0.3	642	0.0	0	213,961
Etawah (22)	0.2	411	0.0	0	0.2	411	205,532
Faizabad (23)	0.0	0	0.0	0	0.2	632	316,101
Farrukhabad (24)	0.1	228	0.2	457	0.4	914	228,383
Fatehpur (25)	1.9	6,303	1.1	3,649	1.5	4,976	331,713
Firozabad (26)	0.2	652	0.2	652	0.0	0	325,971
Gautam Buddha Nagar (27)	0.2	558	0.0	0	0.2	558	279,010
Ghaziabad (28) *	0.7	5,646	0.0	0	0.9	7,259	806,517
Ghazipur (29)	1.3	6,178	0.1	475	0.2	951	475,260
Gonda (30)	2.1	8,955	0.5	2,132	1.2	5,117	426,430
Gorakhpur (31)	1.8	10,779	1.3	7,785	0.9	5,389	598,819
Hamirpur (32)	2.8	3,650	0.2	261	0.5	652	130,358
Hardoi (33)	0.7	3,526	0.3	1,511	1.5	7,556	503,726
Jalaun (34)	1.4	3,228	0.0	0	0.0	0	230,602
Jaunpur (35)	4.2	25,010	0.0	0	0.1	595	595,484
Jhansi (36)	1.7	4,974	0.5	1463	0.9	2,633	292,561
Jyotiba Phule Nagar (37) Currently known as Amroha	0.0	0	0.2	473	0.2	473	236,551
Kannauj (38)	2.3	4,653	1.0	2,023	1.2	2,428	202,294
Kanpur Dehat (39)	0.6	1,404	0.0	0	0.6	1,404	234,063
Kanpur Nagar (40)	0.8	5,178	0.5	3,236	1.0	6,472	647,226
Kanshiram Nagar (41) Currently known as Kasgani	0.6	999	0.2	333	0.2	333	166,527
Kaushambi (42)	0.5	972	0.2	389	0.6	1,166	194,389
Kheri (43) Currently known as Lakhimpur Kheri	0.6	3,255	0.0	0	0.3	1,627	542,497
Kushinagar (44)	3.0	14,399	0.3	1,440	0.3	1,440	479,963
Lalitpur (45)	0.9	1,433	0.2	318	0.5	796	159,225
Lucknow (46)	1.1	8,083	0.0	0	0.4	2,939	734,855
Mahamaya Nagar (47) Currently known as Hathras	2.4	4,650	1.7	3,294	2.2	4,263	193,766
Mahoba (48)	6.0	7,356	0.7	858	1.8	2,207	122,604
Mahrajganj (49)	0.7	2,549	0.3	1,092	0.3	1,092	364,163
Mainpuri (50)	1.0	2,254	0.4	902	0.0	0	225,422

Mathura (51)	0.7	2,282	0.5	1,630	0.2	652	326,057
Mau (52)	3.7	10,676	1.0	2,885	1.2	3,463	288,549
Meerut (53)	0.2	894	0.0	0	0.0	0	447,058
Mirzapur (54)	3.3	10,503	0.2	637	0.8	2,546	318,277
Moradabad (55) *	0.8	4,883	0.8	4,883	0.4	2,441	610,368
Muzaffarnagar (56) *	0.2	1,062	0.2	1,062	0.2	1,062	531,245
Pilibhit (57)	0.9	2,422	0.2	538	0.4	1,077	269,135
Pratapgarh (58)	0.0	0	0.0	0	0.2	874	437,091
Raebareli (59) *	1.4	6,271	0.2	896	0.7	3,136	447,946
Rampur (60)	0.4	1,159	0.2	579	0.4	1,159	289,741
Saharanpur (61)	0.2	917	0.1	459	0.2	917	458,667
Sant Kabir Nagar (62)	0.8	1,689	0.3	633	0.2	422	211,093
Sant Ravidas Nagar (63)	1.8	3,751	0.0	0	0.6	1,250	208,384
Shahjahanpur (64)	0.2	721	0.2	721	0.2	721	360,638
Shravasti (65)	1.2	1,190	0.4	397	0.5	496	99,184
Siddharth Nagar (66)	2.3	6,714	0.4	1,168	0.2	584	291,901
Sitapur (67)	3.8	21,978	0.2	1,157	0.4	2,313	578,367
Sonbhadra (68)	2.8	7,060	0.0	0	0.2	504	252,130
Sultanpur (69) *	4.3	21,468	1.8	8,987	1.7	8,487	499,253
Unnao (70)	2.0	7,947	0.7	2,781	2.4	9,536	397,351
Varanasi (71)	3.4	17,800	0.9	4,712	1.6	8,377	523,533

Table-18: Estimated trends in number of cancers for the leading sites (ICD-10 codes) in India (2015, 2020, and 2025)[Vemula, Priya D. Ind J Med Paediatr Oncol 2025;46:278–287].

