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ORIGINAL ARTICLE

# Global trend of cervical cancer among women aged 55 and older from 2010 to 2019: An analysis by socio-demographic index and geographic regions

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## Abstract

**Objective:** This study describes the 2010–2019 trend of cervical cancer (CC) in women over 55 by socio-demographic index (SDI) and geographical regions.

**Methods:** We obtained data on CC annually from 2010 to 2019 from the 2019 Global Burden of Disease Study (GBD) to analyze the incidence, death and prevalence rates, and disability-adjusted life years (DALYs) associated with CC across different parameters such as global trend, age groups, SDI, continents, World Bank Regions, World Health Organization (WHO) regions, GBD regions, and National and territorial division. This analysis covers data from 204 countries and territories from 1990 to 2019.

**Results:** There were 236,228 CC incidence cases worldwide in 2019, which is a 1.27-fold increase from 2010. Global CC deaths also increased to 169,304 cases in 2019, reflecting a 1.24-fold increase. CC prevalence increased to 769,925 cases in 2019, representing a 1.4-fold rise. The number of CC DALYs globally increased to 3,835,979 cases in 2019, reflecting a 1.24-fold increase. Incidence, death, prevalence, and DALY numbers of CC increased across all age groups females in the 65–69 years age group experienced the highest increase. Middle SDI countries had the highest incidence, death, prevalence, and DALY numbers, while low SDI countries showed increasing trends. Asia exhibited the highest incidence, death, prevalence, and DALY numbers of CC. Upper middle-income countries had the highest incidence, death, prevalence, and DALY numbers, with the highest decreases in these rates except the prevalence rate. The Western Pacific Region showed the highest incidence, death, prevalence, and DALY numbers, with declining rate trends. The Republic of Kiribati showed the highest incidence, death, prevalence, and DALY numbers.

**Conclusion:** Based on the study results, it is clear that although the global trend of epidemiological indicators of CC is decreasing, the largest proportion of the decreasing trend is related to developing countries. But in regions of Africa and Asia that have a lower level of development, sometimes these indicators show upward trends, which shows the worsening of the problem in these regions and the need for serious policies

and plans to implement comprehensive vaccination, screening, and promotion interventions. People's awareness is necessary in the field of better disease control.

**KEYWORDS**
burden, cervical cancer, death, incidence, prevalence, socio-demographic index

## 1 | INTRODUCTION

Cervical cancer (CC) is the fourth most common cancer in the world in terms of incidence and mortality among women worldwide.[1] CC incidence and mortality rates vary significantly between countries. For example, the highest incidence rates (more than 40 per 100,000) are reported in East, Southern, or West African countries, while the lowest incidence rates (less than 3 per 100,000) are reported in higher-income countries from North America, Europe, Australia, and New Zealand.[2] As a major global health concern, most cases of CC have increased significantly in underdeveloped regions.[3]

There are several risk factors associated with CC, of which human papillomavirus (HPV) infection is one of the main causes,[4,5] which is responsible for about 99.7% of all CC cases.[5] Other factors have been reported to increase the risk of CC, including smoking, immunosuppression, HIV and Chlamydia trachomatis infection, poor sexual health and multiple sexual partners, oral contraceptives, and lack of attention to screening.[4,6,7]

Without significant intervention, the global burden of CC is expected to increase to nearly 700,000 cases and 400,000 deaths by 2030 respectively.[8] Therefore, the World Health Organization (WHO) has made a call to eliminate CC by 2030.[8]

Considering the high prevalence of CC in women, the present study was conducted to determine the worldwide trend of CC in women over 55 years of age from 2010 to 2019 based on socio-demographic index (SDI) and geographical regions.

## 2 | METHODS

Numbers and rates of the incidence, deaths, prevalence, and disability-adjusted life years (DALYs) of CC for women over 55 years old from 2010 to 2019 were extracted from the online Global Burden of Disease (GBD) database 2019 based on the International Classification of Diseases 10 (ICD-10 code 53 for CC). This year's data represents the most up-to-date information on epidemiological metrics accessible at http://ghdx.healthdata.org. The GBD has calculated epidemiological metrics for 369 diseases and injuries in both genders across 204 countries and territories based on various geographic divisions.[9] The GBD framework is commonly used to understand the global burden of diseases. Our extraction of CC data for 204 countries based on various classifications ensured precise interpretation (global trend, age groups, SDI, continents, World Bank Regions, WHO regions, GBD regions, and National and territorial divisions). The SDI is the geometric mean of a country's lag-distributed income per capita, the average educational attainment of individuals aged 15 and older, and the total fertility rate among those under 25 years old and provides insight into the social and economic conditions that impact health outcomes within a given location. Countries and territories are stratified into five groups based on their SDI values: low SDI (<0.45), low-middle SDI (≥0.45 and <0.61), middle SDI (≥0.61 and <0.69), high-middle SDI (≥0.69 and <0.80), and high SDI (≥0.80).[10] For analytical purposes, the World Bank classifies economies into four income groups: low, medium-low, medium-high, and high. This categorization relies on per capita gross national income (GNI) data in United States dollars, converted into local currency using the World Bank's Atlas method, which is designed to accommodate fluctuations in exchange rates.[11] For the GBD, a standardized measure of quality-adjusted life years (QALYs) has been developed, referred to as DALYs. DALYs are calculated as the years of life lost (YLLs) due to premature death and the years lived with a disability of specified severity and duration. Each DALY represents a year of healthy life lost. “Premature” death is defined as death occurring before the age at which the individual would have expected to survive if they were part of a standardized population with a life expectancy at birth equal to that of Japan, which has the longest life expectancy globally. To calculate the total DALYs for a specific condition in a population, YLLs and years lived with disability (YLDs) of known severity and duration for that condition must be estimated and then combined.[12]

In this research, the incidence, prevalence, mortality, and DALY rates were presented per 100,000 population. Comparative changes in rates were shown by the relative changes (%) between years. The relative change is calculated by dividing the value of the absolute difference by the value of the year of origin, which is multiplied by 100.[13,14] The data were provided with values accompanied by a 95% confidence interval (CI). Selected epidemiological metrics are delineated individually for each classification system. Definitions of the terms utilized can be accessed at the following links: https://www.healthdata.org/terms-defined and https://www.healthdata.org/gbd/.

## 3 | RESULTS

### 3.1 | The global level of CC

Globally, compared to 2010, the incidence of CC with a 1.27-fold increase, reached 236,228 cases in 2019. In contrast, the incidence rate of CC decreased by 2%, reaching 31.757 per 100,000

individuals in 2019. The global number of CC-related deaths rose to 169,304 cases in 2019, marking a 1.24-fold increase. Conversely, the death rate of CC decreased by 4%, declining to 22.760 per 100,000 individuals in 2019.

The prevalence of CC increased to 769,925 cases in 2019, showing a 1.40-fold increase. Moreover, the prevalence rate of CC increased by 3%, reaching 103.504 per 100,000 individuals in 2019. The DALYs of CC escalated to 3,835,979 cases in 2019, representing a more than 1.24-fold increase. However, the DALYs rate of CC decreased by 5%, declining to 257.314 per 100,000 individuals in 2019. For more details refer to Tables 1–4 and Figures 1 and 2.

### 3.2 | Age pattern of CC

In both years (2010 and 2019), the highest incidence, death, and DALY numbers of CC were reported in the 55–59 age group and the highest prevalence numbers were reported in the 70–74 age group. The lowest incidence, death, prevalence, and DALY numbers were observed in individuals aged ≥85 years (Figures 2–5).

Among subgroups of females aged ≥55 years, the incidence, death, prevalence, and DALY numbers of CC increased in all age groups from 2010 to 2019. Notably, females in the 65–69 years age group experienced the highest increase (Figure 5).

### 3.3 | Level of CC by SDI

In 2019, Low SDI countries had the highest incidence rate, at 63.964 per 100,000 people, while High SDI countries had the lowest, at 19.725 per 100,000 people. The incidence rate in Low-middle SDI countries grew by 0.009 between 2010 and 2019, while other countries experienced a decreasing trend from −0.018 in low-SDI countries to −0.061 in High-middle SDI countries.

Low SDI and High SDI nations displayed the highest and lowest CC death rates, with 52.605 and 12.010 deaths per 100,000 people, respectively. Death rates decreased in all countries from 2010 to 2019, with the Middle SDI countries experiencing the most significant decrease (−0.085 decrease).

Low SDI countries had the highest prevalence rate of 147.615 per 100,000 people in 2019. During 2010–2019, the most significant increase in prevalence rate by 0.094 change was observed in Low-middle SDI countries. High SDI countries had the lowest prevalence rates in 2019 (84.578 per 100,000 people), which showed a downward trend of 2.2% from 2010.

Low SDI and High SDI countries experienced the greatest and smallest DALY rates, with 709.144 and 103.233 per 100,000 people, respectively. From 2010 to 2019, all countries showed a downward trend in DALY rates, with the most significant decrease observed in Middle SDI countries (−0.099 decrease). More details are presented in Tables 1–4 and Figure 6.

### 3.4 | Level of CC in continents

In 2019, the highest incidence rate of CC was observed in Africa (68.095 per 100,000) and Europe demonstrated the lowest incidence rate (23.348 per 100,000). From 2010 to 2019, the incidence rate in European countries showed the most decreasing trend (−0.089 decrease). While Africa and America experienced a downward trend of −0.056 and −0.042, Asia showed a stable trend.

European countries showed the lowest death rate (15.411 per 100,000 women) and the most decreasing trend of death rate by −0.105, from 2010 to 2019. Africa, America, and Asia experienced a decreasing trend of −0.082, −0.066, and −0.030, respectively.

African (164.106) and European (89.402) countries experienced the greatest and lowest prevalence rate per 100,000 people. From 2010 to 2019, Europe showed a downward trend of prevalence rate of −0.054, while Asia and Africa showed an upward trend of 0.066 and 0.029, respectively, and America showed a stable trend.

The highest DALYs rate was reported in Africa (751.444) and the lowest rate was recorded in Europe (141.236) per 100,000 people. All continents observed a downward trend in the DALYs rate from 2010 to 2019 between −0.050 in Africa and −0.114 in Europe.

More details are presented in Tables 1–4 and Figure 1.

### 3.5 | Level of CC by World Bank Income Level

In 2019, the highest incidence rate was allocated to World Bank Low-Income countries (85.247 per 100,000) with a decreasing trend of −0.017 from 2010 to 2019. World Bank High-Income countries (20.741 per 100,000) recorded the lowest incidence rate, showing the most decreasing trend of −0.045 during the same period (Table 1).

The highest death rate was recorded in World Bank Low-Income (69.665 per 100,000) and World Bank High-Income (12.764 per 100,000) countries, respectively. All countries observed a decreasing trend in death rates between −0.037 (World Bank Low-Income countries) and −0.070 (World Bank Upper Middle-Income countries) (Table 2).

World Bank Low-Income (199.994 per 100,000) and World Bank High-Income (88.028 per 100,000) had the greatest and lowest prevalence rate of CC, respectively. World Bank High-Income countries showed a decreasing trend of −0.032 from 2010 to 2019, while other World Bank countries demonstrated an upward trend from 0.034 to 0.058, respectively (Table 3).

World Bank Low-Income (925.504 per 100,000) and World Bank High-Income (108.993 per 100,000) countries showed the highest and lowest DALYs rate. All countries experienced a downward trend in DALYs rate during 2010–2019, with the most significant decrease observed in World Bank Upper Middle-Income countries (−0.093) and the least significant decrease observed in World Bank Low-Income countries (−0.025) (Table 4).

