Type of article: Original article

Title: Incidence and mortality of cervical cancer in Vietnam and South Korea (1999-2017)

Running title: Incidence and mortality of cervical cancer

Authors:

Kim Ngoc Tran¹*, Yoon Park¹*, Byungwoo Kim¹, Jinkyoung Oh¹, Moran Ki¹

¹Department of Cancer Control and Population Health, Graduate School of Cancer Science and Policy, National Cancer Center, Goyang, Korea

*Kim Ngoc Tran and Yoon Park have contributed equally to this work as joint first authors.

Correspondence to: Moran Ki, Department of Cancer Control and Population Health, Graduate School of Cancer Science and Policy, National Cancer Center, 323 Ilsan-ro, Ilsandong-gu, Goyang 410-769, Korea

Tel: +82-31-920-2736, Fax: +82-50-4069-4908, E-mail: moranki@naver.com
Abstract

Objectives: Cervical cancer is a disease burden in Vietnam. This study aimed to estimate incidence and mortality rates of cervical cancer in Vietnam (1999-2017) and to compare those in Korea where population-based cancer registry and national cervical cancer screening program have been implemented.

Method: Estimated incidence and mortality of cervical cancer in Vietnam and Korea (1999-2017) were collected from Global Burden of Disease study (GBD 2017). Estimated age-standardized rates (ASRs) in both countries were calculated utilizing the 1999-2017 population each country and WHO’s standard population. Reported ASRs in Korea were computed using incidence and mortality data (1999-2017) and the Korean population from Korea Statistical Information Service, and WHO’s standard population.

Results: In Vietnam, estimated incidence and mortality of cervical cancer annually decreased by 0.84% and 1.01%. In Korea, the trend of reported incidence dropped dramatically (1999-2007 Annual Percent Change (APC) = -4.53%) before stably declining (2007-2017 APC = -2.71%). Reported mortality trend also significantly decreased (2003-2008 APC = -6.63%) then maintained a stable decline (2008-2017 APC = -3.78%). For the comparison, the incidence and mortality rates were higher in Vietnam than in Korea. A declining trend of incidence and mortality in Vietnam was slower than the falling trends of reported incidence and mortality in Korea.

Conclusions: The introduction of national screening program among Vietnamese women aged over 30 should be implemented that may maintain a stiff decrease in incidence and mortality trends of cervical cancer. It also suggests that the population-based cancer registry may help monitor the effectiveness of cervical cancer screening program.

KEYWORDS: Cervical cancer, Incidence, Mortality, Vietnam, South Korea.
INTRODUCTION

Cervical cancer has become one of the global issues that is the fourth most frequent cancer in both incidence (13.1 per 100,000) and mortality (6.9 per 100,000) among women [1]. In Vietnam, cervical cancer ranks the seventh leading cause of cancer and the first occurring cancer among gynecologic cancers in women (7.1 per 100,000) [2, 3]. Cervical cancer is predicted to be in the top 5 frequent diagnosed cancer for women in Vietnam in the next decade [4].

A reduction in the burden of cervical cancer has been observed in several countries successfully implemented a nationwide screening program. Korea, for instance, is one of Asian countries organizing the effective programs for cervical cancer control and prevention. Before 1999, cervical cancer was in the top five most commonly diagnosed cancers in Korea. Since the National Cancer Screening Program was initiated in 1999, the age-standardized rates (ASRs) of incidence and mortality for cervical cancer significantly decreased [5-7]. Nationwide efforts to implement other prevention programs, such as HPV vaccination program and reproductive education, has also contributed to ease the cervical cancer burden in Korea. Furthermore, Korean Cancer Registries with high-quality data is available for evaluating of the effectiveness of these programs.

In Vietnam, a national screening program has not been implemented. The opportunistic screening program has been organized following the guidelines of the Vietnam Ministry of Health (MOH) since 2011 [8]. According to the guidelines, cervical cancer screening by utilizing cytology and VIA tests are recommended to provide for women aged 21-70 years, particularly focusing on the 30-50-year group [8]. Since screening tests are not included in the national health insurance, individuals have been obligated to pay out of their pocket if they access the cervical cancer screening. Vietnamese women have few opportunities to access screening tests due to a lack of knowledge and the poverty [9].

