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Analysis of the global burden of cervical cancer in young women aged 15–44 years old

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Background: Understanding the burden of cervical cancer (CC) in young women aged 15–44 years old are essential for formulating effective preventive strategies. **Methods:** Utilizing the Global Burden of Disease 2019 Study, we estimated incidence, disability-adjusted life-years (DALYs), years of life lost (YLLs) and years lived with disability (YLDs) due to CC among young women from 1990 to 2019. Additionally, we evaluated the temporal trends using estimated annual percentage changes (EAPCs) during this period. We conducted a decomposition analysis to assess the absolute contributions of three components: population growth, population age structure and epidemiologic changes. **Results:** Globally, there were 187 609.22 incident cases of CC worldwide, resulting in 2621 917.39 DALYs in 2019. From1990 to 2019, the age-standardized rates were decline, only the age-standardized YLDs rate (EAPC = 0.02; 95% CI: −0.02 to 0.05) showed a stable trend. The largest increase in age-standardized incidence rate (ASIR) and age-standardized YLDs rate observed in the high-middle social demographic index (SDI) quintiles. Population growth and age structure changes were associated with substantial changes in cases of CC, especially in South Asia and East Asia. **Conclusions:** Globally, the burden of CC in young women continues to increase, as measured by the absolute number. As populations are growing and age structure changes were associated with substantial changes in cases of CC, governments will face increasing demand for treatment, and support services for CC, especially in South Asia and East Asia.

Introduction

Globally, cervical cancer (CC) is the fourth most common cancer in women.[1] and ranks second among common cancers among women aged 15–44 years old.[2] It is the only cancer for which the cause is well known, making it a disease that can be managed and prevented.[3] The primary cause of CC is persistent high-risk human papillomavirus (HPV) infection.[4] Alarmingly, studies have shown an increasing prevalence of CC among younger age groups.[5]

To combat CC, the World Health Organization (WHO) proposed a global strategy in 2020, aiming to reach the 90-70-90 target by 2030. This ambitious target includes vaccinating 90% of girls by age 15 years old, screening 70% of women with a high-performance test prior to 35 and 45 years old, and treating 90% of women identified with cervical pre-cancer and invasive cancer.[6,7] Currently approved HPV vaccines are available in various formats including: bivalent (Cervarix, Cecolin), quadrivalent (Gardasil, Cervavac) and nonavalent (Gardasil 9), with the vaccine being administered to individuals between the age of 9–45.[8,9] As of 2022, 122 of 195 (63%) WHO member states had incorporated HPV vaccinations nationally.[10] It usually takes from 2 to 15 years for HPV infection to develop into cervical intraepithelial neoplasia (CIN) lesions, while the transition from CIN to advanced cancer stages usually takes 10–20 years.[11,12] A systematic review and meta-analysis found that the risk of CIN2+ decreased by 51% (relative risk 0.49) among 15–19 years old female patients vaccinated against human papillomavirus and by 31% (0.69) among vaccinated 20–24 years old.[13] In this slow progression process, routine CC screening is crucial to detect and prevent it from advancing to precancerous stages. Therefore, it is important to implement a combination of primary and secondary prevention and control measures, including HPV vaccination and routine CC screening to eliminate CC.

Previous studies have explored the estimated annual percentage changes (EAPCs), age-standardized incidence rate (ASIR) and age-standardized disability-adjusted life-years (DALYs) rate (ASDR) of CC worldwide from 1990 to 2019.[14] Additionally, there have investigated into CC burden in certain regions and countries.[15–17] However, an important gap remains as there has not been any research on the burden of CC among women aged 15–44 years old. Therefore, this study aimed to determine and evaluate the changing trend of ASIR, ASDR, age-standardized years lived with disability (YLDs) rate, age-standardized years of life lost (YLLs) rate and EAPC of young women (15–44 years old) diagnosed with CC across 21 regions and 204 countries.[18] The ultimate goal of this study is to explore the distribution of disparities in CC among young women aged 15–44 years old globally. These findings will provide valuable evidence to guide the development and improvement of CC prevention and control strategies.

Methods

Data sources

GBD 2019 synthesizes a large and growing number of data input sources including vital registration, verbal autopsy, police records,

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surveillance, surveys/censuses and other health-related data sources. For this study, data on CC incidence, DALYs, YLLs, YLDs of young women (15–44 years old) and their corresponding respective age-standardized rates (ASRs) from1990 to 2019 are accessible through an interactive citation tool available in the Global Health Data Exchange (GHDx) (http://ghdx.healthdata.org/gbd-results-tool) query tool.[19]

Without any inclusion/exclusion criteria, data related to CC incidence, DALYs, YLLs, YLDs were extracted from the GBD 2019 dataset based on age, social demographic index (SDI) region, geographic region, and country, so as to clarify the regional distribution of the ASIR, and ASDR of CC, as well as the corresponding trends in different countries and regions in the past 30 years. DALYs can be used to estimate the global cancer burden, YLLs can be used to estimate the early death burden related to CC, and YLDs reflects the number of years living with short or long-term health losses, weighted by disability severity.

