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Socioeconomic disparities in uterine cervical cancer burden; an ecological assessment of global incidence and mortality patterns by human development index in 2022

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Abstract

Introduction: Uterine cervical cancer remains a major public health concern worldwide, ranking as the fourth most common cancer among women. Despite advances in prevention and treatment, significant disparities in incidence and mortality persist, largely reflecting underlying socioeconomic inequalities. The human development index (HDI), a composite measure of life expectancy, education, and per capita income, offers a critical lens for examining these disparities on a global scale.

Objectives: This ecological study aimed to investigate the patterns of cervical cancer incidence and mortality across countries stratified by HDI in 2022, highlighting the persistent influence of socioeconomic development on disease burden.

Materials and Methods: This ecological study utilized data from the International Agency for Research on Cancer (IARC) and the Global Cancer Observatory (GLOBOCAN) project for the year 2022. Incidence and mortality statistics for uterine cervical cancer were extracted for countries worldwide and stratified according to the HDI categories. Comparative analyses were then performed to evaluate differences in uterine cancer incidence and mortality across varying HDI levels.

Results: The results showed that countries classified as very high HDI demonstrated the most favorable outcomes in the context of uterine cervical cancer, displaying the smallest proportions of both newly diagnosed cases and resultant mortality. Conversely, as the HDI categorization shifts downwards, transitioning from the designation of high to medium, and subsequently to low, a corresponding and gradual escalation becomes evident in the rates of both the incidence of new cervical cancer diagnoses and the rates of mortality stemming from this particular disease.

Conclusion: In conclusion, the significant socioeconomic disparities identified in uterine cervical cancer incidence and mortality underscore the urgent need for targeted interventions in lower HDI countries. Addressing these inequities through improved access to prevention, screening, and treatment is essential to reduce the disproportionate burden and promote global health equity in cervical cancer outcomes.

Introduction

Uterine cervical cancer represents a significant global health burden, with an estimated 604,000 new cases and 342,000 deaths reported worldwide in 2020, making it the fourth most common cancer among women globally (1-3). This malignancy predominantly affects women in low- and middle-income countries, with the highest burden concentrated in sub-Saharan Africa and south-central Asia (4,5). This cancer is largely driven by persistent infection with high-risk human papillomavirus (HPV) types, most notably HPV-16 and HPV-18, which together account for roughly 70% of cases (6-8). Despite the biological necessity of HPV, the transition from infection to invasive disease is modulated by host immunity,

Key point

The ecological study reveals significant socioeconomic disparities in uterine cervical cancer, with countries of lower human development index bearing a disproportionately higher burden of incidence and mortality. These findings underscore the crucial influence of socioeconomic development on health outcomes, highlighting that lower human development index regions face greater challenges related to cervical cancer.

reproductive factors, sexual behavior, smoking, and co-infections (6,9). Since cytology and HPV testing can detect precancerous lesions years before invasion, cervical cancer serves as a paradigm of a malignancy that is both highly preventable and, when caught early, highly curable. Nevertheless, gaps in vaccine uptake, screening coverage, and timely treatment have slowed progress toward the World Health Organization's (WHO's) elimination target of fewer than 4 cases per 100,000 women in a year (10).

Recent Global Cancer Observatory (GLOBOCAN) updates show that cervical cancer remains a top public health challenge; a granular 2020 assessment documented a three-fold incidence differential and a six-fold mortality differential between low- and very high-human development index (HDI) countries (10). Multivariate ecological models attribute over half of the global variance in mortality to HDI and poverty alone (11). Within countries, women residing in poorer households, rural districts, or minority racial/ethnic groups are more likely to present with advanced disease, receive less definitive surgery, and experience worse overall survival (12,13). Decomposition of screening data from sub-Saharan Africa shows that educational attainment, urban residence, and household wealth collectively explain more than 75% of the pro-rich inequality in cervical cancer screening uptake (14). These findings underscore that socioeconomic context shapes both primary prevention (HPV vaccination), secondary prevention (screening), and tertiary care (access to oncology services). Consequently, addressing cervical cancer inequities demands integrated strategies that couple biomedical interventions with policies targeting social and economic marginalization.

Collectively, these lines of evidence justify the present ecological assessment of incidence and mortality patterns across HDI categories in 2022. By quantifying the scale of socioeconomic disparities, the study aims to inform policy initiatives aligned with the WHO cervical cancer elimination agenda and the broader pursuit of global health equity.