**TABLE 1** Incidence of cervical cancer in ≥55 years old women.

| Location | 2010 | | 2019 | | |
|---|---|---|---|---|---|
| | Incidence number | Incidence rate (per 100,000) | Incidence number | Incidence rate (per 100,000) | % changes (2010–2019) |
| Global | 185,337 | 32.413 | 236,228 | 31.757 | −0.020 |
| | (168840 to 210946) | (29.528 to 36.892) | (205339 to 263653) | (27.605 to 35.444) | (−0.099 to 0.065) |
| SDI | | | | | |
| High SDI | 28,520 | 20.467 | 32,858 | 19.725 | −0.036 |
| | (25412 to 30255) | (18.237 to 21.712) | (28493 to 37025) | (17.105 to 22.227) | (−0.123 to 0.062) |
| High-middle SDI | 42,388 | 27.867 | 50,523 | 26.180 | −0.061 |
| | (38195 to 45173) | (25.11 to 29.698) | (41238 to 57046) | (21.369 to 29.56) | (−0.176 to 0.052) |
| Low SDI | 20,354 | 65.159 | 26,963 | 63.964 | −0.018 |
| | (16316 to 25154) | (52.231 to 80.524) | (21782 to 33120) | (51.672 to 78.57) | (−0.105 to 0.089) |
| Low-middle SDI | 33,960 | 38.784 | 46,313 | 39.142 | 0.009 |
| | (29975 to 43485) | (34.233 to 49.661) | (40342 to 58105) | (34.095 to 49.108) | (−0.085 to 0.127) |
| Middle SDI | 59,978 | 37.196 | 79,402 | 35.535 | −0.045 |
| | (50561 to 65436) | (31.356 to 40.581) | (63839 to 90433) | (28.57 to 40.471) | (−0.146 to 0.07) |
| World Bank Income Level | | | | | |
| World Bank High Income | 36,848 | 21.728 | 41,480 | 20.741 | −0.045 |
| | (32271 to 38659) | (19.03 to 22.796) | (35055 to 46562) | (17.528 to 23.281) | (−0.129 to 0.048) |
| World Bank Low Income | 17,416 | 86.750 | 22,605 | 85.247 | −0.017 |
| | (13650 to 21109) | (67.991 to 105.146) | (17315 to 27739) | (65.296 to 104.608) | (−0.117 to 0.11) |
| World Bank Lower Middle Income | 54,526 | 36.581 | 73,498 | 35.721 | −0.024 |
| | (48526 to 69316) | (32.556 to 46.503) | (63787 to 93053) | (31.002 to 45.225) | (−0.123 to 0.098) |
| World Bank Upper Middle Income | 76,410 | 32.824 | 98,475 | 31.642 | −0.036 |
| | (65184 to 82860) | (28.001 to 35.594) | (75779 to 113360) | (24.349 to 36.425) | (−0.172 to 0.099) |
| Continents | | | | | |
| Africa | 27,509 | 72.099 | 36,055 | 68.095 | −0.056 |
| | (22340 to 32614) | (58.552–85.479) | (28584–42906) | (53.985–81.035) | (−0.144 to 0.052) |
| America | 33,580 | 37.031 | 42,200 | 35.487 | −0.042 |
| | (31138 to 36400) | (34.339–40.141) | (37069–48020) | (31.173–40.381) | (−0.14 to 0.061) |
| Asia | 91,187 | 29.024 | 123,678 | 29.072 | 0.002 |
| | (80669 to 105722) | (25.676–33.65) | (101588–143387) | (23.879–33.704) | (−0.123 to 0.134) |
| Europe | 32,790 | 25.639 | 33,968 | 23.348 | −0.089 |
| | (29863 to 34227) | (23.35–26.762) | (29775–38257) | (20.466–26.296) | (−0.168 to 0.006) |
| WHO Regions | | | | | |
| African Region | 25,300 | 84.421 | 33,162 | 79.333 | −0.060 |
| | (20526 to 29794) | (68.491 to 99.414) | (26130 to 39679) | (62.51 to 94.923) | (−0.154 to 0.056) |
| Eastern Mediterranean Region | 4895 | 20.501 | 6491 | 19.550 | −0.046 |
| | (4001 to 5809) | (16.757 to 24.329) | (5246 to 7712) | (15.802 to 23.227) | (−0.146 to 0.09) |
| European Region | 34,412 | 26.024 | 36,026 | 23.761 | −0.087 |
| | (31397 to 35914) | (23.744 to 27.16) | (31632 to 40518) | (20.863 to 26.724) | (−0.164 to 0.006) |
| Region of the Americas | 33,580 | 37.031 | 42,200 | 35.487 | −0.042 |
| | (31138 to 36400) | (34.339 to 40.141) | (37069 to 48020) | (31.173 to 40.381) | (−0.14 to 0.061) |
| South-East Asia Region | 36,651 | 33.974 | 49,769 | 33.206 | −0.023 |
| | (31990 to 49813) | (29.654 to 46.175) | (41645 to 66983) | (27.786 to 44.692) | (−0.153 to 0.152) |

(Continues)

TABLE 1 (Continued)

| Location | 2010 | | 2019 | | |
|---|---|---|---|---|---|
| | Incidence number | Incidence rate (per 100,000) | Incidence number | Incidence rate (per 100,000) | % changes (2010–2019) |
| Western Pacific Region | 50,016 (38940 to 55311) | 27.014 (21.032 to 29.874) | 67,964 (44782 to 81341) | 27.657 (18.223 to 33.101) | 0.024 (−0.179 to 0.219) |
| GBD Region | | | | | |
| East Asia & Pacific—WB | 61,512 (51528 to 68878) | 28.924 (24.229 to 32.388) | 82,001 (61371 to 95577) | 28.897 (21.627 to 33.681) | −0.001 (−0.166 to 0.17) |
| East Asia | 36,479 (27321 to 41718) | 26.406 (19.777 to 30.198) | 50,900 (29935 to 63675) | 27.109 (15.943 to 33.913) | 0.027 (−0.245 to 0.289) |
| Oceania | 284 (211 to 391) | 73.729 (54.664 to 101.395) | 393 (286 to 536) | 72.616 (52.762 to 98.967) | −0.015 (−0.168 to 0.166) |
| Southeast Asia | 17,355 (14602 to 23240) | 43.537 (36.632 to 58.3) | 22,583 (18430 to 30506) | 40.109 (32.732 to 54.18) | −0.079 (−0.198 to 0.06) |
| Sub-Saharan Africa—WB | 25,597 (20744 to 30363) | 86.697 (70.259 to 102.841) | 33,494 (26351 to 40237) | 81.788 (64.348 to 98.256) | −0.057 (−0.148 to 0.057) |
| Central Sub-Saharan Africa | 3395 (2328 to 4722) | 101.177 (69.385 to 140.729) | 4347 (2871 to 6237) | 92.771 (61.271 to 133.115) | −0.083 (−0.262 to 0.155) |
| Eastern Sub-Saharan Africa | 8963 (6680 to 11481) | 91.194 (67.965 to 116.821) | 12,137 (8731 to 15550) | 90.332 (64.98 to 115.732) | −0.009 (−0.112 to 0.106) |
| Southern Sub-Saharan Africa | 4319 (3708 to 5094) | 102.175 (87.71 to 120.505) | 4797 (4046 to 5714) | 87.033 (73.407 to 103.67) | −0.148 (−0.246 to −0.031) |
| Western Sub-Saharan Africa | 8732 (6921 to 10822) | 79.285 (62.84 to 98.269) | 11,977 (9495 to 14816) | 75.399 (59.771 to 93.272) | −0.049 (−0.199 to 0.121) |
| South Asia—WB | 26,869 (23105 to 35838) | 30.384 (26.127 to 40.526) | 37,887 (30457 to 49022) | 30.891 (24.833 to 39.97) | 0.017 (−0.143 to 0.234) |
| South Asia | 26,136 (22390 to 35035) | 30.461 (26.096 to 40.833) | 37,012 (29637 to 48320) | 31.045 (24.859 to 40.53) | 0.019 (−0.147 to 0.245) |
| Latin America & Caribbean—WB | 25,185 (23494 to 28008) | 55.959 (52.202 to 62.232) | 31,412 (27258 to 36423) | 51.013 (44.267 to 59.151) | −0.088 (−0.191 to 0.032) |
| Andean Latin America | 3530 (2839 to 4087) | 100.565 (80.884 to 116.448) | 4339 (3400 to 5424) | 89.071 (69.809 to 111.352) | −0.114 (−0.286 to 0.097) |
| Caribbean | 2166 (1836 to 2484) | 58.626 (49.705 to 67.223) | 2708 (2213 to 3241) | 57.846 (47.28 to 69.233) | −0.013 (−0.144 to 0.145) |
| Central Latin America | 8751 (8139 to 9888) | 57.662 (53.626 to 65.151) | 11,321 (9413 to 13800) | 52.571 (43.713 to 64.081) | −0.088 (−0.225 to 0.075) |
| Tropical Latin America | 7669 (7119 to 9190) | 46.911 (43.548 to 56.214) | 9496 (8707 to 11541) | 41.568 (38.116 to 50.522) | −0.114 (−0.168 to −0.052) |
| Middle East & North Africa—WB | 3242 (2560 to 3806) | 17.753 (14.02 to 20.843) | 4475 (3525 to 5382) | 17.216 (13.56 to 20.704) | −0.030 (−0.139 to 0.111) |
| North Africa and Middle East | 4446 (3588 to 5109) (3588 to 5109) | 17.677 (14.266 to 20.313) (14.27 to 20.31) | 6003 (4750 to 7092) (4750 to 7092) | 17.109 (13.538 to 20.214) (13.54 to 20.21) | −0.032 (−0.121 to 0.098) (−0.12 to 0.1) |

TABLE 1 (Continued)

| Location | 2010 | | 2019 | | |
|---|---|---|---|---|---|
| | Incidence number | Incidence rate (per 100,000) | Incidence number | Incidence rate (per 100,000) | % changes (2010–2019) |
| Europe & Central Asia—WB | 34,180 (31176 to 35674) | 26.071 (23.779 to 27.21) | 35,754 (31456 to 40184) | 23.801 (20.94 to 26.75) | −0.087 (−0.164 to 0.007) |
| Central Asia | 2128 (2002 to 2333) | 40.904 (38.486 to 44.841) | 2683 (2355 to 3093) | 36.545 (32.081 to 42.138) | −0.107 (−0.202 to 0.015) |
| Central Europe | 7290 (6140 to 7620) | 39.096 (32.93 to 40.867) | 7109 (5812 to 8237) | 34.726 (28.392 to 40.236) | −0.112 (−0.216 to 0.021) |
| Eastern Europe | 10,128 (9611 to 11305) | 30.038 (28.505 to 33.531) | 10,182 (8712 to 12093) | 26.707 (22.851 to 31.721) | −0.111 (−0.232 to 0.045) |
| High Income | 33,566 (29205 to 35315) | 21.281 (18.516 to 22.39) | 38,243 (32491 to 43140) | 20.610 (17.51 to 23.249) | −0.032 (−0.124 to 0.071) |
| Australasia | 715 (612 to 779) | 21.051 (18.024 to 22.933) | 888 (681 to 1112) | 20.495 (15.72 to 25.66) | −0.026 (−0.229 to 0.205) |
| High-income Asia Pacific | 7161 (6017 to 7855) | 21.827 (18.342 to 23.944) | 7827 (6227 to 9326) | 20.906 (16.634 to 24.912) | −0.042 (−0.174 to 0.113) |
| High-income North America | 8523 (7350 to 8906) | 18.428 (15.892 to 19.258) | 10,935 (8732 to 13118) | 18.848 (15.049 to 22.609) | 0.023 (−0.137 to 0.213) |
| Southern Latin America | 3145 (2759 to 3378) | 49.047 (43.023 to 52.672) | 3643 (2807 to 4599) | 46.603 (35.904 to 58.837) | −0.050 (−0.265 to 0.186) |
| Western Europe | 14,022 (12321 to 14721) | 20.361 (17.892 to 21.376) | 14,950 (12593 to 17328) | 19.178 (16.155 to 22.228) | −0.058 (−0.181 to 0.077) |

### 3.6 | Level of CC in WHO regions

In 2019, the highest incidence, death, prevalence, and DALY rate of CC was observed in the African Region with 79.333, 65.053, 187.949, and 874.786 rates per 100,000 individuals. The lowest incidence, death, and prevalence rates were observed in the Eastern Mediterranean Region with 19.550, 14.647, and 56.506 per 100,000 respectively. European Region recorded the lowest DALY rate with 147.065 per 100,000.