Males				Females			
Cancer site (ICD 10)	2015	2020	2025	Cancer site (ICD 10)	2015	2020	2025
Lung (C33–34)	63,087	71,788	81,219	Breast (C50)	180,252	205,424	232,832
Mouth (C03–C06)	50,779	57,380	64,519	Cervix (C53)	65,978	75,209	85,241
Prostate (C61)	36,419	41,532	47,068	Ovary (C56)	38,607	43,886	49,644
Tongue (C01–C02)	35,336	39,902	44,861	Corpus uteri (C54)	23,175	26,514	30,121
Stomach (C16)	28,815	32,713	36,938	Lung (C33–34)	23,163	26,490	30,109
Others	387,301	436,106	488,970	Others	296,027	335,235	378,271
All sites	**601,737**	**679,421**	**763,575**	**All sites**	**627,202**	**712,758**	**806,218**

Table-19: The estimated top five leading sites of cancer (number and proportion) in India by age group (0–14, 15–39, 40–64, and >65 age groups) and sex for the year 2024.

Males			Females
Cancer site	*n* (%)	Cancer site	*n* (%)
0–14 years			
Lymphoid leukemia (C91)	6,365 (29.06)	Lymphoid leukemia (C91)	3,568 (24.07)
Brain and NS (C70–C72)	2,740 (12.6)	Brain and NS (C70–C72)	2,100 (14.17)
NHL (C82–86, C96)	1,720 (7.6)	Bone (C40–C41)	1,226 (8.27)
Hodgkin's disease (C81)	1,624 (7.6)	Myeloid leukemia (C92–C94)	1,270 (8.56)
Myeloid leukemia (C92–C94)	1,601 (7.31)	NHL (C82–86, C96)	953 (6.42)
Other sites	7,848 (36)	Other sites	5,705 (38.5)
All sites	**21,898 (100)**	**All sites**	**14,822 (100)**
15–39 years			
Mouth (C03–C06)	10,122 (12.60)	Breast (C50)	27,562 (27.05)
Tongue (C01–C02)	7,652 (9.53)	Thyroid (C73)	13,324 (13.07)
Brain and NS (C70–C72)	5,923 (7.4)	Ovary (C56)	7,966 (7.82)
Myeloid leukemia (C92–C94)	5,400 (6.72)	Cervix (C53)	6,821 (6.69)
NHL (C82–86, C96)	5,012 (6.23)	Myeloid leukemia (C92–C94)	3,625 (3.56)
Other sites	46,216 (57.5)	Other sites	42,568 (41.8)
All sites	**80,325 (100)**	**All sites**	**101,866 (100)**

40–64 years			
Lung (C33–34)	38,537 (11.0)	Breast (C50)	142,124 (32.3)
Mouth (C03–C06)	38,800 (11.08)	Cervix (C53)	53,687 (12.20)
Tongue (C01–C02)	26,354 (7.52)	Ovary (C56)	29,514 (6.70)
Esophagus (C15)	19,964 (5.7)	Corpus uteri (C54)	20,142 (4.6)
Stomach (C16)	19,231 (5.5)	Lung (C33–34)	15,841 (3.60)
Other sites	207,254 (59.19)	Other sites	178,652 (40.6)
All sites	**350,141 (100)**	**All sites**	**439,960 (100)**
65+ years			
Lung (C33–34)	37,600 (12.90)	Breast (C50)	51,123 (22.7)
Prostate (C61)	34,562 (11.9)	Cervix (C53)	21,134 (9.4)
Esophagus (C15)	15,963 (5.5)	Lung (C33–34)	13,258 (5.9)
Stomach (C16)	15,623 (5.3)	Ovary (C56)	13,245 (5.87)
Mouth (C03–C06)	15,784 (5.40)	Mouth (C03–C06)	10,246 (4.54)
Other sites	172,231 (59.0)	Other sites	116,258 (51.6)
All sites	**291,763 (100)**	**All sites**	**225,264 (100)**