Objectives

This study aimed to examine global socioeconomic disparities in the burden of uterine cervical cancer by analyzing incidence and mortality patterns in relation to the HDI for the year 2022. By conducting an ecological assessment based on data from the International Agency for Research on Cancer (IARC), the research seeks to identify how socioeconomic development, as measured by HDI, influences the distribution of cervical cancer outcomes across countries. The objective is to provide a comprehensive understanding of the relationship between socioeconomic status and cervical cancer burden, thereby informing targeted public health strategies and resource allocation to address observed inequalities.

Materials and Methods

Study design

This study employed an ecological design to investigate the relationship between HDI levels and uterine cervical cancer burden using data from the IARC and GLOBOCAN project for 2022. In this ecological study design, the unit of analysis was countries rather than individuals, with aggregate incidence and mortality data stratified according to HDI classifications (very high, high, medium, and low)

Inclusion and exclusion criteria

Inclusion criteria include all countries with available uterine cervical cancer incidence and mortality data in the IARC and GLOBOCAN 2022 database, countries with established HDI classifications (very high, high, medium, and low HDI), and nations with age-standardized rates (ASRs) per 100,000 women to facilitate valid cross-country comparisons. Exclusion criteria involved countries with incomplete or missing cervical cancer incidence and mortality data for the year 2022, territories or regions without official HDI classifications from the United Nations Development Program (UNDP), countries with unreliable or poor-quality cancer registry data as indicated by GLOBOCAN data quality assessments, and nations where ASRs could not be calculated due to insufficient demographic information.

Data collection

Data for this ecological study were collected from the IARC and GLOBOCAN project for the year 2022. Uterine cervical cancer incidence and mortality statistics were extracted for each country using these publicly available and internationally recognized datasets. Countries were then stratified according to their HDI levels, including very high, high, medium, and low, based on UNDP classifications. Age-standardized rates per 100,000 women were used to facilitate valid cross-country comparisons (https://gco.iarc.who.int/).

Outcomes

The primary outcome of this ecological study was to assess and compare the incidence rates of uterine cervical cancer across countries categorized by different levels of the HDI using data from GLOBOCAN for the year 2022. The secondary outcome involved evaluating and contrasting the mortality rates associated with uterine cervical cancer among these HDI-stratified countries. Collectively, these outcomes aimed to elucidate the extent of global

disparities in uterine cervical cancer burden as influenced by socioeconomic development, providing insight into how incidence and mortality patterns of cervical cancer vary according to HDI classification.

Data analysis

To analyze data, we reported the incidence and mortality of uterine cervical cancer by calculating the global number of new cases and mortality in 2022. For data calculation, two indicators, including ASR per 100,000 women and total number were used. To assess the linear correlation between uterine cervical cancer incidence and mortality with HDI levels, the Scatter analysis was employed.

Results

The global distribution of uterine cervical cancer incidence and mortality demonstrated clear variations across countries with different levels of socioeconomic development, as measured by the HDI. Countries classified as having very high HDI exhibited the lowest rates of both new cases and deaths from cervical cancer. As the HDI classification decreases, from high to medium and then to low, there is a progressive increase in both the incidence and mortality rates associated with this disease. This pattern highlights a marked disparity, with lower HDI countries experiencing a disproportionately greater burden of cervical cancer (Table 1 and Figure 1).

The results indicated that, in countries classified as having very high HDI, the incidence of uterine cervical cancer tends to be lower, with nations such as Australia, Austria, Canada, and the United States exemplifying this trend. High HDI countries, including Albania, Algeria,