From 2010 to 2019, all regions experienced a downward trend in incidence rate trend from −0.023 (South-East Asia Region) to −0.087 (European Region), except for the Western Pacific Region, which showed an upward trend of +0.024.

It is worth noting that all regions experienced a decreasing trend in death rate during 2010–2019, with the most decrease observed in the European Region, with a −0.105 decline from 2010 to 2019.

Only the European Region observed a decreasing trend in prevalence rate from 2010 until 2019, with a decrease of −0.049. The Region of the Americas showed a stable trend, and other regions experienced an increasing trend from 0.022 (African Region) to 0.078 (Western Pacific Region). African Region by −0.053 change experienced the highest DALYs rate from 2010 to 2019. The lowest DALYs rate in 2019 was allocated to the European Region where the most decrease (−0.106 decline) in DALYs rate is observed. It is worth mentioning that all regions experienced a decreasing trend in the DALYs rate from 2010 to 2019.

More details are presented in Tables 1–4 and Figure 7.

### 3.7 | Level of CC in GBD regions

In 2019, the maximum incidence, death, prevalence, and DALY rate of CC in 2019 was detected in Central Sub-Saharan Africa (92.771), Central Sub-Saharan Africa (76.642), Andean Latin America (348.785), and Central Sub-Saharan Africa (1094.293) per 100,000 women, respectively. In contrast, the minimum incidence, death, prevalence, and DALY rates reported in North Africa and the Middle East (17.109), Australasia (9.430), North Africa and the Middle East (54.907), and Australasia (84.569) per 100,000 women, respectively.

Between 2010 and 2019, three regions showed a rising trend in incidence rate, while the other 18 regions experienced a downward trend between −0.148 (Southern Sub-Saharan Africa) and −0.009 (Eastern Sub-Saharan Africa and Caribbean). All regions experienced a decreasing trend in death rate, ranging from −0.004 (High-income North America) to −0.179 (Central Asia).

Ten regions experienced an increasing trend in prevalence rate during 2010–2019, ranging from 0.014 (Southeast Asia) to 0.108 (South Asia and East Asia), while two regions showed no significant

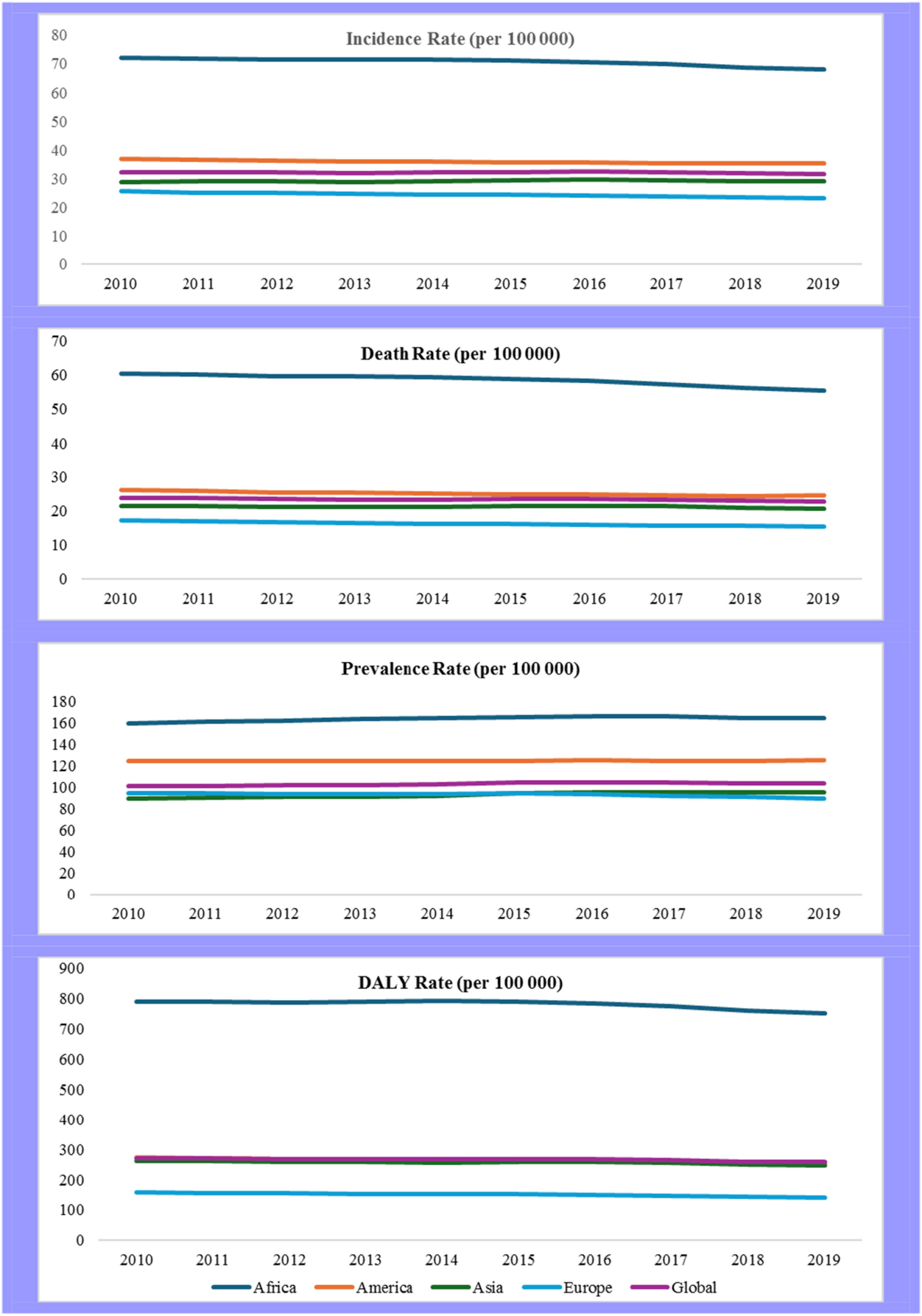


FIGURE 1 Temporal trend of incidence, prevalence, death, and DALYs rates (per 100,000 population) of cervical cancer based on continents and comparison with global data from 2010 to 2019.

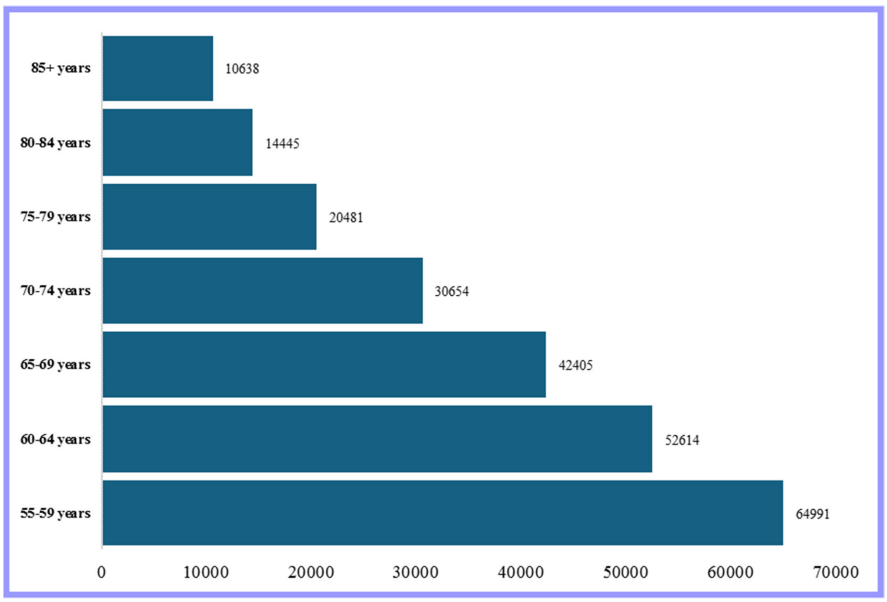


**FIGURE 2** Age-specific incidence cases of cervical cancer among worldwide females over 55 years, 2019.

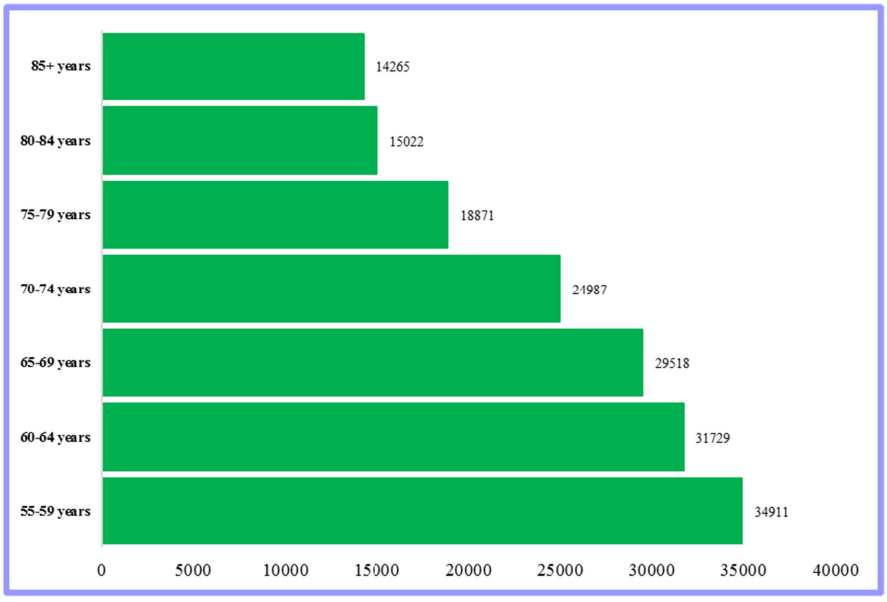


**FIGURE 3** Age-specific death cases of cervical cancers among worldwide females over 55 years, 2019.

changes and nine regions showed a decreasing trend between −0.021 (Australasia) and −0.102 (Central Europe). Except for High-income North America, which had a stable trend, all regions experienced a decreasing trend in DALYs rate, with the most significant decrease in Central Europe (−0.17) and the least decrease in Oceania (−0.01). More details are presented in Tables 1–4 and Figure 8.

## 3.8 | Level of CC by national and territorial division

In 2019, the highest incidence, death, prevalence, and DALY rate of CC was recorded in the Republic of Kiribati with 274.429, 215.882, 692.257, and 3203.470 per 100,000 people, respectively. Controversy, the lowest incidence, death, prevalence, and DALY rate of CC was recorded in the Syrian Arab Republic (9.521), Syrian Arab Republic (6.653), the Arab Republic of Egypt (29.376), and the Republic of Malta (69.759), respectively.