4. METHODS USED IN DIFFERENT STUDIES ARE DELINEATED BELOW:

Extracted data on cervical cancer incidence and mortality from 1990 to 2025 from the Global Burden of Disease 2025 studies and published articles. The case definition was included cervical cancer having ICD-10 codes C53, C53.0, C53.1, C53.3, C53.4, C53.8, C53.9, D06, D06.0, D06.1, D06.7, D06.9, D26.0. Data for the incidence and Death rate of cervical cancer for India were extracted from an online articles/ tool produced by the IHME, which was publicly available called the GHDx (Global Health Data Exchange) query tool (http://ghdx.healthdata.org/gbd-results-tool) [111]. The state-level data on the burden of cervical cancer was extracted from the GBD India Compare tool (https:// vizhub.healthdata.org/gbd-compare/india) [111-118]. The key sources of data that GBD used to model the cause of death due to cervical cancer in India included cancer incidence in five continents by the International Agency for Research on Cancer, International Association of Cancer Registries, Population-based cancer registries of India and various states, medical certification of cause of deaths of the country and various states, vital statistics, other surveys on the cause of death and published scientific articles [113-121].

Population based cancer registries (PBCRs) under the National Cancer Registry Programme (NCRP) are longterm cancer registries that have provided reliable and consistent cancer burden estimates in the country since 1981. In 2024, there were 28 PBCRs covering 10% of the total population of India, with 3.5% of them being rural, 42.9% being urban, and 53.6% being semi-urban. This study utilized the cervical cancer incidence and mortality data for women of different age groups obtained from 28 different PBCRs under the NCRP in the country [15–17]. The cervical cancer incidence and mortality were ascertained by the International Classification of Disease (ICD) -10 code "C53" [18]. The level of registration of mortality is low, ranging between 35% and 100% across the states in India [19]. To account for under reported mortality in the country, we searched for the available evidence on the reported mortality to incidence (MI) ratio in India. Two national-level studies were identified, with average MI ratios for cancer of 35.0% and 75.4% [20, 21]. All longitudinal data points with reported MI ratios of 35.0% or higher for cervical cancer from PBCRs between 2005 and 2016 were extracted to estimate an adjusted MI ratio for cervical cancer among Indian women. Gamma distribution was identified as the best fit to the data based on Akaike's information criteria and Bayesian information criteria (R software, version 4.1.2, R Core Team, Vienna, Austria). The Markov Chain Monte Carlo(MCMC) method, specifically implemented using STATA 14.2 by Stata Corp in College Station, Texas, USA, was employed to estimate a mean MI ratio of 52.5%. This estimation was derived from a data set consisting of 55 data points, all of which had MI ratios equal to or exceeding 35.0%. The MCMC process involved 10,000 iterations, ensuring convergence for accurate and reliable results. For registries with a reported MI ratio less than 52.5%, the MI ratio was replaced with 52.5% to calculate adjusted mortality numbers for further analysis and burden estimation. The populations by age for the years 2012 to 2016 were projected for the 28 states and 2 union territories using the difference distribution method, based on data from the 2001 and 2011 Census of India [22]. The cervical cancer incidence and mortality rates were calculated for quinquennial age groups. The incidence rate for a specific age group was calculated by dividing the number of newly diagnosed cervical cancer cases in a given year by the corresponding mid-year population. Similarly, the mortality rate for a particular group was calculated by dividing the number of cervical cancer deaths in a given year (adjusted) by the corresponding mid-year population. Age-specific all-cause mortality for women during 2012–2024 was obtained from the Sample Registration System, Office of the Registrar General of India [23]. The cancer prevalence was estimated using the DISMOD II tool, incorporating input data such as cancer incidence, cause-specific mortality, mortality-incidence ratio, all-cause mortality, and population information [24]. The regional grouping used in the earlier analysis was utilised for this analysis for uniformity [113]. For the regions where PBCRs already existed, those data sources were used, and for the regions where there weren't any or there weren't enough data, the data from the closest PBCRs were used.

Similarly the burden of cervical cancer was estimated and reported for each state and region in terms of YLLs, YLDs, and DALYs per 100,000 populations, using the available national cancer registry programme data. YLLs were calculated by multiplying the total number of cervical cancer deaths in a specific age group by the standard life expectancy of that age group. The standard life expectancies of different age groups were obtained from the WHO standard life tables. YLDs were estimated by multiplying the total number of prevalent cervical cancer cases in respective five-year age groups by a disability weight of 0.451, which was specific to metastatic cancer according to the Global Burden of Disease Study, 2023 [25]. The sum of the estimated YLLs and YLDs provided the DALY metrics. The burden metrics (YLLs, YLDs, and DALYs) were age standardised using the WHO World Population Standard distribution 2000–2025 [26]. Furthermore, using the available sex and age-specific cancer incidence and estimated mortality information from 2001 to 2024, the cervical cancer burden metrics were projected for 2025. Negative binomial regression was used for prediction as the conditional mean of the burden metrics was less than the conditional variance using IBM SPSS software (Version 26.1; IBM Corp., Armonk, NY, USA). Population-based cancer incidence data in the United States have been collected by the National Cancer Institute's (NCI's) Surveillance, Epidemiology, and End Results (SEER) program since 1973 and by the Centers for Disease Control and Prevention's (CDC's) National Program of Cancer Registries (NPCR) since 1995. The SEER program is the only source for historic population-based incidence data from the eight oldest SEER areas (Connecticut, Hawaii, Iowa, New Mexico, Utah, and the metropolitan areas of Atlanta, San Francisco-Oakland, and Seattle-Puget Sound), representing approximately 8% of the US population[5-21].