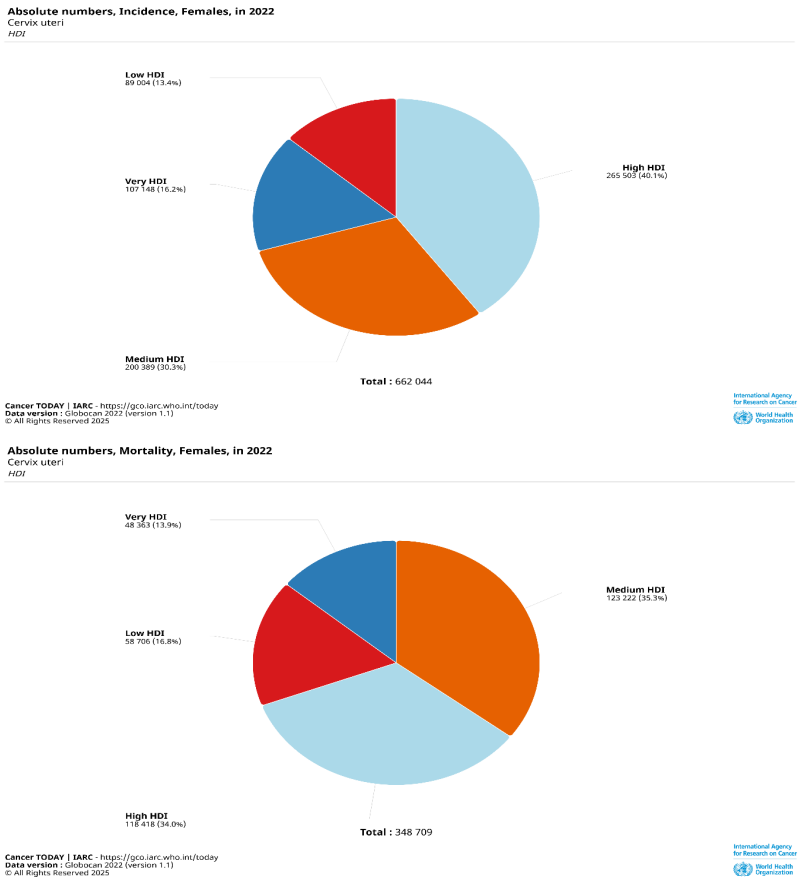

Figure 1. The incidence and mortality of uterine cervical cancer based on HDI classification. Reprinted with permission from IARC/WHO. Copyright (2025). (https://gco.iarc.fr/today/en/dataviz/pie?mode=population&group_populations=0&populations=981_982_983_984&cancers=23).

Table 1. The incidence and mortality of uterine cervical cancer according to global socioeconomic distribution in 2022

HDI classification	Incidence			Mortality		
	ASR (World)	Crude rate	Total (N)	ASR (World)	Crude rate	Total (N)
Very HDI country	9.3	12.9	107148	3.3	5.8	48363
High HDI country	14.1	19.4	265503	5.9	8.7	118418
Medium HDI country	18	18.1	200389	11.2	11.1	123222
Low HDI country	23.8	14.8	89004	16.3	9.8	58706

HDI: Human development index; N: Number; ASR: Age-standardized rate. Reprinted with permission from IARC/WHO. Copyright (2025). (https://gco.iarc.fr/today/en/dataviz/pie?mode=population&group_populations=0&populations=981_982_983_984&cancers=23)

and Azerbaijan, generally exhibit slightly higher rates than their very high HDI counterparts but still maintain relatively moderate levels. In contrast, countries with medium HDI, such as Angola, Bangladesh, and Bolivia, experience a noticeably greater incidence, reflecting more limited access to preventive measures and healthcare infrastructure. The most pronounced burden is observed in low HDI countries like Burundi, the Central African Republic, and Malawi, where cervical cancer is far more prevalent (Table 2 and Figure 2).

The distribution of uterine cervical cancer mortality rates across countries with different levels of HDI reveals a marked disparity that closely mirrors socioeconomic status. Countries with very high HDI (e.g, United Kingdom, Bahrain, Belgium, Saudi Arabia and Canada) generally experience the lowest mortality rates from cervical cancer, reflecting the benefits of advanced healthcare infrastructure, comprehensive screening programs, and access to effective treatment. In contrast, countries with high and medium HDI (e.g, Jordan, Iran, China, India and Mexico) present a more varied picture, with some nations achieving relatively low mortality rates while others still face significant challenges in cervical cancer control, likely due to differences in healthcare

Table 2. The distribution of uterine cervical cancer incidence rates in countries with different HDI levels