Between 2010 and 2019, 44, 29, 90, and 47 out of 204 countries or territories experienced an increase in CC incidence, death, prevalence, and DALY rate of CC, while the remaining countries or territories saw a decrease trend. The most incidence increases were observed in Saint Lucia (16%) and Malaysia (16%). Notably, Guam (21%) recorded the most significant rise in death rate. The Republic of Cabo Verde (39%) experienced the greatest increase. The Republic of Cabo Verde (28%) experienced the greatest increase in DALY rate. The highest decreases in incidence, death, prevalence, and DALY rates of CC were recorded in the United Arab Emirates by −46, −51, −37, and −45%, respectively.

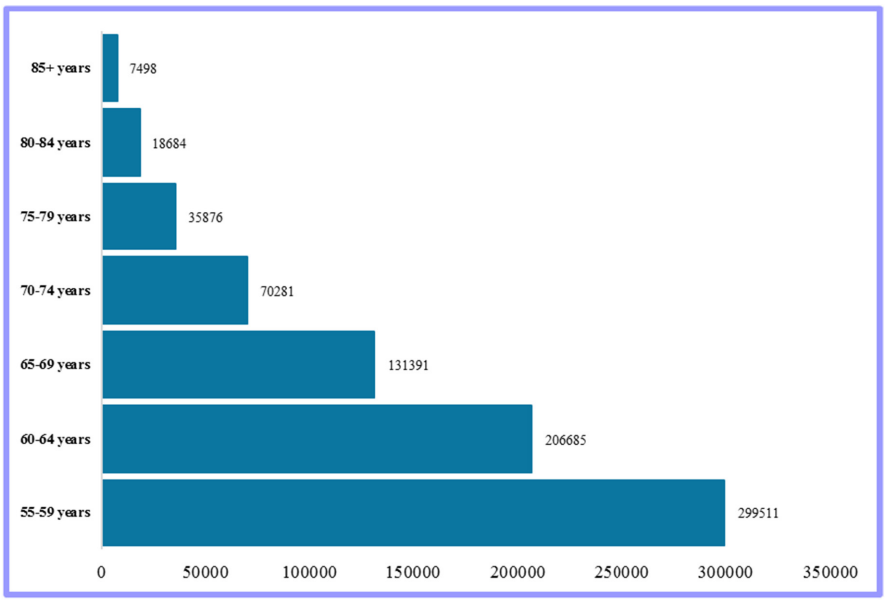


**FIGURE 4** Age-specific prevalence cases of cervical cancers among worldwide females over 55 years, 2019.

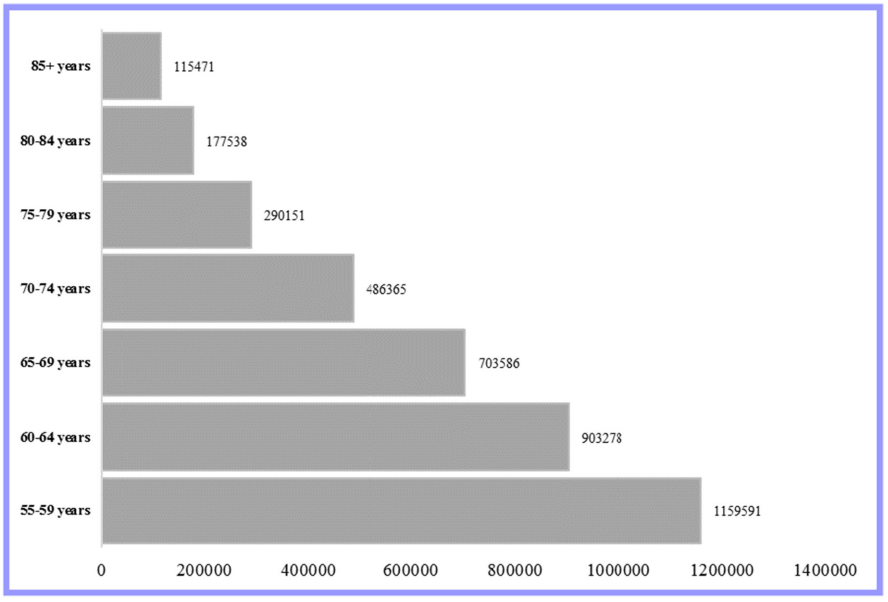


**FIGURE 5** Age-specific DALYs cases of cervical cancers among worldwide females over 55 years, 2019.

## 4 | DISCUSSION

In this study, the results showed that the rates of incidence, death, and DALYs of CC in women aged 55 years and older decreased during 2010–2019, and the prevalence rate has increased. The increase in the prevalence of CC can be a sign of success in controlling the disease by improving the quality of diagnosis and timely treatment of patients. However, the decreasing trend observed in the incidence, mortality, and DALYs of CC is not a strange and far-fetched finding, because in recent decades, in many regions, especially in developed countries, prevention and screening services have been provided, facilitating access to screening and management of diagnosis, and treatment of patients has been organized.[15]

The results revealed that the lowest incidence, prevalence, death, and DALYs of CC in 2019 were related to high-SDI countries, and the highest statistics were related to low-SDI countries. When the analyses were repeated by grouping countries into World Bank regions, again the highest statistics were observed in low-income countries and the lowest statistics were observed in high-income countries. In addition, the trend of CC incidence has been increasing in low-middle-SDI countries, and this finding is in agreement with the findings of the study by Hu Yao et al., who examined the 30-year global trend of CC in all age groups and reported an inverse relationship between death rate and DALYs of CC with SDI.[16] In explaining this finding, it is enough to know that CC is very preventable, and if it is detected quickly, it is easily treatable. However, in low-SDI countries, due to the lack of organized screening, prevention programs, and treatment of precancerous lesions, the CC statistics remain high and are increasing in some of those areas.[17]

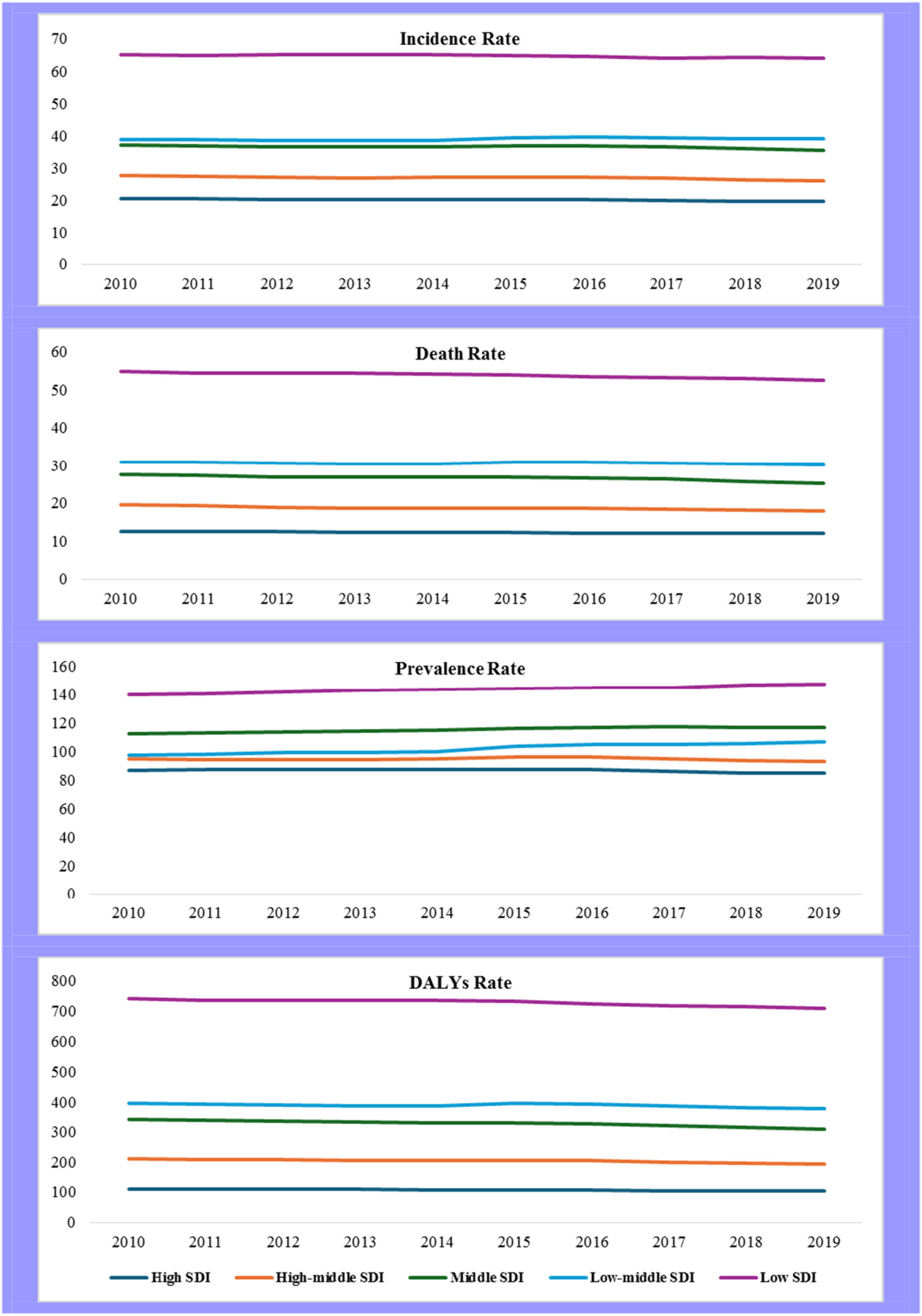


FIGURE 6 Temporal trend of incidence, prevalence, death, and DALYs rates (per 100,000 population) of cervical cancer based on SDI from 1990 to 2019.

TABLE 2 Death of cervical cancer in ≥55 years old women.