5. STATISTICAL CALCULATION WAS USED IN DIFFERENT STUDIES

Crude Incidence Rate:

Crude rate (CR) is the rate found by dividing the total number of cancer cases by the corresponding mid-year population estimate and then multiplying the result by 100,000.

$$\mathrm{CR} = \frac{\text{New cases of cancer of a particular year}}{\text{Estimated population of the same year}} * 100{,}000.$$

Age-Specific Rate:

ASpR is the rate determined by dividing the total number of cancer cases by the estimated population in that age group, gender, site, geographic area, and time, then multiplying the result by 100,000.

$$\mathrm{ASpR} = \frac{\text{New cases of cancer of a particular year in the given age group}}{\text{Estimated population of the same year for the given age group}} * 100{,}000$$

Age-Standardized Rate:

Cancer incidence increases as age increases. Accordingly, the number of cancer cases increases with the percentage of the population that is older. The proportion of older people was higher in most developed and Western countries. Hence, age adjusted rate (AAR) or age-standardized rate were calculated using a world standard population that accounts for this to make cancer rates comparable between nations. By collecting the ASpRs and applying them to the standard population in that age group, this was estimated using the direct technique (Boyle and Parkin, 1991).

$$\mathrm{AAR} = \frac{\Sigma(\mathrm{ASpR}) \times (\text{No.of persons in Std.world population in that 5 yearage group})}{100{,}000}$$

Table- 3 Estimated trends in number of cancers for the leading sites (ICD-10 codes) in India (2015, 2020, and 2025)

To estimate the APC, the following model is used:

log(Yx)=b0+b1x , where log (Yx) is the natural logarithm of the rate in year x. Then, the APC from year x to year x + 1 is:

$$APC = \frac{e^{b_0+b_1(x+1)} - e^{b_0+b_1 x}}{e^{b_0+b_1 x}} * 100 = \left(e^{b_1} - 1\right) * 100$$

Sampling weights and calculation of weighted percentages:

The NFHS-5 dataset provides sampling weights to adjust for differences in selection probability and non-response rates.[1] The individual weight (v005) was used for all calculations. Since NFHS-5 weights are provided as six-digit integers, they were normalized by dividing by 1,000,000 before use.[2] The weighted percentage of women who underwent cervical cancer screening in each state was calculated using the formula:

$$\text{Weighted percentage} = \left(\frac{\sum(\text{screened} \times \text{v005})}{\sum \text{v005}) \times 100} \right) \times 100$$

Where:

- Screened = Indicator variable (1 = screened, 0 = not screened)
- v005 = Individual sampling weight

- ∑ (screened × v005) = Sum of weighted counts of screened women
- ∑ v005 = Sum of all individual weights for eligible women in each state.

6. DISCUSSION

In this review, the documented reports advocated that there has been a significant decline in the incidence and mortality of cervical cancer over the past three decades in India [5-21]. This corroborated with studies conducted by various researchers [146–149]. Whereas, in high-income countries, cervical cancer incidence and mortality have decreased by more than half over the past 30 years after the introduction of formalized screening programmes [150]. Recent evidence suggested that factors such as socioeconomic development and high-income countries type lifestyle-related transitions underpin changes in cancer risk, reduced the cervical cancer rates in countries with emerging economies [11, 21]. A trend of decline in the incidence rates in urban areas truly represented the societal changes that were not reflected in India's rural areas [22].

The reported documents also advocated that the cervical cancer presented significant public health challenges in India, with higher incidence and mortality rates compared to other regions [5-21]. The burden of the disease remained substantial due to lower coverage of HPV vaccination, approximately 22%, and the limited implementation of Pap smear screenings. These factors contributed to the continued high mortality, with approximately 60,000 deaths annually in India. In contrast, countries with the 10^{x100} effective HPV vaccination programs and widespread cervical screening practices have seen a decline in cervical cancer rates [7]. The several studies have discussed on epigenetic modifications which highlighted their critical role in the progression of cervical cancer. Aberrant DNA methylation, histone modifications, and the involvement of noncoding RNAs were also significant to silent the tumor suppressor genes which activated oncogenes to drive cancer development. The importance of biomarkers like HPV DNA testing and HPV E6/E7 mRNA testing was emphasized for early detection and treatment. These tools were crucial to identify both cervical cancer and precancerous lesions, though their implementation in India was limited, particularly in rural areas [28-31].