Socioeconomic classification											
Very HDI			High HDI			Medium HDI			Low HDI		
Country	ASR (World)	Total (N)	Country	ASR (World)	Total (N)	Country	ASR (World)	Total (N)	Country	ASR (World)	Total (N)
Argentina	16.78	4696	Albania	8.7	171	Angola	30.4	2823	Afghanistan	10.27	1218
Australia	5.25	898	Algeria	7.96	1799	Bangladesh	11.28	9640	Burundi	43.58	1457
Austria	5.87	409	Azerbaijan	8.18	547	Bhutan	13.56	49	Central African Republic	21.77	295
Bahamas	15.15	42	Armenia	6.83	156	Bolivia (Plurinational State of)	38.65	2213	Chad	23.51	1111
Bahrain	2.66	18	Barbados	13.75	36	Botswana	39.06	454	Congo, Democratic Republic of	32.91	8705
Belgium	6.3	531	Bosnia Herzegovina	12.33	263	Belize	17.27	34	Benin	18.12	701
Brunei Darussalam	20.01	53	Brazil	12.69	18715	Solomon Islands	26.15	72	Ethiopia	22.28	8168
Belarus	9.25	668	Bulgaria	15.41	877	Myanmar	21.44	7028	Eritrea	16.41	196
Canada	6.63	1730	Sri Lanka	9.18	1579	Cambodia	15.24	1274	Djibouti	16.53	71
Chile	11.34	1559	China	13.83	150659	Cameroon	33.11	2525	The Republic of the Gambia	39.37	325
Costa Rica	10.6	341	Colombia	13.68	4570	Cape Verde	16.07	46	Guinea	55.01	2551
Croatia	8.25	272	Cuba	12.83	1122	Comoros	52.01	163	Haiti	16.59	869
Cyprus	6.99	62	Dominican Republic	15.63	967	Congo, Republic of	22.32	397	Lesotho	60.49	598
Czechia	8.01	658	Ecuador	17.66	1792	El Salvador	15.19	627	Liberia	39.61	717
Denmark	9.74	373	Fiji	34.97	165	Equatorial Guinea	33.23	127	Madagascar	41.77	4060
Estonia	11.81	121	Gabon	32.48	271	Ghana	27	3072	Malawi	70.85	4701
Finland	4.63	179	Gaza Strip and West Bank	3.12	59	Guatemala	21.49	1761	Mali	43.14	2436
France (metropolitan)	6.55	3185	Guyana	30.31	129	Honduras	19.5	916	Mozambique	47.79	5456
Georgia	10.35	330	Indonesia	23.31	36964	India	17.71	127526	Niger	9.31	624
Germany	7.14	4544	Iran, Islamic Republic of	2.53	1265	Iraq	2.18	311	Nigeria	26.18	13676
Greece	5.46	473	Jamaica	20.4	376	Côte d'Ivoire	32.04	2360	Pakistan	5.4	4762
Hungary	12.62	964	Jordan	3.19	133	Kenya	32.83	5845	Guinea-Bissau	34.3	224
Iceland	9.37	19	Lebanon	3.59	144	Kyrgyzstan	14.14	479	Rwanda	18.92	866
Ireland	7.47	242	Libya	8	278	Lao People's Democratic Republic	11.95	401	Senegal	34.26	2064
Italy	4.99	2479	Mexico	13.18	10348	Morocco	11.97	2644	South Sudan	21.42	749
Japan	12.53	10958	Mongolia	20.19	361	Namibia	33.45	350	Sudan	8.6	1234
Kazakhstan	15.52	1824	Republic of Moldova	14.18	420	Nepal	14.15	2169	Togo	19.05	511