| Location | 2010 | | 2019 | | |
|---|---|---|---|---|---|
| | Death number | Death rate (per 100,000) | Death number | Death rate (per 100,000) | % changes (2010–2019) |
| Global | 136,192 | 23.818 | 169,304 | 22.760 | −0.044 |
| | (123373 to 156445) | (21.576 to 27.36) | (145729 to 190817) | (19.591 to 25.652) | (−0.118 to 0.039) |
| SDI | | | | | |
| High SDI | 17,504 | 12.561 | 20,007 | 12.010 | −0.044 |
| | (15186 to 18617) | (10.898 to 13.361) | (17248 to 21655) | (10.354 to 13) | (−0.082 to 0.004) |
| High-middle SDI | 29,746 | 19.555 | 34,671 | 17.966 | −0.081 |
| | (26596 to 31945) | (17.485 to 21.001) | (28326 to 38837) | (14.678 to 20.125) | (−0.183 to 0.023) |
| Low SDI | 17,137 | 54.860 | 22,175 | 52.605 | −0.041 |
| | (13806 to 21051) | (44.197 to 67.391) | (17749 to 27034) | (42.105 to 64.132) | (−0.126 to 0.067) |
| Low-middle SDI | 27,061 | 30.905 | 35,738 | 30.204 | −0.023 |
| | (24008 to 35304) | (27.417 to 40.318) | (31002 to 45920) | (26.202 to 38.81) | (−0.125 to 0.093) |
| Middle SDI | 44,644 | 27.687 | 56,591 | 25.326 | −0.085 |
| | (37446 to 49209) | (23.223 to 30.518) | (45313 to 64787) | (20.279 to 28.994) | (−0.192 to 0.034) |
| World Bank Income Level | | | | | |
| World Bank High Income | 22,811 | 13.451 | 25,526 | 12.764 | −0.051 |
| | (19712 to 24104) | (11.624 to 14.214) | (21824 to 27547) | (10.912 to 13.774) | (−0.089 to −0.002) |
| World Bank Low Income | 14,517 | 72.309 | 18,473 | 69.665 | −0.037 |
| | (11428 to 17636) | (56.925 to 87.848) | (14164 to 22628) | (53.413 to 85.334) | (−0.129 to 0.084) |
| World Bank Lower Middle Income | 42,138 | 28.270 | 54,793 | 26.630 | −0.058 |
| | (37038 to 54234) | (24.849 to 36.385) | (46901 to 72508) | (22.795 to 35.24) | (−0.164 to 0.063) |
| World Bank Upper Middle Income | 56,626 | 24.325 | 70,389 | 22.617 | −0.070 |
| | (48002 to 61777) | (20.62 to 26.538) | (54639 to 80850) | (17.557 to 25.979) | (−0.202 to 0.064) |
| Continents | | | | | |
| Africa | 23,059 | 60.436 | 29,362 | 55.455 | −0.082 |
| | (18732 to 27001) | (49.096 to 70.769) | (23161 to 34832) | (43.743 to 65.786) | (−0.166 to 0.023) |
| America | 23,755 | 26.196 | 29,087 | 24.460 | −0.066 |
| | (21777 to 25764) | (24.015 to 28.412) | (26123 to 32189) | (21.967 to 27.068) | (−0.13 to 0.005) |
| Asia | 67,176 | 21.381 | 88,208 | 20.734 | −0.030 |
| | (59417 to 79767) | (18.912 to 25.389) | (72367 to 102851) | (17.01 to 24.176) | (−0.153 to 0.104) |
| Europe | 22,013 | 17.212 | 22,420 | 15.411 | −0.105 |
| | (19885 to 23046) | (15.548 to 18.02) | (19805 to 24733) | (13.613 to 17) | (−0.158 to −0.028) |
| WHO Regions | | | | | |
| African Region | 21,320 | 71.141 | 27,193 | 65.053 | −0.086 |
| | (17324 to 24978) | (57.805 to 83.344) | (21468 to 32225) | (51.358 to 77.092) | (−0.173 to 0.029) |
| Eastern Mediterranean Region | 3848 | 16.118 | 4863 | 14.647 | −0.091 |
| | (3131 to 4507) | (13.114 to 18.878) | (3913 to 5808) | (11.787 to 17.493) | (−0.188 to 0.029) |
| European Region | 23,198 | 17.543 | 23,803 | 15.699 | −0.105 |
| | (20996 to 24271) | (15.878 to 18.355) | (21131 to 26289) | (13.937 to 17.339) | (−0.158 to −0.03) |
| Region of the Americas | 23,755 | 26.196 | 29,087 | 24.460 | −0.066 |
| | (21777 to 25764) | (24.015 to 28.412) | (26123 to 32189) | (21.967 to 27.068) | (−0.13 to 0.005) |
| South-East Asia Region | 28,016 | 25.970 | 36,900 | 24.620 | −0.052 |
| | (24123 to 39203) | (22.361 to 36.34) | (30562 to 51931) | (20.391 to 34.648) | (−0.197 to 0.097) |

TABLE 2 (Continued)

| Location | 2010 | | 2019 | | |
|---|---|---|---|---|---|
| | Death number | Death rate (per 100,000) | Death number | Death rate (per 100,000) | % changes (2010–2019) |
| Western Pacific Region | 35,705 (27925 to 39763) | 19.285 (15.083 to 21.476) | 47,024 (30951 to 56783) | 19.136 (12.595 to 23.107) | −0.008 (−0.201 to 0.196) |
| GBD Region | | | | | |
| East Asia & Pacific—WB | 43,881 (36844 to 49379) | 20.634 (17.325 to 23.219) | 56,615 (42064 to 66693) | 19.951 (14.823 to 23.503) | −0.033 (−0.192 to 0.144) |
| East Asia | 27,408 (20322 to 31103) | 19.840 (14.71 to 22.514) | 36,702 (22405 to 46196) | 19.547 (11.933 to 24.603) | −0.015 (−0.257 to 0.239) |
| Oceania | 215 (159 to 305) | 55.826 (41.139 to 79.024) | 290 (212 to 400) | 53.551 (39.211 to 73.933) | −0.041 (−0.183 to 0.128) |
| Southeast Asia | 12,330 (10349 to 16670) | 30.931 (25.962 to 41.82) | 15,189 (12537 to 21454) | 26.976 (22.266 to 38.103) | −0.128 (−0.236 to 0) |
| Sub-Saharan Africa—WB | 21,622 (17470 to 25335) | 73.235 (59.171 to 85.811) | 27,561 (21831 to 32767) | 67.301 (53.31 to 80.014) | −0.081 (−0.167 to 0.03) |
| Central Sub-Saharan Africa | 2889 (1970 to 4005) | 86.105 (58.704 to 119.367) | 3591 (2391 to 5132) | 76.642 (51.031 to 109.535) | −0.110 (−0.271 to 0.099) |
| Eastern Sub-Saharan Africa | 7657 (5661 to 9819) | 77.906 (57.605 to 99.912) | 10,120 (7217 to 13035) | 75.321 (53.71 to 97.017) | −0.033 (−0.126 to 0.08) |
| Southern Sub-Saharan Africa | 3561 (3041 to 4142) | 84.247 (71.946 to 97.988) | 3859 (3227 to 4496) | 70.014 (58.545 to 81.575) | −0.169 (−0.259 to −0.066) |
| Western Sub-Saharan Africa | 7368 (5821 to 9262) | 66.900 (52.859 to 84.098) | 9817 (7806 to 12133) | 61.799 (49.139 to 76.378) | −0.076 (−0.21 to 0.095) |
| South Asia—WB | 21,239 (18077 to 29094) | 24.017 (20.441 to 32.9) | 29,010 (23378 to 38825) | 23.653 (19.061 to 31.656) | −0.015 (−0.195 to 0.175) |
| South Asia | 20,707 (17640 to 28376) | 24.134 (20.559 to 33.072) | 28,398 (22784 to 38197) | 23.820 (19.111 to 32.039) | −0.013 (−0.195 to 0.185) |
| Latin America & Caribbean—WB | 18,722 (17180 to 20669) | 41.598 (38.173 to 45.925) | 22,737 (20271 to 25795) | 36.925 (32.921 to 41.891) | −0.112 (−0.188 to −0.031) |
| Andean Latin America | 2350 (1868 to 2702) | 66.954 (53.217 to 76.97) | 2748 (2165 to 3405) | 56.406 (44.448 to 69.895) | −0.158 (−0.308 to 0.02) |
| Caribbean | 1605 (1343 to 1844) | 43.452 (36.345 to 49.9) | 1962 (1605 to 2343) | 41.923 (34.298 to 50.049) | −0.035 (−0.156 to 0.106) |
| Central Latin America | 6652 (6128 to 7443) | 43.831 (40.374 to 49.043) | 8380 (7070 to 10169) | 38.914 (32.83 to 47.22) | −0.112 (−0.244 to 0.028) |
| Tropical Latin America | 5817 (5303 to 6999) | 35.581 (32.44 to 42.815) | 7064 (6379 to 8627) | 30.924 (27.923 to 37.763) | −0.131 (−0.181 to −0.068) |
| Middle East & North Africa—WB | 2408 (1927 to 2802) | 13.189 (10.552 to 15.343) | 3128 (2502 to 3736) | 12.034 (9.625 to 14.372) | −0.088 (−0.179 to 0.032) |
| North Africa and Middle East | 3382 (2760 to 3919) | 13.449 (10.975 to 15.581) | 4309 (3431 to 5030) | 12.281 (9.779 to 14.335) | −0.087 (−0.169 to 0.025) |
| Europe & Central Asia—WB | 23,039 (20853 to 24,105) | 17.572 (15.905 to 18.385) | 23,616 (20962 to 26072) | 15.721 (13.954 to 17.356) | −0.105 (−0.158 to −0.031) |
| Central Asia | 1572 (1478 to 1716) | 30.204 (28.406 to 32.981) | 1821 (1610 to 2106) | 24.810 (21.926 to 28.695) | −0.179 (−0.263 to −0.07) |

(Continues)

TABLE 2 (Continued)

| Location | 2010 | | 2019 | | |
|---|---|---|---|---|---|
| | Death number | Death rate (per 100,000) | Death number | Death rate (per 100,000) | % changes (2010–2019) |
| Central Europe | 5197 | 27.871 | 5064 | 24.734 | −0.113 |
| | (4453 to 5429) | (23.883 to 29.113) | (4245 to 5870) | (20.735 to 28.674) | (−0.214 to 0.011) |
| Eastern Europe | 6900 | 20.465 | 6660 | 17.470 | −0.146 |
| | (6482 to 7716) | (19.224 to 22.885) | (5732 to 7840) | (15.036 to 20.565) | (−0.256 to −0.009) |
| High Income | 20,581 | 13.048 | 23,329 | 12.572 | −0.036 |
| | (17729 to 21785) | (11.24 to 13.812) | (19887 to 25146) | (10.717 to 13.551) | (−0.072 to 0.007) |
| Australasia | 332 | 9.774 | 409 | 9.430 | −0.035 |
| | (279 to 359) | (8.202 to 10.564) | (333 to 459) | (7.69 to 10.598) | (−0.118 to 0.06) |
| High-income Asia Pacific | 3902 | 11.893 | 4388 | 11.721 | −0.014 |
| | (3180 to 4273) | (9.694 to 13.026) | (3487 to 4940) | (9.313 to 13.195) | (−0.069 to 0.045) |
| High-income North America | 5118 | 11.067 | 6448 | 11.114 | 0.004 |
| | (4402 to 5388) | (9.517 to 11.651) | (5360 to 6902) | (9.238 to 11.896) | (−0.05 to 0.049) |
| Southern Latin America | 2354 | 36.702 | 2651 | 33.917 | −0.076 |
| | (2059 to 2524) | (32.103 to 39.356) | (2295 to 2951) | (29.36 to 37.754) | (−0.16 to 0.012) |
| Western Europe | 8875 | 12.887 | 9433 | 12.101 | −0.061 |
| | (7653 to 9416) | (11.112 to 13.673) | (8075 to 10275) | (10.359 to 13.181) | (−0.1 to −0.009) |

TABLE 3 Prevalence of cervical cancer in ≥55 years old women.

| Location | 2010 | | 2019 | | |
|---|---|---|---|---|---|
| | Prevalence number | Prevalence rate (per 100,000) | Prevalence number | Prevalence rate (per 100,000) | % changes (2010–2019) |
| Global | 575,169 | 100.589 | 769,925 | 103.504 | 0.029 |
| | (522868 to 637278) | (91.443 to 111.452) | (664692 to 859696) | (89.357 to 115.572) | (−0.057 to 0.121) |
| SDI | | | | | |
| High SDI | 120,490 | 86.468 | 140,890 | 84.578 | −0.022 |
| | (109652 to 127448) | (78.691 to 91.462) | (122510 to 158826) | (73.544 to 95.344) | (−0.116 to 0.085) |
| High-middle SDI | 143,934 | 94.624 | 179,133 | 92.825 | −0.019 |
| | (127056 to 152132) | (83.528 to 100.014) | (146723 to 202111) | (76.03 to 104.731) | (−0.135 to 0.101) |
| Low SDI | 43,708 | 139.922 | 62,226 | 147.615 | 0.055 |
| | (34914 to 53774) | (111.769 to 172.147) | (50175 to 76088) | (119.029 to 180.5) | (−0.051 to 0.182) |
| Low-middle SDI | 85,406 | 97.536 | 126,219 | 106.674 | 0.094 |
| | (75593 to 108089) | (86.329 to 123.441) | (109450 to 156186) | (92.502 to 132.002) | (−0.015 to 0.226) |
| Middle SDI | 181,213 | 112.382 | 260,909 | 116.765 | 0.039 |
| | (150834 to 197621) | (93.542 to 122.558) | (204937 to 299281) | (91.716 to 133.937) | (−0.083 to 0.17) |
| World Bank Income Level | | | | | |
| World Bank High Income | 154,143 | 90.895 | 176,051 | 88.028 | −0.032 |
| | (138171 to 160971) | (81.477 to 94.922) | (151738 to 197620) | (75.871 to 98.812) | (−0.128 to 0.073) |
| World Bank Low Income | 38,070 | 189.629 | 53,033 | 199.994 | 0.055 |
| | (29847 to 46007) | (148.671 to 229.165) | (41126 to 65221) | (155.091 to 245.957) | (−0.065 to 0.202) |
| World Bank Lower Middle Income | 146,496 | 98.283 | 214,051 | 104.032 | 0.058 |
| | (131839 to 181823) | (88.45 to 121.984) | (185302 to 258642) | (90.06 to 125.704) | (−0.055 to 0.2) |