Further, various recent researches have also highlighted that the decline in the incidence of cervical cancer was also because of an organized mass screening program for the early detection of cervical cancer in India [155].

Notwithstanding with the caveat of the estimates from various information, the absolute number of cases of cervix uteri cancer has increased over time (GLOBCAN) (471000 in 2000, 529000 in 2008, 570,000 in 2018) [27, 28]. The rising age at marriage, increase in the age at first term pregnancy, lowering parity could have contributed to reducing the risk of HPV acquisition, decreasing the incidence of cervical cancer in India. Further, vaccination could have led to this significant decline in the burden of cervical cancer [6]. As evident from developed countries, screening and vaccination have been identified as preventive measures in reducing cervical cancer burden [49]. Consistent with the present findings, a study conducted across 38 countries found a substantial decrease in the age-standardized incidence rates in the highest-income countries. However, these rates were found to increase, or stabilized rates were visible in lower-resourced settings [5-21,44].

This review also highlighted the reports of published data which advocated that, a substantial decline was observed in the mortality due to cervical cancer in the country[6-11]. This finding was consistent with other studies as well [12, 18, 44, 76, 88.100]. The decline in the morality was mainly attributable to improved health facilities, screening and vaccination coverage. A study also reported that the proportion of deaths due to cervical cancer has decreased from 8.2% in 2008 to 7.5% in 2018 [130]. A study also observed that the introducing HPV vaccination alone led to a 60% decline in cervical cancer-related mortality compared to those without any vaccination and screening [131]. This study revealed that different screening strategies have a varying reduction in lifetime occurrence of cervical cancer caused by HPV from 16 to 61% and reducing mortality due to cervical cancer from 28 to 70% [131]. Furthermore, a successful organized and opportunistic screening has led to a substantial decline in the last 50 years in cervical cancer morbidity and mortality in high- and middle-income countries [132]. There has been a 21.32 percentage change in the incidence of cervical cancer in the period 1990-2019. Similarly, a change of 32.29 percentage point was observed in the country's mortality due to cervical cancer. The trends observed in cervical cancer incidence and mortality in the country over the period were likely due to population ageing, changes in knowledge and literacy, early screening, improved access to health care, and other risk factors. Studies have also highlighted the lack of inadequate and incomplete information on deaths leading to the inaccuracy of mortality statistics and trends. Reproductive risk factors such as later age at first birth, lower parity was inversely related to decreasing age-standardized incidence rates [133]. The age-standardized incidence and death rates of cervical cancer are 13.10 and 7.38 per 100,000 females. Consistent with our findings, researchers found the age-standardized incidence and mortality rates of cervical cancer to be 14.7 and 9.2 per 100,000 among Indian women [134]. Similarly, researchers at George institute also found the age-standardized incidence and mortality rates of cervical cancer to be 22 and 12.4 per 100,000 women. The rank of age-standardized cervical cancer incidence rate has decreased significantly in states like Arunachal Pradesh and Assam [153]. A geographical difference reflected in the incidence of mortality was due to differences in exposure to risk factors and serious inequalities in access to adequate screening and effective cancer treatment facilities. Even after more than a decade of the introduction of HPV vaccines, the prevalence of cervical cancer was quite alarming. In India, Universal cervical cancer screening was an unmet need [35]. The fourth round of the National Family Health Survey estimated that only 22.3% of eligible women received cervical cancer screening during 2015- 16 [36]. The associated mortality with Cervical cancer in India was one of the highest in the world [137–139]. Studies have also reported that India's overall knowledge and awareness about cervical cancer, HPV, and HPV vaccination was very poor. Researchers were of the opinion that factors such as societal, religious and prejudiced ideas, socioeconomic status, including lack of knowledge, awareness and attitude, affect the HPV vaccination in India.

In this review, reported comparative analysis of various studies with high-income countries revealed stark difference in the adoption and accessibility of preventive measures. While HPV DNA testing was a standard practice in many countries, its application in India was inconsistent. The variability in access to these crucial diagnostic tools highlights the need for a more robust and systematic approach to cervical cancer prevention and early detection in India [6-21, 155].