Table 2. Continued

Socioeconomic classification											
Very HDI			High HDI			Medium HDI			Low HDI		
Country	ASR (World)	Total (N)	Country	ASR (World)	Total (N)	Country	ASR (World)	Total (N)	Country	ASR (World)	Total (N)
Korea, Republic of	8.59	3397	Paraguay	30.61	1115	Vanuatu	18.15	23	Uganda	53.76	6938
Kuwait	3.06	61	Peru	23.9	4809	Nicaragua	20.61	721	Tanzania, United Republic of	64.75	10868
Latvia	16.91	238	Saint Lucia	15.72	20	Papua New Guinea	27.77	1053	Burkina Faso	15.88	988
Lithuania	13.69	296	Viet Nam	7.12	4612	Philippines	15.51	8549	Yemen	2.14	212
Luxembourg	4.35	22	South Africa	33.18	10532	Timor-Leste	14.75	77			
Malaysia	10.33	1913	Suriname	24.2	81	Sao Tome and Principe	18.77	14			
Malta	4.22	13	Tunisia	5.25	414	Zimbabwe	68.2	3520			
Mauritius	12.9	136	Turkmenistan	14.1	451	Eswatini	95.89	417			
Montenegro	11.96	58	Ukraine	15.24	5163	Syrian Arab Republic	2.51	206			
Oman	6.44	90	North Macedonia	6.72	107	Tajikistan	6.64	277			
The Netherlands	6.67	756	Egypt	2.77	1302	Venezuela	22.73	3965			
New Zealand	4.93	149	Uzbekistan	14.81	2654	Zambia	71.5	3640			
Norway	10.91	376	Samoa	13.29	11						
Panama	14.46	371									
Poland	11.32	4008									
Portugal	11.08	897									
Qatar	4.67	25									
Romania	21.67	3368									
Russian Federation	17.56	18369									
Saudi Arabia	2.36	332									
Serbia	13.35	906									
Singapore	7.42	353									
Slovakia	12.93	557									
Slovenia	7.16	119									
Spain	5.44	2020									
Sweden	8.55	561									
Switzerland	4.08	269									
Thailand	14.91	8662									
Trinidad and Tobago	18.28	192									
United Arab Emirates	5.7	138									
Türkiye	4.75	2593									
United Kingdom	7.51	3235									
United States of America	6.32	13920									
Uruguay	15.94	377									

HDI: Human development index; N: Number; ASR: Age-standardized rate. Reprinted with permission from IARC/WHO. Copyright (2025). (https://gco.iarc.fr/today/en/dataviz/pie?mode=population&group_populations=0&populations=981_982_983_984&cancers=23).

access, public health policies, and resource allocation. The highest mortality rates are predominantly observed in countries with low HDI (e.g, Guinea, Malawi and Uganda), where limited healthcare resources, inadequate screening, and delayed diagnosis contribute to poor outcomes (Table 3 and Figure 3).

Discussion

Our study results indicated that uterine cervical cancer incidence and mortality vary among countries with different levels of HDI. Very high HDI countries showed the lowest rates of both incidence and mortality of cervical cancer. With the decrease of HDI classification, from high to medium and low, we found a progressive increase in both the incidence and mortality rates associated with this disease. Our findings demonstrating an inverse relationship between HDI levels and cervical cancer incidence and mortality rates are strongly supported by

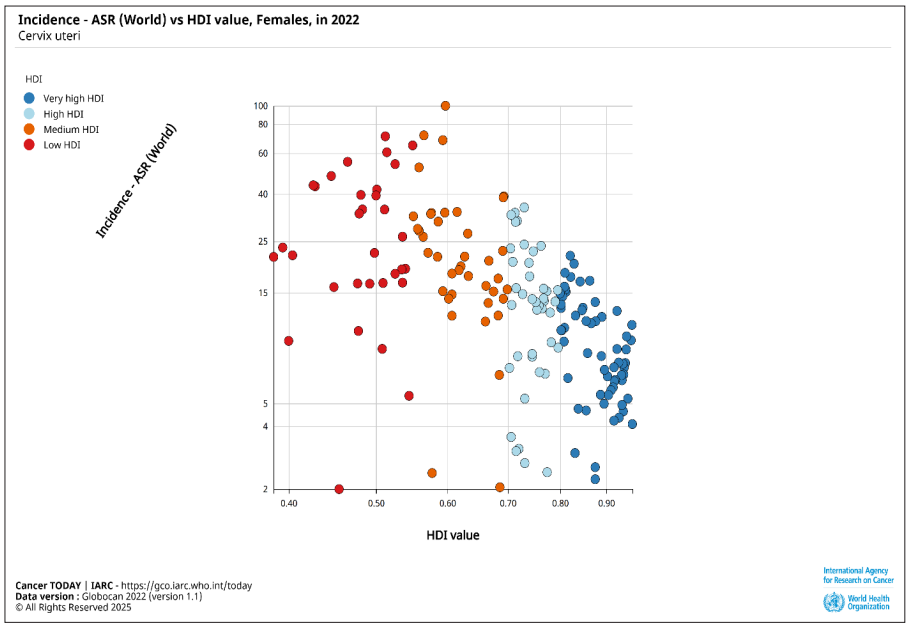

Figure 2. Linear correlation between uterine cervical cancer incidence rates and HDI using Scatter plot analysis. HDI: Human development index; ASR: Age-standardized rate. Reprinted with permission from IARC/WHO. Copyright (2025). (https://gco.iarc.fr/today/en/dataviz/scatter-plot?mode=population&group_populations=0&populations=981_982_983_984&cancers=23&x_indicator=hdi&color_plot=hdi&y_indicator=0).