Definition of CC

CC refers to a malignant tumour that occurs at the junction of squamous epithelial cells in the cervical vagina or transitional zone and columnar epithelial cells in the cervical lining. The different categories of CC in the GBD 2019 dataset are classified based on the ICD-10 codes C53-C53.9, D06-D06.9, D26.0.

Statistical analysis

We calculated the ASIR, ASDR, age-standardized YLDs rate, age-standardized YLLs rate and their 95% confidence interval (CI) based on global standards (WHO 2000–25) to quantify the burden of CC on young women, with the following equation.

$$\mathrm{ASR} = \frac{\sum_{i=1}^{A} \alpha_{iwi}}{\sum_{i=1}^{A} w^{i}} \times 100\ \ 000$$

where α_i represents the age-specific rate in the i th age group, w represents the number of people (or weight) in the respective i th age group among the selected standard population and A represents the number of age groups.

In assessing the burden of CC, we used YLD, YLL and DALY. DALY is calculated as the sum of YLL and YLD. YLDs are calculated by multiplying the estimated incidence rate with the specific disability weight, while YLLs are calculated by multiplying the number of deaths due to CC in a certain age group with the standard life expectancy at the time of death. Further details on the calculation of YLL and YLD can be found in the reference.[20]

To assess the time trend of ASRs in young women with CC from 1990 to 2019, we used EAPCs and 95% CI, with the following logarithmic linear regression.

$$y = \alpha + \beta x + \varepsilon$$

where y is the natural logarithm of ASR, i.e. ln (ASR), x is the year, and β is the regression coefficient. The EAPC is calculated using the formula.

$$\mathrm{EAPC} = 100 \times (\exp(\beta) - 1)$$

We considered ASR trends based on the following criteria: If $P < 0.05$ and EAPC > 0, it indicates an increasing ASR trend during the study period; If $P < 0.05$ and EAPC < 0, it signifies a decreasing trend in ASR. If $P \geq 0.05$, the trend is considered stable. The 95% CI of EAPCs were generated using the standard error of linear regression. We conducted these analyses using R Version 4.1.2 (R Foundation for Statistical Computing).

To quantify the drivers of changes in incident cases and DALYs of CC among young women, we estimated the relative contributions of population growth, population age structure and epidemiologic changes. The method developed by Das Gupta for decomposition analysis was employed,[21] which separated the standardized effects of each contribution multiplication factor through algebra, and summarized the contributions of various factors to the observed changes.[22]

Results

Disease burden of CC among young women worldwide

In 2019, there were 187 609.22 (95% CI: 157 610.01–212 743.01) incident cases of CC among young women globally, contributing to 2621 917.39 (95% CI: 2209 602.74–3010 724.73) DALYs. Among these DALYs, 93 740.06 (95% CI: 63 706.76–129 831.4) were attributed to YLDs, and 2528 177.32 (95% CI: 2128 394.86–2900 185.02) were due to YLLs. See figure 1 and Supplementary table S1 for details.

The global ASIR of CC in young women was 10.7/100 000 (95% CI: 8.99–12.13), demonstrating a decreasing trend from 1990 to 2019 (EAPC = −0.18; 95% CI: −0.22 to −0.14) (table 1). The ASDR was 149.6/100 000 (95% CI: 126.02–171.74). The age-standardized YLDs rate was 5.4/100 000 (95% CI: 3.63–7.4), and the age-standardized YLLs rate was 144.2/100 000 (95% CI: 121.4–165.44). The ASDR (EAPC = −0.99; 95% CI: 1.06 to 0.92) and the age-standardized YLLs rate (EAPC = −1.02; 95% CI: −1.09 to −0.95) for young women with CC exhibited decreasing trends. However, the age-standardized YLDs rate showed a stable trend with an EAPC of 0.02 (95% CI: −0.02–0.05). See Supplementary table S2 for details.

Disease burden of CC among young women in different SDI quintiles and 21 regions

Between 1990 and 2019, the number of incident cases, DALYs, YLDs, and YLLs of CC among young women increased except for the high SDI quintiles. Both the ASIR (EAPC = 0.28; 95% CI: 0.24–0.33) and the age-standardized YLDs rate (EAPC = 0.51; 95% CI: 0.46–0.56) in the high-middle SDI quintiles has shown an increasing trend, while the age-standardized YLDs rate in the middle (EAPC = 0.08; 95% CI: −0.04–0.19) and low-middle SDI quintiles (EAPC = −0.06; 95% CI: −0.15–0.02) have remained steady (table 1, Supplementary tables S1 and S2).