TABLE 3 (Continued)

| Location | 2010 | | 2019 | | |
|---|---|---|---|---|---|
| | Prevalence number | Prevalence rate (per 100,000) | Prevalence number | Prevalence rate (per 100,000) | % changes (2010–2019) |
| World Bank Upper Middle Income | 236,040 (201089 to 255707) | 101.396 (86.382 to 109.845) | 326,239 (248740 to 378974) | 104.827 (79.925 to 121.772) | 0.034 (−0.119 to 0.189) |
| Continents | | | | | |
| Africa | 60,828 (49297 to 71870) | 159.428 (129.206 to 188.369) | 86,890 (68889 to 103670) | 164.106 (130.108 to 195.797) | 0.029 (−0.075 to 0.156) |
| America | 113,028 (106415 to 122181) | 124.645 (117.352 to 134.738) | 148,358 (130538 to 170212) | 124.758 (109.772 to 143.135) | 0.001 (−0.112 to 0.12) |
| Asia | 279,487 (242805 to 317233) | 88.957 (77.282 to 100.971) | 403,468 (322402 to 464151) | 94.838 (75.783 to 109.102) | 0.066 (−0.068 to 0.211) |
| Europe | 120,893 (108622 to 125706) | 94.527 (84.932 to 98.29) | 130,065 (112658 to 146524) | 89.402 (77.437 to 100.715) | −0.054 (−0.147 to 0.053) |
| WHO Regions | | | | | |
| African Region | 55,104 (44511 to 65628) | 183.869 (148.523 to 218.983) | 78,565 (61756 to 94549) | 187.949 (147.738 to 226.188) | 0.022 (−0.088 to 0.156) |
| Eastern Mediterranean Region | 12,692 (10314 to 14997) | 53.161 (43.2 to 62.814) | 18,760 (14906 to 22487) | 56.506 (44.897 to 67.731) | 0.063 (−0.061 to 0.231) |
| European Region | 125,821 (113538 to 130718) | 95.152 (85.863 to 98.856) | 137,223 (119135 to 154184) | 90.507 (78.576 to 101.693) | −0.049 (−0.14 to 0.054) |
| Region of the Americas | 113,028 (106415 to 122181) | 124.645 (117.352 to 134.738) | 148,358 (130538 to 170212) | 124.758 (109.772 to 143.135) | 0.001 (−0.112 to 0.12) |
| South-East Asia Region | 99,943 (87453 to 134431) | 92.643 (81.065 to 124.612) | 146,053 (122172 to 190301) | 97.447 (81.514 to 126.97) | 0.052 (−0.093 to 0.248) |
| Western Pacific Region | 166,987 (132156 to 184416) | 90.192 (71.379 to 99.605) | 238,836 (156560 to 285020) | 97.192 (63.71 to 115.986) | 0.078 (−0.133 to 0.283) |
| GBD Region | | | | | |
| East Asia & Pacific—WB | 203,759 (169436 to 225648) | 95.811 (79.672 to 106.104) | 287,526 (213136 to 336018) | 101.323 (75.109 to 118.412) | 0.058 (−0.115 to 0.236) |
| East Asia | 110,811 (81480 to 127669) | 80.212 (58.98 to 92.415) | 166,647 (94572 to 211596) | 88.755 (50.368 to 112.694) | 0.107 (−0.196 to 0.411) |
| Oceania | 765 (570 to 1009) | 198.622 (147.869 to 261.693) | 1118 (810 to 1531) | 206.436 (149.522 to 282.853) | 0.039 (−0.146 to 0.274) |
| Southeast Asia | 56,131 (47381 to 72889) | 140.811 (118.86 to 182.851) | 80,413 (65467 to 105343) | 142.816 (116.272 to 187.094) | 0.014 (−0.138 to 0.196) |
| Sub-Saharan Africa—WB | 55,315 (44621 to 65844) | 187.351 (151.13 to 223.012) | 78,539 (61759 to 94747) | 191.785 (150.81 to 231.365) | 0.024 (−0.085 to 0.155) |
| Central Sub-Saharan Africa | 7001 (4713 to 9833) | 208.640 (140.44 to 293.049) | 9770 (6335 to 14079) | 208.532 (135.218 to 300.49) | −0.001 (−0.218 to 0.286) |
| Eastern Sub-Saharan Africa | 19,255 (14443 to 24768) | 195.916 (146.959 to 252.015) | 28,002 (20276 to 35913) | 208.409 (150.908 to 267.292) | 0.064 (−0.065 to 0.212) |
| Southern Sub-Saharan Africa | 9588 (8290 to 11712) | 226.814 (196.107 to 277.049) | 12,049 (10074 to 14456) | 218.617 (182.793 to 262.305) | −0.036 (−0.161 to 0.115) |

(Continues)

TABLE 3 (Continued)

| Location | 2010 | | 2019 | | |
|---|---|---|---|---|---|
| | Prevalence number | Prevalence rate (per 100,000) | Prevalence number | Prevalence rate (per 100,000) | % changes (2010–2019) |
| Western Sub-Saharan Africa | 18,960 (14933 to 23916) | 172.165 (135.592 to 217.163) | 28,003 (21777 to 35191) | 176.289 (137.093 to 221.535) | 0.024 (−0.157 to 0.235) |
| South Asia—WB | 67,183 (58228 to 87102) | 75.971 (65.845 to 98.495) | 102,860 (82520 to 128905) | 83.867 (67.282 to 105.103) | 0.104 (−0.079 to 0.347) |
| South Asia | 64,883 (55636 to 84422) | 75.620 (64.843 to 98.392) | 99,904 (79439 to 125934) | 83.797 (66.632 to 105.631) | 0.108 (−0.081 to 0.363) |
| Latin America & Caribbean—WB | 77,018 (72622 to 86789) | 171.127 (161.36 to 192.837) | 101,525 (87796 to 120066) | 164.877 (142.582 to 194.988) | −0.037 (−0.157 to 0.101) |
| Andean Latin America | 12,726 (10334 to 15019) | 362.576 (294.428 to 427.906) | 16,990 (12940 to 21723) | 348.785 (265.644 to 445.958) | −0.038 (−0.254 to 0.235) |
| Caribbean | 6552 (5702 to 7363) | 177.340 (154.336 to 199.289) | 8623 (7009 to 10282) | 184.224 (149.736 to 219.658) | 0.039 (−0.119 to 0.224) |
| Central Latin America | 25,704 (24239 to 29677) | 169.359 (159.708 to 195.537) | 35,070 (29080 to 43232) | 162.853 (135.037 to 200.754) | −0.038 (−0.197 to 0.15) |
| Tropical Latin America | 22,537 (21122 to 27603) | 137.862 (129.202 to 168.849) | 29,313 (26974 to 35844) | 128.320 (118.078 to 156.907) | −0.069 (−0.138 to 0.006) |
| Middle East & North Africa—WB | 9665 (7522 to 11399) | 52.929 (41.192 to 62.422) | 14,929 (11493 to 18203) | 57.429 (44.212 to 70.027) | 0.085 (−0.048 to 0.255) |
| North Africa and Middle East | 12,737 (10155 to 14893) | 50.644 (40.379 to 59.213) | 19,264 (15101 to 23035) | 54.907 (43.041 to 65.654) | 0.084 (−0.035 to 0.253) |
| Europe & Central Asia—WB | 124,982 (112665 to 129870) | 95.328 (85.933 to 99.056) | 136,240 (118263 to 152992) | 90.693 (78.726 to 101.845) | −0.049 (−0.139 to 0.053) |
| Central Asia | 6312 (5812 to 6963) | 121.314 (111.715 to 133.832) | 9170 (7941 to 10612) | 124.917 (108.177 to 144.573) | 0.030 (−0.1 to 0.191) |
| Central Europe | 24,246 (19923 to 25750) | 130.025 (106.843 to 138.092) | 23,912 (19575 to 28309) | 116.804 (95.619 to 138.282) | −0.102 (−0.224 to 0.048) |
| Eastern Europe | 34,954 (33155 to 38015) | 103.671 (98.334 to 112.749) | 37,965 (32441 to 45411) | 99.583 (85.094 to 119.111) | −0.039 (−0.176 to 0.142) |
| High Income | 142,006 (127198 to 148484) | 90.030 (80.642 to 94.137) | 163,712 (139749 to 185281) | 88.226 (75.312 to 99.85) | −0.020 (−0.123 to 0.089) |
| Australasia | 3882 (3366 to 4301) | 114.241 (99.065 to 126.557) | 4849 (3651 to 6219) | 111.885 (84.235 to 143.511) | −0.021 (−0.246 to 0.247) |
| High-income Asia Pacific | 34,057 (29755 to 37406) | 103.814 (90.699 to 114.022) | 36,928 (29433 to 44423) | 98.641 (78.621 to 118.662) | −0.050 (−0.199 to 0.129) |
| High-income North America | 36,495 (31597 to 38300) | 78.914 (68.322 to 82.817) | 47,386 (37507 to 57132) | 81.673 (64.646 to 98.471) | 0.035 (−0.134 to 0.239) |
| Southern Latin America | 9731 (8507 to 10856) | 151.747 (132.656 to 169.289) | 11,831 (8834 to 15301) | 151.360 (113.01 to 195.744) | −0.003 (−0.259 to 0.291) |
| Western Europe | 57,839 (50965 to 60893) | 83.987 (74.004 to 88.421) | 62,718 (51936 to 73161) | 80.455 (66.624 to 93.852) | −0.042 (−0.182 to 0.103) |