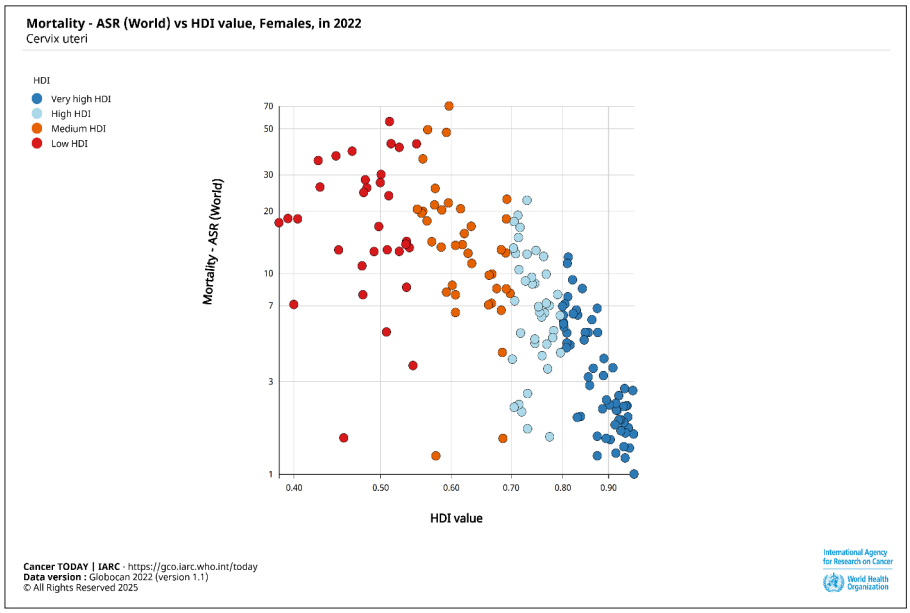

Figure 3. iLinear correlation between uterine cervical cancer mortality rates and HDI using Scatter plot analysis. HDI: Human development index; ASR: Age-standardized rate. Reprinted with permission from IARC/WHO. Copyright (2025). (https://gco.iarc.fr/today/en/dataviz/scatter-plot?mode=population&group_populations=0&populations=981_982_983_984&cancers=23&x_indicator=hdi&color_plot=hdi).

previous research. Singh et al conducted a comprehensive analysis using GLOBOCAN 2020 data from 185 countries, revealing that cervical cancer incidence was three times higher in countries with low HDI compared to very high HDI countries (27.2 vs 9.1 cases per 100,000 women-years), while mortality rates were six times higher (19.8 vs 3.1 deaths per 100,000 women-years) (1). Similarly, Shen et al analyzed 61 countries and found that favorable mortality-to-incidence ratios were significantly correlated with good HDI rankings and high current health expenditure as a percentage of gross domestic product (GDP) (15). Arbyn et al reported that approximately 570,000 cervical cancer cases and 311,000 deaths occurred globally in 2018, with the vast majority concentrated in lower-resource countries based on HDI classifications (5). These findings consistently demonstrate the persistent socioeconomic gradient in cervical cancer burden, with our results further confirming the progressive deterioration of both incidence and mortality rates as HDI classification decreases from very high to low levels.

Table 3. The distribution of uterine cervical cancer mortality rates in countries with different HDI levels