The burden of CC among young women varied significantly by regions. In 2019, South Asia had the highest number of incident cases, DALYs, YLDs and YLLs, followed by East Asia. The highest ASIR of CC for young women was observed in Southern Latin America (26.9/100 000; 95% CI: 17.35–39.52), Southern Sub-Saharan Africa (24.5/100 000; 95% CI: 15.44–35.34), and Caribbean (24.07/100 000; 95% CI: 16.04–33.82) (table 1). In terms of ASDR, the highest rates were observed in Central Sub-Saharan Africa (411.51/100 000; 95% CI: 245.93–639.05), Southern Sub-Saharan Africa (393.96/100 000; 95% CI: 256.17–555.82) and Caribbean (389.14/100 000; 95% CI: 243.22–570.47) (Supplementary table S2).

In East Asia, the ASIR of CC among young women showed the greatest upward trend (EAPC = 1.96; 95% CI: 1.69–2.23). However, ASDR and age-standardized YLLs have remained steady, the age-standardized YLDs rate increased significantly (EAPC = 2.37; 95% CI: 2.08–2.66). Similarly, in Eastern Europe, the ASIR of CC among young women increased significantly (EAPC = 1.46; 95% CI: 1.2–1.71), second only to East Asia, while the ASDR and age-standardized YLLs remained stable, and the age-standardized YLDs showed an upward trend (EAPC = 1.62; 95% CI: 1.37–1.86). Additionally, Central Europe and Western Europe experienced a significant decline in ASIR, ASDR, age-standardized YLLs and age-standardized YLDs (table 1 and Supplementary table S2).

Disease burden of CC among young women in 204 countries

In 2019, the burden of CC among young women varied significantly across different countries. India had the highest number of incident cases, DALYs, YLDs and YLLs in CC among young women in 204 countries, followed by China (Supplementary tables S3 and S4).

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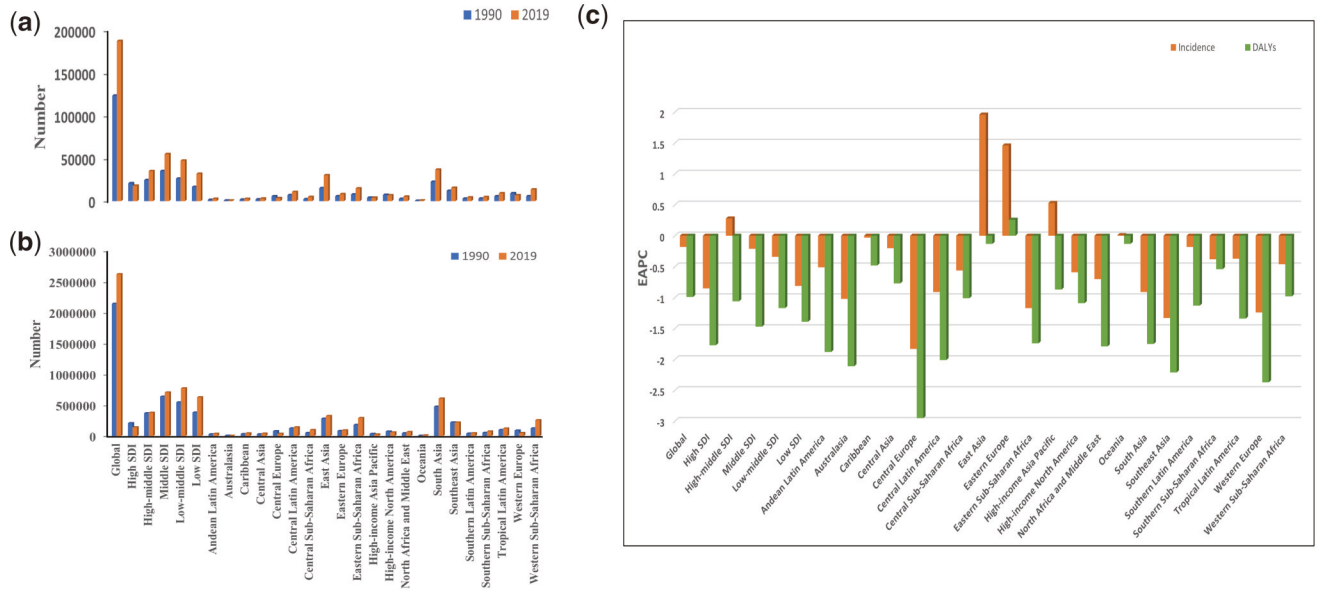


Figure 1 The distribution of cases of CC among young women worldwide in 1990 and 2019, and time trends from 1990 to 2019. (a) Incident cases, (b) disability-adjusted life years (DALYs). (c) The temporal trends using annual percentage changes (EAPCs). SDI, sociodemographic index.

Supplementary table S3 shows for ASIR, the three countries with the highest ASIR of CC in young women were Kiribati (79.54/100 000; 95% CI: 44–125.73), Solomon Islands (52.03/100 000; 95% CI: 12.89–97.98), and Saint Vincent and the Grenadines (35.35/100 000; 95% CI: 24.33–49.43), while Lesotho (EAPC = 3.95; 95% CI: 3.32–4.58), Saudi Arabia (EAPC = 2.63; 95% CI: 2.33–2.94), and Russia (EAPC = 2.48; 95% CI: 2.1–2.86) showed the highest upward trends from 1990 to 2019.