Vietnam has 63 cities and provinces with over 96 million people but only nine regional cancer registries has been established [9]. Among 9 registries, cancer registry data, Hanoi and Ho Chi Minh, are selectively used to estimate the global burden of cancer on databases, such as Cancer Incidence in Five Continents (CI5) by International Agency for Research on Cancer (IARC) or the Global Burden of Disease 2017 (GBD 2017) study performed by the Institute for Health
Metrics and Evaluation (IHME), after evaluating data quality with assessment of quality indices [10-14].

Under the circumstance of Vietnam, the aims of study were to overview the incidence and mortality of cervical cancer among Vietnamese women and to compare those in Korea, where national cervical cancer screening has been implemented with the basis of comprehensive establishment of nationwide cancer registry.

**MATERIALS AND METHODS**

*Source of data*

The estimated number of new cases and deaths in Vietnam and Korea due to cervical cancer (1999-2017) were derived from GBD 2017. These data were available and collected directly from GBD Results Tool of IHME (http://ghdx.healthdata.org/gbd-results-tool). Cervical cancer was classified according to the International Classification of Diseases (using both ICD-9 and ICD-10) for Oncology (C53: Cervix uteri) [15]. According to the definition from GBD 2017, the estimated incidence cases each year were defined as the number of new cases diagnosed during a given year in a specified population and the estimated number of deaths was counted as deaths by virtue of a given cause occurring in a specified population per year, that were incorporated from published literature, surveillance data, survey data, hospital and clinical data, and other types of data [14, 15].

For the comparison between the estimated and the reported data for both incidence and mortality rates of cervical cancer in Korea, we used data in Korea from two separate sources: the estimated cases of incidence and mortality in Korea from GBD 2017, and the number of new cases and deaths occurring in Korea from the Korean Statistical Information Service (KOSIS) (Available on: http://www.kosis.kr). Since the available data for incidence and mortality in Korea were limited from 1999 to 2017, we decided to collect the estimated data of cervical cancer incidence and mortality in Vietnam from GBD 2017 in the same period time (1999-2017).

*Statistical analysis*
For the calculation of estimated ASRs for incidence and mortality in Vietnam and Korea, age-specific rates were computed for each year by using the estimated incident cases and deaths from GBD 2017 and the distribution of female population in each country (1999-2017) from World Population Prospects 2019 Project [16].

For the calculation of reported incidence and mortality ASRs in Korea, reported data was collected and corrected from KOSIS submitted by Korea Central Cancer Registry (KCCR). The KCCR is a national population-based registry data and data quality of KCCR is annually evaluated by using three indices, including the proportion of Death Certificate Only (DCO%), the proportion of microscopic verification (MV%) and Mortality/Incidence ratios (M/I) [17]. As of 2019, several indices of quality was examined in an annual report published to assess the quality of the data of 2017 [17]. In term of completeness and validity, DCO% were computed as 0.8% and 1.0% for men and women. MV% of the diagnosis were 89.7% for men and 92.8% for women. M/I were reported as 40.4 and 27.5 for men and women [17]. ASRs of reported incidence and mortality were computed by using the distribution of Korean female population (1999-2017) derived from the KOSIS.

For the comparison, we used the World Health Organization (WHO) world standard population to calculate the estimated ASRs in Vietnam and South Korea, and the reported ASRs in Korea [18].

Annual percent change (APC) that is the average percent change of ASRs is utilized to illustrate trends in cancer rates over a given time [19]. APC for the estimated ASR incidence and mortality rates in both countries, and APC for the reported ASRs of incidence and mortality in Korea were determined using Joinpoint Regression Analysis program provided by the Surveillance Research Program of the US National Cancer Institute (Version 4.8.0.1, https://surveillance.cancer.gov/joinpoint/).