**TABLE 4** DALY of cervical cancer in ≥55 years old women.

| Location | 2010 | | 2019 | | |
|---|---|---|---|---|---|
| | DALYs number | DALYs rate per 100,000 | DALYs number | DALYs rate per 100,000 | % changes (2010–2019) |
| Global | 3,090,147 | 271.020 | 3,835,979 | 257.314 | −0.051 |
| | (2798501 to 3542079) | (245.441 to 310.656) | (3308729 to 4315418) | (221.947 to 289.475) | (−0.127 to 0.035) |
| SDI | | | | | |
| High SDI | 338,152 | 110.277 | 383,462 | 103.233 | −0.064 |
| | (302170 to 358847) | (98.543 to 117.026) | (339752 to 416368) | (91.465 to 112.091) | (−0.106 to −0.016) |
| High-middle SDI | 654,861 | 210.613 | 759,033 | 192.262 | −0.087 |
| | (594039 to 700944) | (191.052 to 225.434) | (617123 to 850508) | (156.317 to 215.433) | (−0.196 to 0.024) |
| Low SDI | 419,799 | 742.071 | 543,005 | 709.144 | −0.044 |
| | (335725 to 515905) | (593.456 to 911.956) | (432252 to 660994) | (564.504 to 863.232) | (−0.137 to 0.075) |
| Low-middle SDI | 648,326 | 396.565 | 851,795 | 379.781 | −0.042 |
| | (574268 to 844195) | (351.266 to 516.373) | (737890 to 1080936) | (328.995 to 481.946) | (−0.148 to 0.075) |
| Middle SDI | 1,026,761 | 340.016 | 1,295,945 | 306.420 | −0.099 |
| | (853224 to 1119747) | (282.548 to 370.809) | (1029140 to 1484060) | (243.335 to 350.899) | (−0.207 to 0.025) |
| World Bank Income Level | | | | | |
| World Bank High Income | 443,414 | 118.060 | 489,239 | 108.993 | −0.077 |
| | (392615 to 464204) | (104.534 to 123.595) | (425740 to 528960) | (94.846 to 117.842) | (−0.118 to −0.027) |
| World Bank Low Income | 353,256 | 949.448 | 450,606 | 925.504 | −0.025 |
| | (273833 to 427889) | (735.982 to 1150.037) | (345537 to 557265) | (709.702 to 1144.571) | (−0.13 to 0.105) |
| World Bank Lower Middle Income | 1,012,959 | 365.702 | 1,317,597 | 345.841 | −0.054 |
| | (892551 to 1295906) | (322.232 to 467.852) | (1122726 to 1728345) | (294.691 to 453.653) | (−0.163 to 0.069) |
| World Bank Upper Middle Income | 1,278,260 | 284.175 | 1,575,788 | 257.699 | −0.093 |
| | (1074328 to 1384726) | (238.838 to 307.844) | (1206219 to 1820652) | (197.261 to 297.744) | (−0.229 to 0.045) |
| Continents | | | | | |
| Africa | 552,524 | 790.951 | 708,587 | 751.444 | −0.050 |
| | (445763 to 650569) | (638.12 to 931.304) | (560790 to 843870) | (594.707 to 894.909) | (−0.144 to 0.064) |
| America | 509,939 | 274.328 | 623,824 | 256.170 | −0.066 |
| | (476769 to 552472) | (256.484 to 297.209) | (568824 to 694206) | (233.585 to 285.072) | (−0.134 to 0.009) |
| Asia | 1,572,389 | 262.289 | 2,045,576 | 246.518 | −0.060 |
| | (1393052 to 1878876) | (232.374 to 313.414) | (1660676 to 2385634) | (200.132 to 287.499) | (−0.187 to 0.076) |
| Europe | 451,229 | 159.375 | 453,167 | 141.236 | −0.114 |
| | (417040 to 470654) | (147.299 to 166.236) | (406313 to 501251) | (126.634 to 156.222) | (−0.171 to −0.033) |
| WHO Regions | | | | | |
| African Region | 509,767 | 923.995 | 654,961 | 874.786 | −0.053 |
| | (411568 to 602557) | (746.001 to 1092.185) | (514941 to 781360) | (687.771 to 1043.607) | (−0.152 to 0.07) |
| Eastern Mediterranean Region | 93,213 | 216.270 | 117,974 | 200.794 | −0.072 |
| | (75044 to 110214) | (174.113 to 255.714) | (93670 to 142754) | (159.428 to 242.971) | (−0.18 to 0.062) |

(Continues)

TABLE 4 (Continued)

| Location | 2010 | | 2019 | | |
|---|---|---|---|---|---|
| | DALYs number | DALYs rate per 100,000 | DALYs number | DALYs rate per 100,000 | % changes (2010–2019) |
| European Region | 479,445 | 164.490 | 487,791 | 147.065 | −0.106 |
| | (444319 to 500019) | (152.439 to 171.549) | (438361 to 539022) | (132.162 to 162.51) | (−0.164 to −0.027) |
| Region of the Americas | 509,939 | 274.328 | 623,824 | 256.170 | −0.066 |
| | (476769 to 552472) | (256.484 to 297.209) | (568824 to 694206) | (233.585 to 285.072) | (−0.134 to 0.009) |
| South-East Asia Region | 680,478 | 342.066 | 886,106 | 314.951 | −0.079 |
| | (587389 to 952030) | (295.271 to 478.571) | (731863 to 1250286) | (260.128 to 444.393) | (−0.225 to 0.069) |
| Western Pacific Region | 809,986 | 224.089 | 1,056,119 | 213.335 | −0.048 |
| | (619428 to 901044) | (171.37 to 249.28) | (675025 to 1282124) | (136.355 to 258.988) | (−0.246 to 0.16) |
| GBD Region | | | | | |
| East Asia & Pacific—WB | 1,003,027 | 242.555 | 1,281,839 | 226.573 | −0.066 |
| | (834048 to 1126907) | (201.692 to 272.512) | (933217 to 1517386) | (164.952 to 268.208) | (−0.228 to 0.108) |
| East Asia | 636,626 | 245.121 | 841,364 | 229.512 | −0.064 |
| | (464713 to 722914) | (178.929 to 278.345) | (502698 to 1066874) | (137.129 to 291.028) | (−0.305 to 0.186) |
| Oceania | 5292 | 784.447 | 7202 | 778.683 | −0.007 |
| | (3863 to 7239) | (572.658 to 1073.013) | (5210 to 9962) | (563.296 to 1077.111) | (−0.167 to 0.182) |
| Southeast Asia | 287,817 | 383.902 | 356,173 | 344.327 | −0.103 |
| | (239207 to 387368) | (319.064 to 516.686) | (292716 to 497463) | (282.98 to 480.917) | (−0.221 to 0.038) |
| Sub-Saharan Africa—WB | 518,686 | 956.335 | 665,389 | 908.419 | −0.050 |
| | (416157 to 616160) | (767.295 to 1136.053) | (524732 to 796807) | (716.388 to 1087.837) | (−0.147 to 0.071) |
| Central Sub-Saharan Africa | 71,663 | 1180.099 | 89,662 | 1094.293 | −0.073 |
| | (48534 to 99817) | (799.22 to 1643.711) | (58891 to 128541) | (718.746 to 1568.8) | (−0.249 to 0.169) |
| Eastern Sub-Saharan Africa | 188,097 | 1052.787 | 247,336 | 1019.593 | −0.032 |
| | (139169 to 240971) | (778.934 to 1348.728) | (176762 to 318843) | (728.666 to 1314.367) | (−0.132 to 0.092) |
| Southern Sub-Saharan Africa | 80,813 | 997.795 | 87,018 | 840.380 | −0.158 |
| | (69534 to 96283) | (858.528 to 1188.802) | (72708 to 102370) | (702.185 to 988.649) | (−0.257 to −0.043) |
| Western Sub-Saharan Africa | 174,862 | 869.726 | 237,487 | 854.134 | −0.018 |
| | (136062 to 221503) | (676.742 to 1101.713) | (185300 to 297743) | (666.439 to 1070.847) | (−0.171 to 0.177) |
| South Asia—WB | 521,602 | 322.799 | 701,919 | 304.944 | −0.055 |
| | (446698 to 712268) | (276.443 to 440.794) | (565600 to 939543) | (245.721 to 408.177) | (−0.232 to 0.133) |
| South Asia | 509,076 | 324.684 | 687,903 | 307.540 | −0.053 |
| | (433309 to 697522) | (276.361 to 444.874) | (554555 to 919579) | (247.924 to 411.115) | (−0.233 to 0.139) |
| Latin America & Caribbean—WB | 405,829 | 455.206 | 490,671 | 401.602 | −0.118 |
| | (380197 to 452633) | (426.455 to 507.705) | (438649 to 562757) | (359.023 to 460.603) | (−0.199 to −0.03) |
| Andean Latin America | 51,210 | 738.460 | 59,146 | 616.036 | −0.166 |
| | (41186 to 59987) | (593.916 to 865.031) | (45611 to 74232) | (475.069 to 773.171) | (−0.33 to 0.033) |
| Caribbean | 35,582 | 476.138 | 43,672 | 461.803 | −0.030 |
| | (29176 to 41525) | (390.414 to 555.665) | (35044 to 53011) | (370.564 to 560.561) | (−0.16 to 0.125) |
| Central Latin America | 144,710 | 490.952 | 182,229 | 433.570 | −0.117 |
| | (135845 to 164454) | (460.875 to 557.936) | (153952 to 222052) | (366.292 to 528.318) | (−0.256 to 0.031) |

TABLE 4 (Continued)

| Location | 2010 | | 2019 | | |
|---|---|---|---|---|---|
| | DALYs number | DALYs rate per 100,000 | DALYs number | DALYs rate per 100,000 | % changes (2010–2019) |
| Tropical Latin America | 127,086 (118522 to 151481) | 397.823 (371.013 to 474.187) | 152,744 (140263 to 188095) | 339.996 (312.215 to 418.685) | −0.145 (−0.198 to −0.082) |
| Middle East & North Africa—WB | 55,408 (43360 to 64993) | 165.434 (129.461 to 194.052) | 72,837 (57461 to 87221) | 156.580 (123.527 to 187.502) | −0.054 (−0.161 to 0.083) |
| North Africa and Middle East | 75,770 (61744 to 88090) | 162.051 (132.054 to 188.399) | 97,191 (76759 to 114531) | 152.428 (120.384 to 179.623) | −0.059 (−0.152 to 0.063) |
| Europe & Central Asia—WB | 476,094 (441275 to 496513) | 164.645 (152.604 to 171.707) | 483,991 (434771 to 534463) | 147.240 (132.266 to 162.594) | −0.106 (−0.164 to −0.027) |
| Central Asia | 37,357 (35090 to 40910) | 368.533 (346.161 to 403.577) | 45,701 (40258 to 52770) | 359.550 (316.727 to 415.165) | −0.024 (−0.132 to 0.11) |
| Central Europe | 114,772 (95449 to 119799) | 290.853 (241.885 to 303.592) | 108,078 (90258 to 125427) | 240.303 (200.681 to 278.876) | −0.174 (−0.273 to −0.051) |
| Eastern Europe | 154,080 (146818 to 170034) | 212.753 (202.725 to 234.782) | 148,928 (127809 to 174996) | 187.386 (160.814 to 220.186) | −0.119 (−0.237 to 0.024) |
| High Income | 395,333 (349839 to 414275) | 112.538 (99.588 to 117.93) | 444,147 (386023 to 475861) | 106.104 (92.219 to 113.681) | −0.057 (−0.096 to −0.014) |
| Australasia | 6444 (5596 to 6909) | 88.563 (76.911 to 94.959) | 7936 (6691 to 8945) | 84.569 (71.305 to 95.327) | −0.045 (−0.139 to 0.067) |
| High-income Asia Pacific | 73,808 (62439 to 80561) | 99.175 (83.899 to 108.25) | 77,004 (63931 to 86304) | 85.133 (70.68 to 95.414) | −0.142 (−0.189 to −0.084) |
| High-income North America | 105,829 (91871 to 110533) | 108.060 (93.808 to 112.864) | 135,086 (112560 to 144108) | 109.961 (91.624 to 117.305) | 0.018 (−0.033 to 0.066) |
| Southern Latin America | 48,483 (42009 to 51908) | 356.517 (308.911 to 381.702) | 54,395 (46886 to 60974) | 329.408 (283.937 to 369.249) | −0.076 (−0.164 to 0.024) |
| Western Europe | 160,770 (143766 to 168625) | 101.717 (90.959 to 106.687) | 169,725 (149845 to 184788) | 94.609 (83.527 to 103.005) | −0.070 (−0.111 to −0.017) |