Supplementary table S5 shows for ASDR, the three countries with the highest rates were Kiribati (1576.84/100 000; 95% CI: 892.15–2491.62), Solomon Islands (873.01/100 000; 95% CI: 222.51–1629.09) and Guinea (741.27/100 000; 95% CI: 417.58–1214.33), while the ASDR displayed a greatest increasing trend in most countries, especially in Lesotho (EAPC = 3.82; 95% CI: 3.16–4.49), Zimbabwe (EAPC = 2.66; 95% CI: 1.87–3.46) and Russia (EAPC = 1.31; 95% CI: 0.85–1.77) (figure 2). The age-standardized YLDs rate had a considerable increasing trend in Lesotho (EAPC = 3.85; 95% CI: 3.25–4.45), Saudi Arabia (EAPC = 2.86; 95% CI: 2.56–3.71) and China (EAPC = 2.67; 95% CI: 2.34–3.01). The age-standardized YLLs rate had a significant rising trend in Lesotho (EAPC = 3.82; 95% CI: 3.16–4.49), Zimbabwe (EAPC = 2.7; 95% CI: 1.89–3.51) and Russia (EAPC = 1.25; 95% CI: 0.79–1.72). Saint Kitts and Nevis, Maldives and Austria showed significant downward trends in their respective ASIR, ASDR, age-standardized YLDs rates and age-standardized YLLs rates (Supplementary tables S3 and S5).

Decomposition analysis of disease burden of CC among young women worldwide

From 1990 to 2019, the growth in incident cases and DALYs in CC among young women worldwide can be largely attributed to population growth and age structure changes. Despite these overall increases, the epidemiological changes of incidence and DALYs rates decreased by 9.93% and 131.55% in global (figure 3).

In the high SDI quintiles, there was a noticeable decrease in the total variation of incidence (−2908), and DAYLs (−67 841) despite population growth and age structure changes. For the low-middle SDI quintiles, the decomposition of CC incidence among young women showed the highest variance (21 012), primarily driven by population growth (90.73%) (Supplementary table S6). The total variation in DALYs among young women in the low SDI quintiles were 246 167.26, mainly due to population growth of 174.94% (Supplementary table S7).

In regions like Australasia, Central Europe, High-income Asia Pacific, High-income North America and Western Europe where CC incidence, and DALYs declined, the total variation decreased despite the influence of population growth and age structure. Specifically, East Asia had a total variation in CC incidence of 15 138.38, primarily due to the prevalence rate of 62.84%. Western Sub-Saharan Africa experienced the greatest total variation in CC DALYs among young women (2475.63), mainly due to population growth (133.54%) (figure 3, Supplementary tables S6 and S7).

Discussion

In this study, we used the GBD 2019 to describe and analyze the spatial and temporal trends in the incidence, DALYs, YLDs, YLLs and the EAPC of CC in young women aged 15–44 years old from 1990 to 2019 at the global, regional and national levels. The results provided valuable insights into our understanding of the current situation of the CC burden of young women, and provided some data-based support for the future prevention and control of CC and the optimization of various strategies.

We noticed that the ASIR and ASDR of CC in young women aged 15–44 years old worldwide was showing a downward trend, with ASDR decreasing more significantly than those in women of the total age group. This suggested that global strategies for CC prevention and treatment have been successful in recent years for young women.[23] In the high-middle SDI quintiles, we observed an unexpected upward trend in the ASIR of CC among young women from 1990 to 2019. This finding contrasts with previous studies that reported a declining trend.[14,24] This may be related to the ineffective implementation of CC prevention and treatment strategies in some countries of the high-middle SDI quintiles. For example, Argentina and Belarus faced challenges related to opportunistic CC screening, with insufficient Pap testing among young women and a low acceptance rate for CC screening.[25,26] These have caused a surge in CC incidence among young women in the high-middle SDI quintiles.

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Table 1 Number, ASIR and temporal trends of CC among young women in various regions in 1990 and 2019