RESULTS

In Vietnam, the estimated ASR incidence rates of cervical cancer slightly declined from 21.23 (1999) to 18.12 (2017) per 100,000 (Table 1). There was a statistically significant decline in the trend of estimated ASR incidence that annually decreased by 0.84% (p < 0.05) (Figure 1.A). In
The incidence rates of the 30-69 groups were higher in 1999 than those in 2017, whereas the rates among women aged 70 years or over were higher in 2017 than in 1999. The peak of age-specific incidence rate stably maintained in the 55-to-59-year group in both 1999 and 2017.

For the estimated mortality for cervical cancer in Vietnam, the ASRs also gradually decreased during 1999-2017 (Table 1). In figure 3.A, the trend of estimated ASRs in mortality has gradually declined until 2008 (1999-2008 APC = -1.01%, p < 0.05), then moderately decreased in subsequent years (2008-2017 APC = -1.35%, p < 0.05). The age-specific mortality rates among women aged 30-74 years were also higher in 1999 than 2017 (Figure 4). The highest incidence rate was in the 70-74 group in 1999 (46.1 per 100,000) that was replaced by the 75-79 group in 2017 (48.3 per 100,000).

In Korea, the reported incidence showed a significant declining trend (Figure 1.B). The trend of reported incidence rates substantially dropped until 2007 (1999-2007 APC = -4.53%, p < 0.05), then modestly decreased in the following years (2007-2017 APC = -2.71%, p < 0.05). Although similar reduction tendencies were observed in both the reported ASR incidence and the estimated ASR incidence over years, the reported incidence rates of Korea were higher than the estimated incidence rates (Figure 1.B & 1.C). For the mortality, the trend of reported ASRs significantly rose until 2003 (1999-2003 APC = 10.55%, p < 0.05) before falling annually by 6.63% during 2003-2008 (p < 0.05), then stably declined in the next years (2008-2017 APC = -3.78%, p < 0.05) (Figure 3.B). A shape of falling trends in reported mortality was similar to that in estimated mortality since 2008 (Figure 3.B & 3.C).

For the comparison, the estimated incidence rates were higher in Vietnam than the reported incidence rates in Korea over years (Figure 1.A&B). When a gradual decline in incidence trend of Vietnam was observed over years (1999-2017 APC = -0.84%), Korea experienced a marked drop in a trend of reported incidence during 1999-2007 (APC = -4.53%), then steadily decreased (2007-2017 APC = -2.72%). For the mortality, a declining trend in mortality was observed in both countries, but the estimated mortality rates were also higher in Vietnam than the reported mortality in Korea (Figure 3.A&B). The estimated mortality trend in Vietnam gradually declined (1999-2008 APC = -1.01%; 2008-2017 APC = -1.35%), while the trend in reported mortality in Korea dramatically falling during 2003-2008 (APC = -3.78%), then stably decreased (2008-2017 APC = -6.63%).
DISCUSSION

In Vietnam, trends of cervical cancer incidence and mortality slightly decreased during 1999-2017. APCs of incidence and mortality in Vietnam show a slow decline in trends of rates is observed. The incidence peaked the age of 55-59 years in both 1999 and 2017. The mortality reached the peak at the 70-74 group in 1999, and the 75-79 group in 2017. In Korea, trends of reported incidence and mortality rates has significantly declined since the nationwide cancer screening for cervical cancer was initiated in 1999. However, incidence and mortality rates in Vietnam were higher than those in Korea over years.