Also, according to the study results, among different continents, the highest age-standardized incidence, prevalence, death, and DALY rates were related to the African continent in 2019. This is while the continent of Europe had the lowest rates and showed the best-decreasing trend in all four indicators compared to other continents. The slower decline in other continents (compared to Europe) can be attributed to the lack of effective health policies that lead to inadequate diagnoses, diagnosis of the disease in more advanced stages, and treatment failure compared to European countries. In previous studies have reported higher new cases of the disease in Asia and Africa and lower in Europe and North America, in line with our findings, and they have also announced the decreasing trend of the disease in western developed countries.[16] A study was conducted in 2018 on 31 countries and reported that the Human Development Index (HDI) has a significant inverse correlation with CC incidence and mortality.[18] This inverse relationship stems from the fact that prevention and medical resources (including HPV vaccination coverage and CC cytological screening) are more abundant in developed countries. Global estimates also support this point and show that the incidence and death of CC will decrease in proportion to the increase in vaccination and screening (as primary and secondary prevention methods, respectively).[19–21] The clear importance of these two preventive interventions in CC is related to the risk factors of the disease because the main cause is HPV which is responsible for about 99.7% of all CC cases.[5]

We also grouped the countries according to the GBD classification, and the results showed that the incidence rate of CC in the 10-year study period in East Asia, South Asia, and high-income North America had an upward trend. Similar to our findings, a study conducted in Asia[22] reported the highest incidence of the disease from East Asia. Asian countries have taken steps to improve screening, and although screening is available in most Asian countries, its coverage is poor,[23] which is the lack of awareness as a major obstacle in performing regular screening of Asian women.[24] In addition, factors such as attitude, culture, beliefs, and structural factors can partially explain this high incidence of the disease.[25,26] However, since we know that the rate of progression of pre-cancerous lesions to cancer is slow and these lesions respond well to treatment, the importance of the screening program becomes clearer in justifying this finding.[27] Therefore, it can be

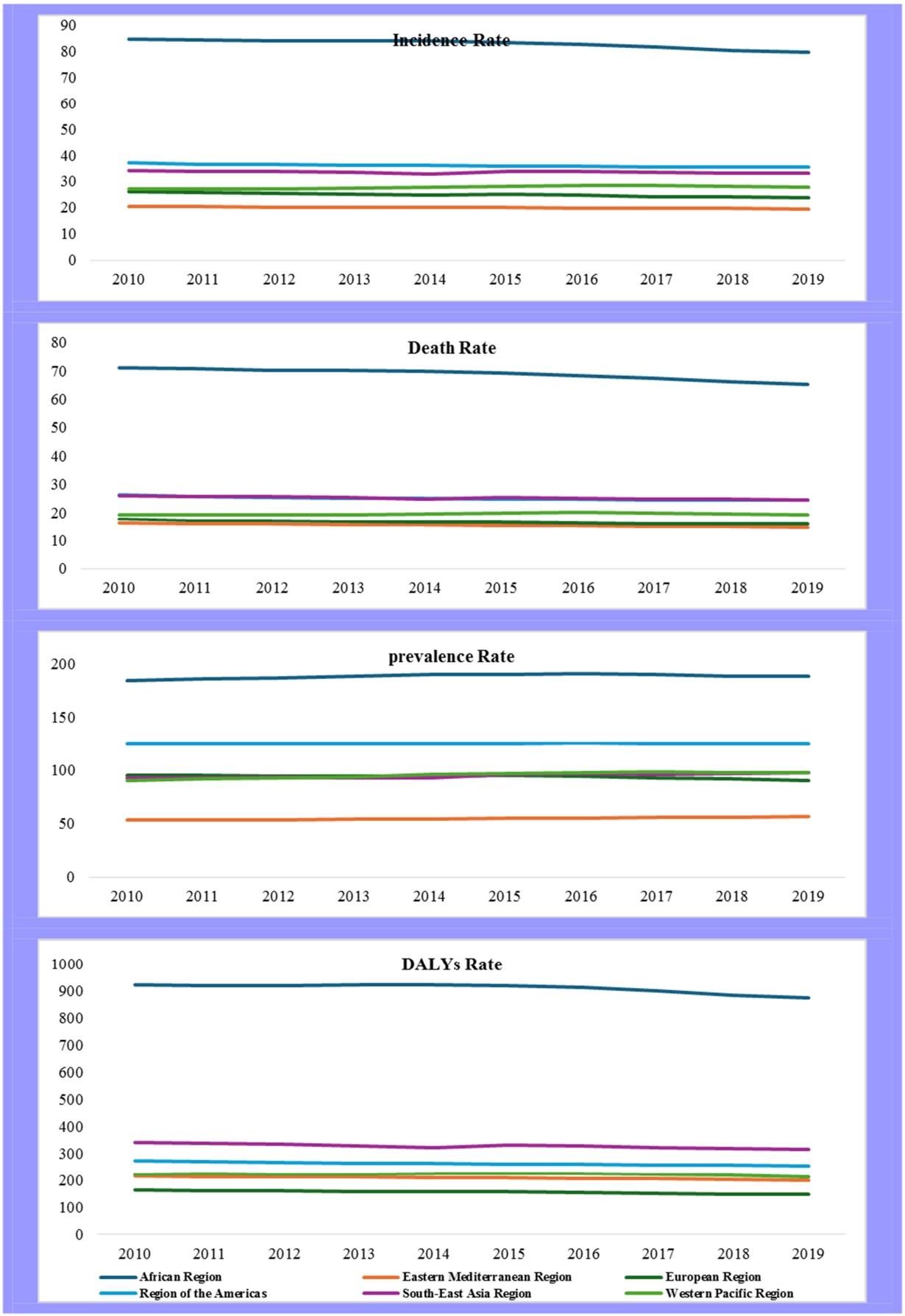


FIGURE 7 Temporal trend of incidence, prevalence, death, and DALYs rates (per 100,000 population) of cervical cancer based on WHO regions from 1990 to 2019.

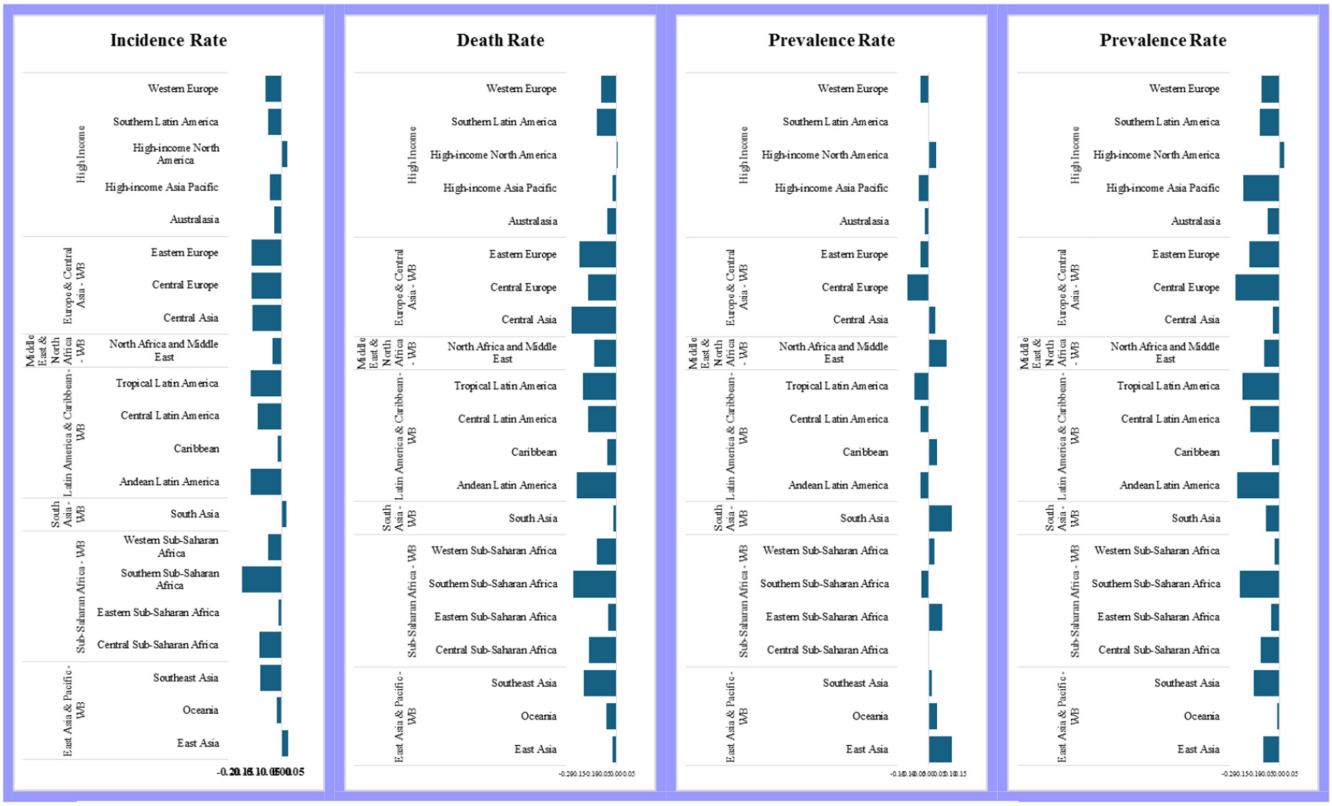


**FIGURE 8** The relative change in incidence, death, prevalence, and DALYs rates (per 100,000) of cervical cancer among worldwide females over 55 years based on GBD regions from 1990 to 2019.

hoped that by implementing educational interventions, increasing the level of awareness and attitude of people regarding CC, and emphasizing the preventable nature of this cancer through vaccination and screening, many related obstacles will be reduced and the control of the disease will be improved.

Finally, the highest increase in CC incidence rate was experienced by females aged 65 years and older in our study, which is inconsistent with previous studies stating that the age-specific epidemiology of CC is expected to change with an increase in peak incidence rates for older age groups.[28] Currently, CC screening ceases between the ages of 60 and 65 in most countries. However, a significant proportion of CC cases are diagnosed in women above the screening age.[29] The world population is aging and sexual behaviors have changed over time.[30] Thus current guidelines do not adequately address these changes and may be missing significant opportunities to prevent CC cases in older women. Current guidelines do not fully address these modifications and could be missing crucial opportunities to prevent or diagnose CC cases in older women through screening programs. Furthermore, exploring the impact of HPV vaccination programs on older populations is essential due to the significant variability in vaccine uptake between different socio-demographic segments and geographic regions.

### 4.1 | Strengths and weaknesses

The strength of this study is that real-world data obtained from the study of the global burden of diseases during the years 2010 to 2019 were used, which are reliable data. However, poor data availability in some regions or countries hinders the study's quality of GBD estimates. Moreover, GBD data may not encompass every aspect of national cervical cancer control programs and not display information based on the pathological types of CC.

## 5 | CONCLUSION

The results of the study made it clear that although the global trend of epidemiological indicators of CC is decreasing, the largest proportion of the decreasing trend is related to developed countries, including European countries. But in regions of Africa and Asia that have a lower level of development, sometimes these indicators show upward trends, which shows the worsening of the problem in these regions and the need for serious policies and plans to implement comprehensive vaccination, screening, and promotion interventions. People's awareness is necessary in the field of better disease control.

### AUTHOR CONTRIBUTIONS

All authors have equal contributions to the prepared article and approved the submitted version.

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## CONFLICT OF INTEREST STATEMENT

All authors declare that they have no conflict of interest.

## ETHICS STATEMENT

This study was approved by the ethics committee of the Jahrom University of Medical Sciences, Iran (IR.JUMS.REC.1402.092 code).

## CONSENT

As anonymous online datasets were used in this study, informed consent was not required.

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