Characteristics	1990		2019		1990–2019
	Number (95% CI)	ASIR (per 100 000) (95% CI)	Number (95% CI)	ASIR (per 100 000) (95% CI)	EAPC (95% CI)
Global	123 637.74 (107 592.92–144 573.65)	11.14 (9.71–13.04)	187 609.22 (157 610.01–212 743.01)	10.7 (8.99–12.13)	−0.18 (−0.22–−0.14)
SDI					
High	20 903.48 (17 827.52–22 252.4)	10.42 (8.87–11.1)	17 995.23 (15 192.76–20 710.31)	8.16 (6.89–9.4)	−0.85 (−0.96–−0.74)
High-middle	24 558.17 (22 572.92–29 394.64)	9.3 (8.55– 11.13)	35 107.64 (27 025.49–40 799.69)	9.93 (7.65–11.54)	0.28 (0.24–0.33)
Middle	35 231.83 (30 322.75–44 626.82)	10.11 (8.73–12.84)	55 028.97 (44 067.25–63 716.42)	9.56 (7.66–11.07)	−0.21 (−0.32–−0.1)
Low-middle	26 297.07 (20 411.78–32 416.5)	12.76 (9.93–15.73)	47 309.49 (38 742.39–57 277.57)	12.01 (9.84–14.54)	−0.34 (−0.43–−0.25)
Low	16 544.54 (12 002.26–20 831.83)	18.79 (13.69–23.6)	32 009.27 (24 316.41–41 229.65)	15.41 (11.73–19.82)	−0.81 (−0.86–−0.75)
Region					
Andean Latin America	1394.98 (1067.96–1832.96)	19.29 (14.83–25.23)	2584.04 (1730.97–3711.22)	17.54 (11.75–25.18)	−0.51 (−0.66–−0.35)
Australasia	538.59 (391.26–659.16)	10.64 (7.73–13.04)	472.54 (302.85–714.97)	7.32 (4.68–11.1)	−1.02 (−1.48–−0.57)
Caribbean	1716.76 (1273.29–2220.88)	22.93 (17.09–29.55)	2563.9 (1707.63–3602.21)	24.07 (16.04–33.82)	−0.03 (−0.15–0.1)
Central Asia	1926.43 (1678.59–2200.25)	14.56 (12.76–16.59)	2952.66 (2384.77–3631.96)	13.36 (10.79–16.41)	−0.2 (−0.31–−0.08)
Central Europe	5568.04 (4873.64–6166.72)	19 (16.59–21.06)	3438.75 (2724.7–4223.28)	12.58 (9.95–15.48)	−1.83 (−2–−1.66)
Central Latin America	6956.72 (6430.26–7616.73)	21.83 (20.23–23.84)	10 697.96 (8271.46–13 577.74)	17.83 (13.79–22.64)	−0.91 (−1.09–−0.73)
Central Sub-Saharan Africa	2154.78 (1228.08–3404.71)	23.64 (13.65–37.13)	4788.39 (2836.06–7510.31)	20.23 (12.04–31.59)	−0.56 (−0.67–−0.45)
East Asia	15 140.05 (11 086.37–27 799.25)	5.52 (4.04–10.19)	30 278.42 (16 836.13–39 653.68)	8.56 (4.77–11.21)	1.96 (1.69–2.23)
Eastern Europe	5602.35 (4940.41–6389.3)	10.37 (9.13–11.82)	8102.23 (5891.59–10 372.61)	15.29 (11.11–19.6)	1.46 (1.2–1.71)
Eastern Sub-Saharan Africa	7782.73 (5522.59–10 297.54)	25.45 (18.19–33.51)	14 805.43 (10 254.95–21 102.34)	19.55 (13.58–27.75)	−1.17 (−1.28–−1.06)
High-income Asia Pacific	3856.36 (3229.88–4565.88)	9.09 (7.59–10.78)	3853.51 (2659.47–4961.82)	9.84 (6.75–12.7)	0.53 (0.37–0.68)
High-income North America	7240.4 (5800.25–7820.28)	9.99 (8–10.79)	6682.69 (5134.22–8427.9)	8.68 (6.67–10.96)	−0.59 (−0.77–−0.41)
North Africa and Middle East	2590.22 (1787.14–3289.72)	4.33 (2.99–5.49)	5155.7 (3749.96–6752.55)	3.57 (2.6–4.68)	−0.7 (−0.75–−0.64)
Oceania	252.64 (158.99–361.83)	21.8 (13.81–31.13)	591.62 (322.62–915.61)	21.18 (11.6–32.74)	0.01 (−0.06–0.08)
South Asia	22 618.88 (16 567.52–27 919.22)	11.12 (8.17–13.72)	36 788.72 (28 270.82–47 569.05)	9.01 (6.93–11.64)	−0.91 (−1.05–−0.76)
Southeast Asia	12 007.07 (8307.14–15 417.89)	12.99 (9.05–16.67)	15 537.35 (11 816.94–20 438.45)	9.45 (7.18–12.43)	−1.33 (−1.48–−1.18)
Southern Latin America	2903.61 (2388.36–3475.99)	26.96 (22.19–32.27)	4246.14 (2741.6–6233.41)	26.9 (17.35–39.52)	−0.18 (−0.43–0.07)
Southern Sub-Saharan Africa	2940.2 (2178.73–3821.06)	29.13 (21.64–37.65)	4630.77 (2893.8–6708.92)	24.5 (15.44–35.34)	−0.38 (−1.01–0.24)
Tropical Latin America	5608.51 (5069.44–6673.69)	17.28 (15.64–20.5)	9110.25 (7950.46–10322.41)	15.91 (13.86–18.04)	−0.37 (−0.51–−0.23)
Western Europe	9144.02 (7301.45–10 009.21)	10.32 (8.22–11.3)	6766.58 (5414.36–8251.36)	7.4 (5.92–9.03)	−1.24 (−1.37–−1.11)
Western Sub-Saharan Africa	5694.4 (4317.3–7479.04)	18.35 (13.98–23.89)	13 561.56 (10 019.25–18 190.21)	16.07 (11.91–21.52)	−0.46 (−0.5–−0.42)

ASIR, age-standardized incidence rate; SDI, sociodemographic index; EAPC, estimated annual percentage change; CI, confidence interval.