The current situation in Vietnam

In Vietnam, trends in cervical cancer incidence and mortality have slightly and slowly declined. Compared to trends of cervical cancer incidence in two cities in Vietnam during 2004-2013, a falling trend in our study is similar to that in Ho Chi Minh city (2004-2013 APC = -1.5%) and is different to that in Hanoi (2004-2013 APC = 2.8%) [4]. Incidence rates for cervical cancer of Duong AV (2010) using data obtained from the Globocan database and the National Cancer Institute differed to that in our study (GBD 2017) [20]. The age of peak for incidence in 2017 was in the 55-59 group that was younger than the age groups having the highest rate in observed incidence in Hanoi and Ho Chi Minh (1991-2012) [21]. The age of peak for incidence rate in Vietnam (55-59 years) in both 1999 and 2017 differed to that in Korea (65-69 years in 1999 and ≥80 years in 2017, data were not showed). In several findings, the proportion of deaths due to cervical cancer was estimated at <9% of the total female cancer deaths in Vietnam (2005-2006) which was similar to that in the GLOBOCAN 2012 estimates for mortality [21]. A stability in the percentage of deaths from cervical cancer over years might cause a gradual decrease in mortality trend for cervical cancer in Vietnam. Mortality rate in Vietnam peaked the age of 75-79 in 2017 that was different to the age of peak for mortality in Korea (≥80 years in 2017) [17].
A declining shape in trends of incidence and mortality for cervical cancer in Vietnam might be due to the influence of the reduction in HPV infection and HIV intervention program. The prevalence of HPV infection stably decreased in South and North regions of Vietnam [21]. Moreover, the effectiveness of HIV prevention program in Vietnam has contributed in a reduction of risky sexual behaviors, particularly in women living with HIV and sexual workers [22]. The HIV prevention program is more likely to be helpful in early detection for cervical cancer among high-risk groups that might enhance the effective treatment for precancerous lesions [23]. Additionally, a greater awareness of cervical cancer among Vietnamese women of reproductive age might contribute a slightly declining trend in incidence and mortality of cervical cancer [24]. Also, the improvement in the quantity of medical treatment could support early diagnosis and prolong survival for cervical cancer patients in Vietnam [9].

However, incidence and mortality data is lacking in Vietnam. Nine regional cancer registries have launched that are not sufficient to cover the whole Vietnamese population (over 95 million individuals) living in 64 cities and provinces [9]. Two population-based cancer registries of Hanoi and Ho Chi Minh cover approximately 20% of Vietnamese population [21], that have been used in publications of CI5 series (IARC) and the data quality of these two cancer registries is evaluated [11-13]. In these publications, only MV% was assessed, whereas DCO% and M/I ratio were not included due to the lack of mortality data in Vietnam [11-13]. Although death registry has been initiated since 1992, information of medical cause-related death is not compulsory in death certificate [25].

In Vietnam, a nationwide population-based cancer screening for cervical cancer has not implemented. The screening is only performed spontaneously or opportunistically and screening tests are not covered by National Health Insurance [26]. During 2008-2016, some pilot screening projects for cervical cancer were organized by the support from the National Cancer Control Program and other international organizations [9, 27, 28]. The coverage of almost these screening programs was only 2% of the target population due to the lack of follow-up schedule, finance and human resources [9, 10]. Additionally, a lack of knowledge, beliefs and behaviors of individuals on cancer prevention contributed to the low proportion of participants in these screening programs [9]. Although child-bearing aged women have a great awareness of cervical
cancer, the knowledge of cervical cancer is insufficient among those living in both urban and rural areas [24]. Thus, providing health education related to cervical cancer should be implemented that can improve the knowledge of cervical cancer and promote the uptake of cervical screening among adult women [24, 29].

Several risk factors associated to cervical cancer have been also considered to tightly control in Vietnam. The HPV prevalence ranges 6.1-8.4% among Vietnamese women and estimated 97% cervical cancer cases occurred in Vietnam are attributable to HPV infection [4]. Despite the high cost of HPV vaccines, the HPV vaccination program that is in the pilot process will be included in the national immunization program in the following years [9]. For smoking, Vietnam’s efforts in terms of anti-tobacco actions and policies for tobacco control has contributed a stability in the prevalence of tobacco use among women (2.6-3.6% over years) [9, 21]. For unhealthy diet, the prevalence of low intake of fruits and vegetables was as high as 80% of the general population and the consumption of salt per individuals (10-15 gram everyday) was 2-3 times higher than the WHO’s recommendation [9]. Enhancing healthy diet is one of the major priorities in cancer control strategy in Vietnam [9]. Furthermore, oral contraceptives are commonly used, with an increase in the prevalence of those from 11.9% (2004) to 18.8% (2015) [21]. The increasing use oral contraceptives may hinder a decrease in incidence trend of cervical cancer among Vietnamese women [21]. Due to the successful family planning program, there is a decrease in the number of births per woman from 6.1 (1969-1974) to 2.1 (2015) [21]. The prevalence of women having three births or over also declined from 20.8% (2005) to 14.2% (2012) [21].