It has also observed that the availability of cervical cancer screening services in India has substantially increased over the last decade, with standardized Pap smears in urban areas and higher centers as well as visual inspection with acetic acid or Lugol's iodine methods in most rural primary health facilities and other low-resource settings.[24] However, the estimated weighted prevalence of cervical cancer screening among women aged 30-49 years was notably low (1.9%), which aligns with patterns noted in some other LMICs [25,26].

This was in stark contrast to the higher rates observed in developed regions,[27-29], indicative of disparity in access to an utilization of preventive healthcare. The NFHS-5 estimate was comparatively lower than those from studies conducted in Bangladesh (7.5%),[30] Ethiopia (n = 18067, 14.8%)[31] and Oman (n = 805, 15.7%).[32]. In comparison, NFHS-4 estimated the coverage of cervical cancer screening as 29.8%, which was based on women who had previously undergone a cervical examination.[14] This discrepancy between the NFHS-4 data, which reported the percentage of women who had undergone a cervical examination, and the NFHS-5 data, which reported the percentage of cervical cancer screening, limits direct comparison. Future rounds of the NFHS survey may improve comparability by consistently reporting data on cervical cancer screening across multiple iterations, allowing for more accurate trend analysis and a better understanding of changes in cervical health monitoring practices over time.

This review also observed that the reported data which revealed the several socio-demographic factors such as, the higher education levels and belonging to a higher wealth quintile were significantly associated with increased cervical cancer screening, probably due to better awareness of cancer and easier access to healthcare services.[33] This was also particularly evident in the context of cervical cancer screening, where awareness and affordability play central roles in encouraging women to undergo preventive screenings.[34] Moreover, the dominance of the wealth index as a predictor of screening behavior underscores the critical intersection between economic capability and access to health services.[35]

Screening costs can also be included both direct and indirect expenses, such as the cost of the screening itself, transportation to health facilities, and the opportunity cost of time taken off work. Previous research consistently supported the notion that higher socioeconomic status facilitates better access to healthcare services, including preventive screenings,[36] indicating that financial barriers were a significant impediment to cancer screening uptake in India [37,38].

Education in women translated into improved health literacy, enabling them to better understand the importance of early detection and prevention of diseases like cervical cancer [39]. Educated women were also more likely to have better access to health information and resources, empowering them to make informed decisions about their health. This aligns with findings from various settings, where education has been shown to be a key determinant of health behaviors, including participation in cancer screenings [16,40]. Additionally, educational interventions to improve awareness and sensitization, especially those utilizing mHealth components such as texting and audio calls, have been shown to significantly improve adherence rates among women who were non-adherent to cervical cancer screening[141].

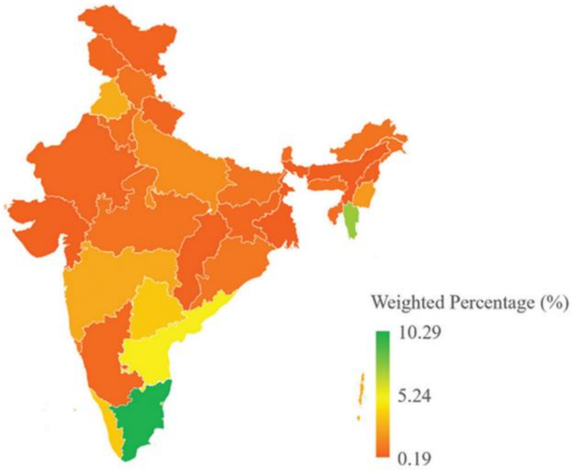
Contraceptive used; particularly the use of contraceptive pills and condoms, was associated with a lower likelihood of cervical cancer screening. This could reflected a complex interplay of factors, including possible misconceptions about the reduced need for screening among women who perceived themselves to be at lower risk of contracting sexually transmitted infections (STIs), such as human papillomavirus (HPV), due to protected sexual activity [142]. Conversely, the use of tobacco and alcohol was also associated with a lower likelihood of undergoing cervical cancer screening. As reported in studies conducted elsewhere, these behaviors may be reflected broader lifestyle patterns that could be linked to lower health literacy[43] and awareness, or higher engagement in behaviors perceived as risky, which may be deter women from seeking preventive healthcare services [144]. Targeting these groups with tailored health promotion strategies that address specific barriers and misconceptions could help improve screening rates. Obesity and additional comorbidities also emerged as significant predictors of cervical cancer screening, likely reflecting broader health engagement and access issues. Obese women and those with comorbid conditions may interacted with healthcare systems more frequently, providing more opportunities for healthcare providers to recommend cancer screening. This was consistent with prior studies that have found associations between higher BMI and increased healthcare utilization,[45] though the relationship with preventive services like cancer screening can vary[146, 147].