Notably, there were significant differences in the burden of CC among young women across different regions and countries, and our study shed light on some concerning trends in specific regions, such as South Asia (India), East Asia (China), and Western Sub-Saharan Africa (Nigeria). These regions have experienced an increase in the number of YLLs and YLDs of CC among young women in the last 30 years. This indicated that the economic and healthcare systems in these areas have been not able to keep pace with population growth.[27] One critical observation is that the DALYs in different regions of the world were mostly attributed to YLLs, this means that CC poses a high risk of life loss for young women. This could be indicative of inadequate interventions and healthcare resources for CC prevention and treatment on a global scale, particularly for young women.[28,29] Thus, we should increase the HPV vaccination rate of young women, and enhance CC screening to achieve early detection, diagnosis and treatment.

The ASIR and ASDR for CC among young women showed a significant downward trend in Western Europe, Central Europe,

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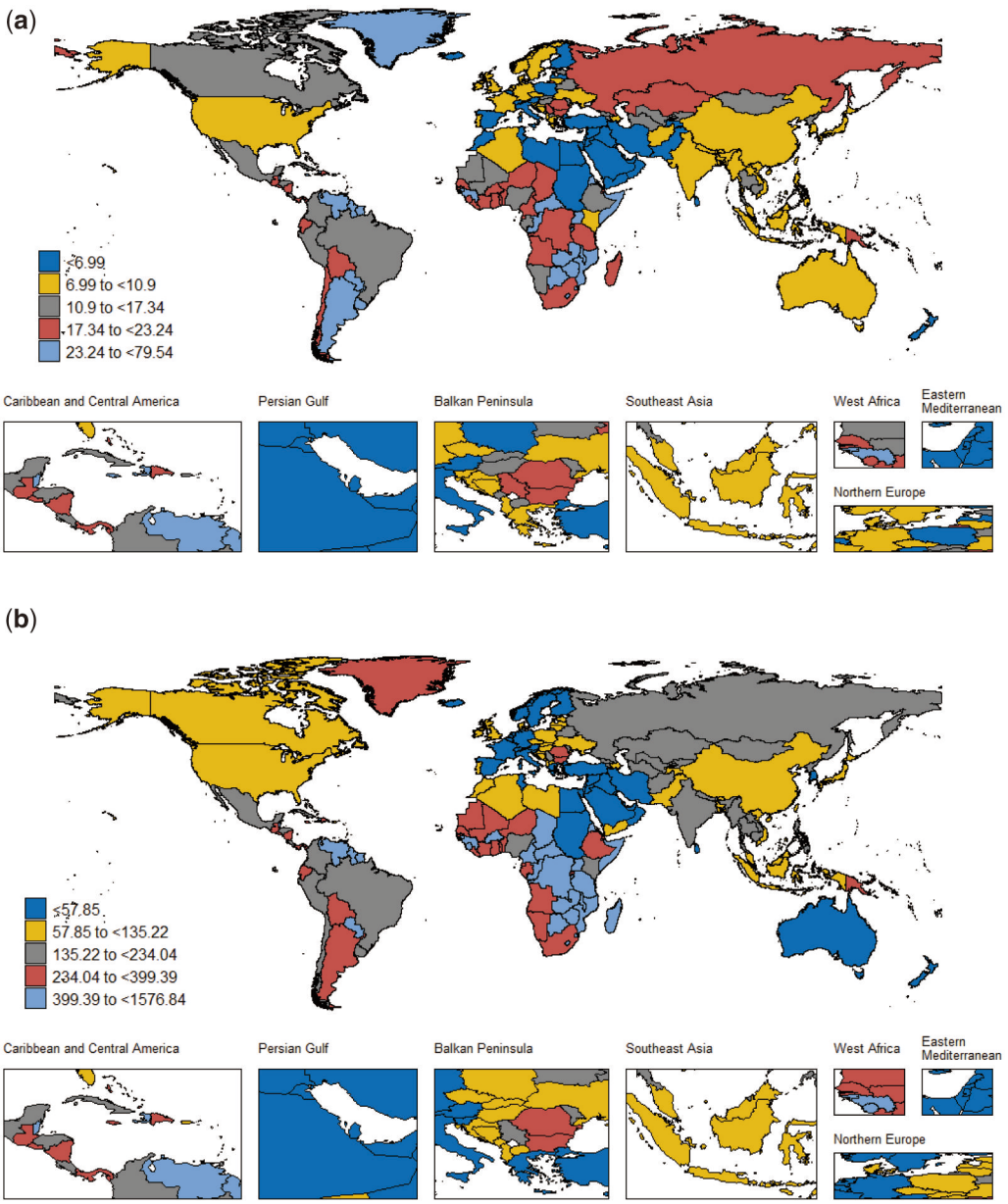