Socioeconomic classification											
Very HDI			High HDI			Medium HDI			Low HDI		
Country	ASR (World)	Total (N)	Country	ASR (World)	Total (N)	Country	ASR (World)	Total (N)	Country	ASR (World)	Total (N)
Argentina	8.43	2559	Albania	4.13	97	Angola	20.22	1715	Afghanistan	7.87	888
Australia	1.43	323	Algeria	4.58	1013	Bangladesh	7.03	5826	Burundi	35.04	1081
Austria	1.85	180	Azerbaijan	4.8	325	Bhutan	7.15	26	Central African Republic	18.31	240
Bahamas	11.96	33	Armenia	3.99	99	Bolivia (Plurinational State of)	18.3	1138	Chad	18.38	841
Bahrain	1.63	8	Barbados	7.89	24	Botswana	22.77	253	Congo, Democratic Republic of	24.56	6187
Belgium	1.9	231	Bosnia Herzegovina	4.88	151	Belize	12.99	24	Benin	12.75	475
Brunei Darussalam	6.64	16	Brazil	6.48	9905	Solomon Islands	17.89	48	Ethiopia	16.82	5975
Belarus	4.36	371	Bulgaria	6.24	453	Myanmar	13.37	4374	Eritrea	12.73	150
Canada	2.27	760	Sri Lanka	5.27	946	Cambodia	8.1	670	Djibouti	12.98	54
Chile	5.17	825	China	4.54	55694	Cameroon	25.69	1837	The Republic of the Gambia	27.41	204
Costa Rica	4.6	167	Colombia	6.89	2435	Cape Verde	9.78	27	Guinea	38.88	1695
Croatia	2.87	138	Cuba	6.42	695	Comoros	35.68	102	Haiti	8.55	451
Cyprus	2.44	31	Dominican Republic	9.89	622	Congo, Republic of	14.2	248	Lesotho	42.27	413
Czechia	3.2	369	Ecuador	8.87	939	El Salvador	8.43	367	Liberia	28.28	478
Denmark	1.79	115	Fiji	22.51	105	Equatorial Guinea	21.86	76	Madagascar	30.02	2690
Estonia	3.87	60	Gabon	17.77	139	Ghana	16.85	1815	Malawi	54.07	3340
Finland	1.28	65	Gaza Strip and West Bank	2.32	37	Guatemala	12.48	973	Mali	26.09	1431
France (metropolitan)	2.31	1530	Guyana	14.87	65	Honduras	15.55	669	Mozambique	36.91	4000
Georgia	5.77	210	Indonesia	13.22	20708	India	11.15	79906	Niger	7.06	440
Germany	2.28	2071	Iran, Islamic Republic of	1.62	743	Iraq	1.59	216	Nigeria	14.25	7093
Greece	2.21	260	Jamaica	12.44	236	Côte d'Ivoire	20.38	1461	Pakistan	3.58	3069
Hungary	4.76	482	Jordan	2.14	84	Kenya	21.38	3591	Guinea-Bissau	25.87	157
Iceland	2.71	8	Lebanon	2.25	93	Kyrgyzstan	8.4	278	Rwanda	13.79	609
Ireland	2.29	89	Libya	5.14	169	Lao People's Democratic Republic	6.46	200	Senegal	23.7	1327
Italy	1.59	1156	Mexico	6.15	4909	Morocco	6.62	1468	South Sudan	17.55	593
Japan	2.56	3864	Mongolia	9.55	156	Namibia	20.48	203	Sudan	5.2	738
Kazakhstan	7.69	918	Republic of Moldova	7.16	236	Nepal	8.74	1313	Togo	13.3	334
Korea, Republic of	1.95	1143	Paraguay	16.65	601	Vanuatu	13.63	18	Uganda	40.58	4782
Kuwait	2.01	34	Peru	12.05	2545	Nicaragua	9.9	345	Tanzania, United Republic of	42.19	6832
Latvia	5.96	113	Saint Lucia	10.39	13	Papua New Guinea	19.91	686	Burkina Faso	12.96	775
Lithuania	6.76	191	Viet Nam	3.84	2571	Philippines	7.99	4380	Yemen	1.6	153
Luxembourg	1.73	10	South Africa	19.03	5976	Timor-Leste	7.86	37			
Malaysia	5.5	1018	Suriname	12.36	43	Sao Tome and Principe	13.74	10			
Malta	1.35	6	Tunisia	2.62	210	Zimbabwe	47.93	2318			
Mauritius	5.7	67	Turkmenistan	8.93	279	Eswatini	64.33	269			
Montenegro	6.28	32	Ukraine	6.97	2598	Syrian Arab Republic	1.31	106			
Oman	4.5	56	North Macedonia	3.45	61	Tajikistan	4.14	159			
The Netherlands	1.69	275	Egypt	1.77	820	Venezuela	12.54	2246			