Several studies advocated the geographic variation in screening rates; with higher percentages in southern India, underscores the impact of regional health infrastructure, translating into differential access and availability of screening programs, awareness campaigns, and the overall prioritization of women's health issues in different states. These disparities may be reflected differences in healthcare priorities, resource allocation, and the effectiveness of public health campaigns across states, indicating the need for region-specific strategies to improve screening coverage[124].

Table-20:Percentage of cervical cancer screening across India: [155]

Indian states	Number of women eligible for screening (*N*)	Number of women screened for cervical cancer (*n*)	Unweighted percentage (%)	Weighted percentage (%)
Andaman and Nicobar Islands	1,215	66	5.4	2.7
Andhra Pradesh	5,315	263	4.9	4.8
Arunachal Pradesh	9,265	86	0.9	0.9
Assam	15,573	32	0.2	0.2
Bihar	17,171	118	0.7	0.9
Chandigarh	334	6	1.8	1.8
Chhattisgarh	11,963	37	0.3	0.3
Dadra and Nagar Haveli	1,122	5	0.4	0.4
Goa	1,031	12	1.2	1.2
Gujarat	16,029	44	0.3	0.2
Haryana	9,981	84	0.8	0.8
Himachal Pradesh	5,650	41	0.7	0.9
Jammu and Kashmir	10,200	52	0.5	0.5
Jharkhand	11,245	53	0.5	0.5
Karnataka	14,055	77	0.5	0.6
Kerala	6,118	221	3.6	3.5
Ladakh	1,069	3	0.3	0.3
Lakshadweep	616	12	1.9	1.9
Madhya Pradesh	21,054	149	0.7	0.9
Maharashtra	16,145	320	2	2.5
Manipur	3,659	65	1.8	2.0
Meghalaya	5,120	21	0.4	0.7
Mizoram	3,123	178	5.7	7.3
Nagaland	4,219	17	0.4	0.3
Delhi	5,005	39	0.8	0.7
Odisha	12,754	113	0.9	1.0
Puducherry	1,857	83	4.5	7.8
Punjab	10,619	285	2.7	2.7
Rajasthan	18,267	66	0.4	0.4
Sikkim	1,563	9	0.6	0.7
Tamil Nadu	12,865	1,346	10.5	10.3
Telangana	12,756	468	3.7	3.5
Tripura	3,533	23	0.7	0.7
Uttar Pradesh	37,647	635	1.7	1.6
Uttarakhand	5,999	20	0.3	0.5
West Bengal	9,786	25	0.3	0.2
Total	**3,23,923**	**5,074**	**1.6**	**1.9**

Figure-6: Weighted percentage of cervical cancer screening across Indian states and union territories.



This map,illustrated the weighted percentage of cervical cancer screening across Indian states and union territories. [Maheshwari, et al.,Cancer Research, Statistics and Treatment. 2025; 8(1): 30-39]

Table- 21. Estimated Age-Specific and Total Incidence Cases of Cervical Cancer from 2015 to 2030 [145]

Year	Incidence cases of age-specific and total cervical cancer*												Total
	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+	
2015	2	9	29	66	110	140	136	133	136	98	55	51	965
2016	2	9	28	64	110	141	139	135	132	103	58	54	974
2017	2	8	27	62	108	140	139	136	132	102	60	56	972
2018	1	8	26	61	106	139	140	138	132	101	62	59	972
2019	1	8	25	60	105	138	141	139	132	101	64	61	975
2020	1	7	24	59	104	138	142	142	133	100	66	64	981
2021	1	7	23	58	103	138	144	144	135	100	68	67	989
2022	1	7	23	57	102	138	144	146	138	101	68	70	996
2023	1	7	23	56	102	138	145	149	141	102	68	73	1005
2024	1	6	23	55	102	138	147	152	144	103	68	76	1016
2025	1	6	23	55	102	139	148	155	148	105	69	79	1029
2026	1	6	23	54	102	139	150	159	152	107	69	82	1044
2027	1	6	22	55	102	140	151	161	156	110	70	84	1057
2028	1	6	22	55	101	140	152	163	160	113	72	86	1072
2029	1	6	22	55	101	142	154	166	165	117	73	88	1089
2030	1	5	22	56	101	143	155	169	169	121	75	91	1108

Figure-7: The 20 countries with the highest ASIR and ASMR of cervical cancer in 2030.