Figure 2 Age-standardized burden of CC among young women across 204 countries in 2019. (a) age-standardized incidence rate (ASIR), (b) age-standardized disability-adjusted life years (DALYs) rate.

Australasia and Southeast Asia, such as Maldives, Austria, Poland and Australia. On the contrary, there is a concerning trend in East Asia and Eastern Europe, where ASIR among young women has been on the rise.[24] This can be attributed to a surge in risk factors for HPV infection and an absence of effective CC control strategies, resulting in low screening and vaccine coverage for CC.[30,31] Notably, China has seen a significant increase trend in CC incidence among young women aged 15–44 years old, making it the second leading cause of cancer-related deaths in this group.[32] Although China approved HPV vaccines in 2016, the coverage was still low and the CC screening system needed to be improved.[33] Additionally, the limited implementation of regional vaccine programs in Russia, has contributed to a rise in high-risk HPV infection.[26,34] It is worth noting that South Asia has witnessed a significant burden of CC among young women. However, some countries in this region have made commendable efforts to optimize prevention strategies. For example, Nepal has improved healthcare facilities, along with cytology-based screening and visual inspection of the cervix by applying 3–5% acetic acid, thus increasing the number of people being screened.[35] Brisson M et al.'s research models predict that if this global elimination strategy of combined intensive scale-up of HPV vaccination and cervical screening can be achieved, CC elimination could be achieved in all countries by 2100. In doing so, CC incidence would be reduced by 97% and more than 74 million cases would be averted over the next century.[36] In conclusion, the rising incidence trends of CC among young women across some regions and countries presents a major challenge of public health. It is crucial to acknowledge the need for culturally appropriate, cost-effective, and effective prevention and control strategies tailored to the unique circumstances of each country and region.

The global rise in CC among young women can be primarily attributed to population growth and age structure changes, though the magnitude of the impact of each of these factors varied across different regions. Regions like Australasia, Central Europe, Western Europe and High-income North America experienced a decrease in the number of incident cases and DALYs attributed to CC among young women. Decomposition analysis showed in these developed regions both population growth and the impact of population age structure were relatively low, and there was a decline in the epidemic of CC. In contrast, regions like South Asia, East Asia and Sub-

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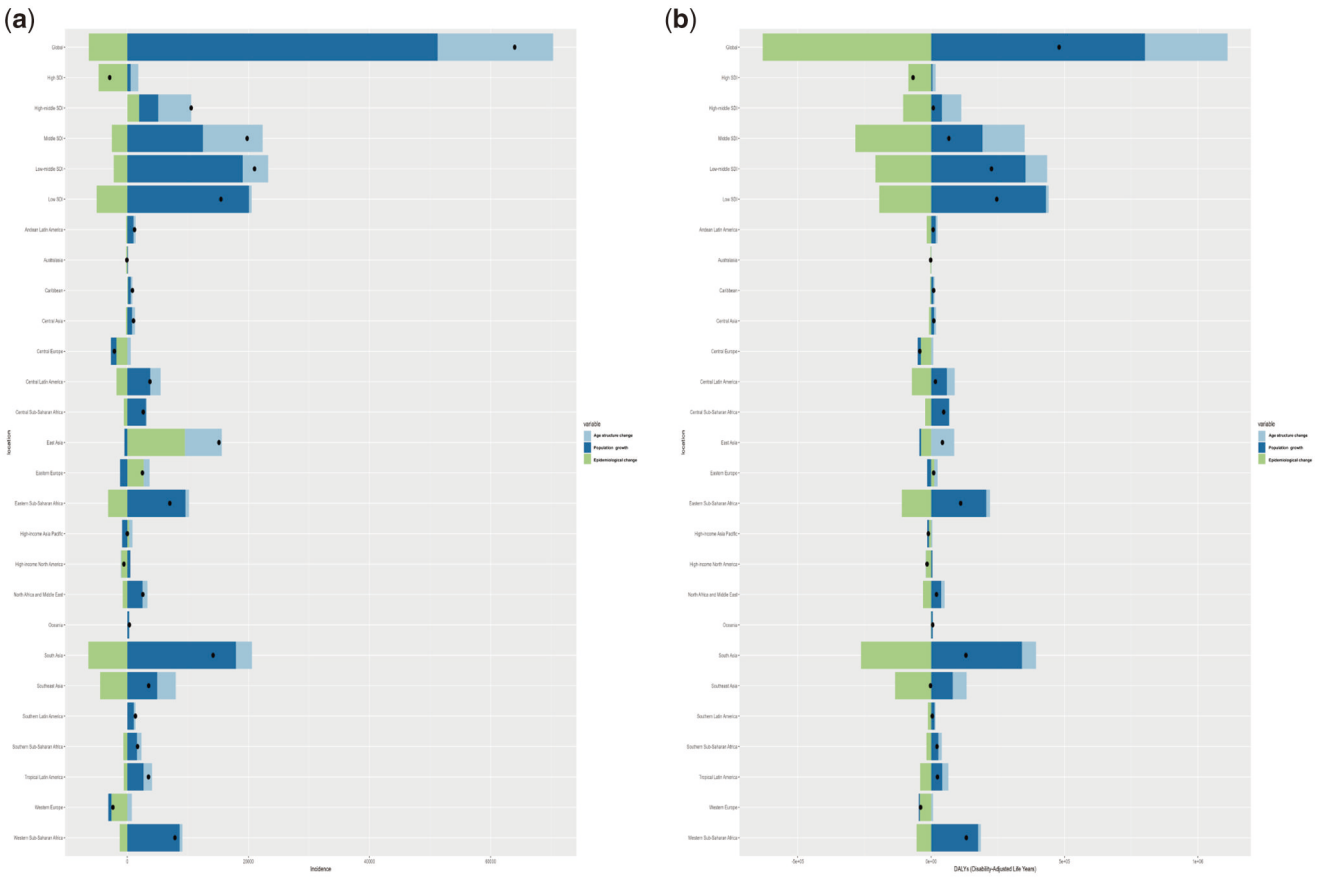