Table 3. Continued

Socioeconomic classification											
Very HDI			High HDI			Medium HDI			Low HDI		
Country	ASR (World)	Total (N)	Country	ASR (World)	Total (N)	Country	ASR (World)	Total (N)	Country	ASR (World)	Total (N)
New Zealand	1.45	63	Uzbekistan	9.18	1585	Zambia	49.39	2285			
Norway	1.67	104	Samoa	7.36	6						
Panama	7.1	192									
Poland	5.17	2188									
Portugal	3.47	459									
Qatar	3.15	13									
Romania	9.29	1793									
Russian Federation	6.37	7903									
Saudi Arabia	1.31	164									
Serbia	6.27	505									
Singapore	2.77	153									
Slovakia	5.17	276									
Slovenia	2.35	61									
Spain	1.57	802									
Sweden	2.02	238									
Switzerland	1.07	99									
Thailand	6.92	4576									
Trinidad and Tobago	11.15	122									
United Arab Emirates	3.49	69									
Türkiye	2.03	1203									
United Kingdom	1.96	1154									
United States of America	2.17	5932									
Uruguay	5.15	160									

HDI: Human development index; N: Number; ASR: Age-standardized rate. Reprinted with permission from IARC/WHO. Copyright (2025). (https://gco.iarc.fr/today/en/dataviz/pie?mode=population&group_populations=0&populations=981_982_983_984&cancers=23).

The consistent pattern observed across multiple studies, including our findings, reflects the profound impact of healthcare infrastructure, screening program availability, and socioeconomic determinants on cervical cancer outcomes. Studies have demonstrated that countries with higher HDI levels benefit from well-established population-based screening programs, HPV vaccination initiatives, and improved access to early detection and treatment services (1,16). The progressive increase in cervical cancer burden with decreasing HDI levels can be attributed to several interconnected factors: inadequate healthcare infrastructure, limited access to screening services, low HPV vaccination coverage, and delayed diagnosis leading to advanced-stage disease presentation (17,18). Research has shown that approximately 85-90% of new cervical cancer cases and deaths occur in less developed countries, highlighting the stark global inequities in cancer outcomes (16,17). The mortality-to-incidence ratio, which serves as a proxy for healthcare system effectiveness, has been consistently shown to improve with higher HDI rankings, indicating better survival outcomes in more developed nations (15). Furthermore, studies have revealed that cervical cancer screening coverage in developing countries averages only 19% compared to 63% in developed countries, contributing significantly to the observed disparities (19).

Overall, the evidence from our study and previous research establishes a clear and consistent inverse relationship between HDI levels and cervical cancer burden, with very high HDI countries demonstrating the most favorable incidence and mortality rates. This pattern reflects the critical importance of comprehensive healthcare systems, effective screening programs, and equitable access to preventive services in reducing cervical cancer burden. The findings underscore the urgent need for targeted interventions in low and medium HDI countries, including the implementation of cost-effective screening strategies, expansion of HPV vaccination programs, and strengthening of healthcare infrastructure to achieve the WHO's cervical cancer elimination goals (1,16). Given that cervical cancer is largely preventable through effective screening and vaccination, the persistent global disparities identified in our study and confirmed by previous research represent a significant public health

challenge that requires sustained international cooperation and resource allocation to address the inequities in cancer outcomes across different levels of human development (17,20).

Conclusion

Our findings highlight a marked disparity in uterine cervical cancer socioeconomic patterns, with lower HDI countries experiencing a disproportionately greater burden of this cancer. The observed disparities in cervical cancer incidence and mortality across HDI categories emphasize the critical role of socioeconomic development in shaping health outcomes. The markedly higher burden of cervical cancer in countries with lower HDI underscores the urgent need for targeted public health interventions, improved access to screening and vaccination, and strengthened healthcare infrastructure in these regions. Addressing these inequalities is essential for reducing the global impact of cervical cancer and achieving more equitable health outcomes for women worldwide.

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Conflicts of interest

The authors declare that they have no competing interests.

Declaration of generative artificial intelligence (AI) and AI-assisted technologies in the writing process

During the preparation of this work, the authors utilized AI (Perplexity.ai and Grammarly.com) to refine grammar points and language style in writing. Subsequently, the authors thoroughly reviewed and edited the content as necessary, assuming full responsibility for the accuracy and content of the publication.

Ethical issues

This study has been compiled based on data from the IARC-GLOBOCAN website (https://gco.iarc.who.int/). Ethical considerations related to data extraction were formally addressed, which included written correspondence via email communications with IARC officials to ensure compliance with established ethical standards. Also, the study protocol was registered on the Research Registry (unique identifying number [UIN]: researchregistry11354) website. Besides, the authors have observed ethical issues (including plagiarism, data fabrication, and double publication).

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