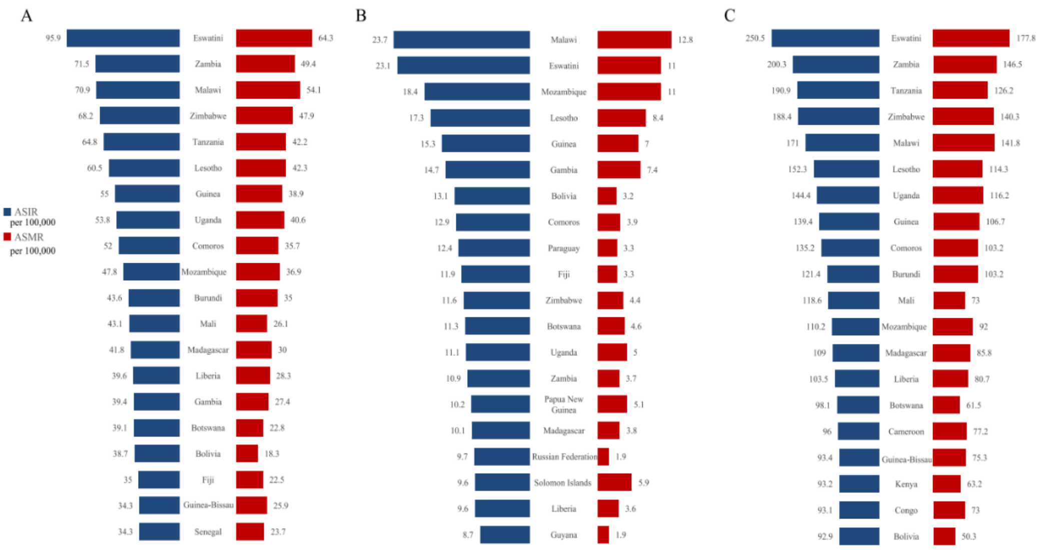


Figure-7, illustrated that the, A) Overall cervical cancer, B) Early-onset cervical cancer, C) Late-onset cervical cancer. ASIR, Age-Standardized Incidence Rates; ASMR, Age-Standardized Mortality Rates.

The present study has a few limitations. First, that the data has taken from different articles/ sources which applied various methods to improve the quality of data by adjusting for missing or incomplete data, but it can't be rule out the possibility of some inaccuracy in the mortality data. Second, this was an review study based on published data from articles; hence, interpretations from this study were true at population levels, but they do not necessarily hold at the individual level.

7. CONCLUSION

Cervical cancer remains a critical public health concern in India, with incidence and mortality rates significantly higher than in many other countries. The limited coverage of HPV vaccination, at around 22%, and inadequate implementation of Pap smear screenings were key factors contributing to the high burden of this disease. These gaps in preventive measures have led to approximately 60,000 cervical cancer-related deaths annually, highlighting the urgent need for improved healthcare strategies. In contrast, countries with comprehensive HPV vaccination programs and routine cervical screening have achieved substantial reductions in cervical cancer incidence and mortality. The effective deployment of these preventive measures has not only decreased the disease burden but has also improved overall survival rates. This comparison underscores the importance of strengthening India's healthcare infrastructure to provide more consistent and widespread access to vaccinations and screenings. Moreover, the role of epigenetic modications, such as DNA methylation and histone changes, in the progression of cervical cancer points to the need for advanced diagnostic tools like HPV DNA and HPV E6/E7 mRNA testing. Despite their proven effectiveness in early detection, these technologies are underutilized in India, especially in rural areas. Addressing these disparities by integrating advanced diagnostic methods into routine practice and enhancing public health campaigns for vaccination and screening could significantly reduce the impact of cervical cancer in India, ultimately leading to better outcomes and decreased mortality.

In view of above facts, based on published articles and data, this study concluded as that the overall incidence and mortality of cervical cancer showed a significant decreasing trend in India between 1990 and 2024, the highest decline in the incidence and mortality rates were reported in the period 1998-2005. The highest incidence and mortality of cervical cancer were reported in Tamilnadu and lowest in Jammu & Kashmir and Ladakh during 1990 & 2024. The highest percentage decrement in the incidence of cervical cancer was reported in Jharkhand and lowest in Jammu & Kashmir during the study period. The highest percentage decrement in cervical cancer mortality was seen in Jharkhand from 1990 to 2024. Though the incidence and mortality of cervical cancer declined over the past three decades but it was still a major public health problem in India. Information, education and communication activities for girls, boys, parents and the community regarding the risk factors of cervical cancer, mode of transmission, screening programme, HPV, HPV vaccination and treatment modalities should be provided throughout the country. HPV vaccine should be included in the national immunization program to improve its availability and accessibility to all eligible beneficiaries. The cervical cancer screening facility should be available at a peripheral level for early diagnosis of precancerous conditions. The involvement of non-government organizations can play a key role in primary, secondary and tertiary levels of prevention for cervical cancer.

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