Figure 3 Decomposition of the percentage changes in CC among young women worldwide from 1990 to 2019. (a) Incidence, (b) disability-adjusted life years (DALYs). SDI, sociodemographic index.

Saharan Africa witnessed an increase in the total number of incident cases and DALYs. Decomposition analysis indicated that in South Asia and Sub-Saharan Africa, population growth had a more substantial impact, while in East Asia, population age structure played a more influential role. Understanding how changes in social and demographic structures affect the burden of CC among young women is crucial. This knowledge can guide the development of healthcare services and interventions to address the specific challenges faced by different regions and contribute to improved healthcare outcomes in the future.

Despite it has several strengths, this study does have some noteworthy limitations. First, it is important to acknowledge the limitations inherent in the GBD methodology, as this study is part of the GBD research. One key limitation is the reliance on health information reporting, which can have significant time delays in some countries. As a result, the GBD research may not capture the most recent advancements in women's health in these countries, potentially leading to underestimations or inaccuracies. Second, despite the relatively substantial registration data on women's CC globally, the available data are scarce and of low quality. Especially in low and middle-income countries, there may not be sufficient data to determine the changes in CC among young women, in terms of geography and time, thus their estimates are based on predicted covariates or trends from neighbouring countries.[37]

In summary, the period spanning from 1990 to 2019 witnessed declining trends in the ASRs of CC among young women worldwide. However, the absolute number of cases continued to rise, indicating that the burden of CC among young women worldwide remains high, especially in the low-middle and low SDI quintiles. It is worth noting that the high-middle SDI quintiles had an increase trend in ASIR. The study also reveals a strong association between population growth, population age structure and the substantial changes in CC. South Asia and East Asia currently bearing the brunt of nearly half of all incident cases, while the East Asia had the greatest upward trend in ASIR. Therefore, developing countries urgently need to implement more sensitive and cost-effective detection and treatment interventions, improve HPV vaccination rates to the ultimate goal of eradicating CC among young women as swiftly as possible.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Conflict of interest: None declared.

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Data availability

Data can be obtained from the Global Health Data Exchange Global Burden of Disease Results Tool (https://ghdx.healthdata.org/gbd-2019/data-input-sources).

Ethics approval and consent to participate

The study does not involve any ethical problem. This study was based on publicly available GBD 2019 study data, GBD 2019 was done in accordance with the Guideline for Accurate and Transparent Health Estimates Reporting (GATHER).

Consent for publication

All authors agree to publish this article.

Key points

- This study aims to determine and evaluate the changing trend of ASIR, ASDR, age-standardized YLDs rate, age-standardized YLLs rate and EAPC of young women (15–44 years old) diagnosed with CC across 21 regions and 204 countries.
- It witnessed declining trends in the ASR of CC among young women worldwide, while the absolute number of cases continued to rise from 1990 to 2019.
- It is worth noting that the high-middle SDI quintiles had an increase trend in ASIR.
- The study reveals a strong association between population growth, population age structure and the epidemiologic changes in CC observed between 1990 and 2019, especially in South Asia and East Asia.
- This study will be highly beneficial in devising and refining strategies to combat CC, thus reducing the number of premature deaths caused by CC and the future burden of the disease.

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