**The National Screening Program and other prevention programs in Korea**

In Korea, the decreasing trends of incidence and mortality with similar patterns were observed in both estimates and reported rates. This comparison illustrates that the estimates of incidence and mortality from GBD 2017 can be used to overview the burden of disease in Vietnam where is lacking nationwide data. Reported incidence and mortality rates in Korea were substantially dropped rather than estimated incidence and mortality rates in Vietnam. It might be due to the fact that organizing a population-based screening program and other prevention programs are effective in a reduction of cervical cancer burden in Korea.
In 1980, Korean Ministry of Health and Welfare has established a national hospital-based cancer registry that is the Korea Central Cancer Registry (KCCR) [6]. The KCCR data, including hospital data, 11 population-based regional cancer registries and additional medical chart reviews, has covered approximately 90% of new cases for all cancer sites [6]. In 2005, the first national incidence statistics for cancer in 1999-2002 has been produced by the KCCR [17, 30]. Since 2007, the KCCR published annual report of cancer incidence, survival and prevalence in Korea, in which indices of data quality have been evaluated, including M/I ratio, MV% and DCO% [17]. The completeness of Korean cancer registry data was reported up to 98.2% in 2015 and 2017 [31]. Korea is one of a few Asian nation where cancer registry data is available to access and utilize.

The National Cancer Screening Program including cervical cancer screening has been initiated to low-income population since 1999 [32]. Pap smear test was offered free-of-charge to screen cervical cancer due to a low cost of test [5, 33]. Until now, guidelines for early screening of cervical cancer in general population developed by the Korean National Cancer Center has recommended cervical cancer screening test (Pap smear) for all women aged from 20 with 2-year intervals [33]. The effectiveness of screening program has been evaluated using the cancer registry data. In addition, free HPV vaccination program for young girls aged 12 has been introduced since 2016. Moreover, health education is effective in creating awareness for and improving the knowledge of child-bearing aged women about cervical cancer and prevention, particularly in younger girls [34, 35].

Other countries implemented the organized cancer screening program

In Vietnam, incidence peaked in the 55-59 group and mortality reached the peak at the 75-79 group in 2017. To reduce the burden of cervical cancer among middle-aged and older women, a population-based screening program should be implemented for younger women. In several countries, a reduce of incidence and mortality for cervical cancer was observed due to population-based cervical cancer screening with using Pap test established for younger women [36]. For instance, since Finland initiated a nationwide cervical cancer screening program for women from 30 to 50 in 1960s, the 80% drop of incidence and mortality rates for cervical cancer in all age groups was observed from 1965 to 2003 [37]. In Italia where
implemented population-based screening for cervical cancer in 1996, a stably decreasing trend in cervical cancer incidence was observed after 17 years later that was declined by 2.7% per year (1994-2013) [38].

Beneficial outcomes of implementing national cancer screening programs for cervical cancer have been reported in several Asian countries where the situation in terms of health system and the cervical cancer burden was similar to Vietnam. In Thailand, the national cervical cancer screening program using VIA test was organized for women aged 35-60 years with 5-year intervals in 2005 that provided a good-quality evidence with a low-cost approach [39, 40]. After the beginning of population-based cervical cancer screening program, a stiff decreasing trend in nationwide incidence was observed in Thailand that annually dropped by 4.4% until 2012 [41]. In other counties where a national cervical cancer screening was available, the screening coverage was 19.9% in suburban areas and 29.1% in urban areas in China after a year of the implementation of program (2009), and 7.3% of the target population in Indonesia after 5 years launching program (2014) [40]. Although the coverages of screening in China and Indonesia are low, the implementation of program might reduce the burden of cervical cancer in the following years [40].

**Strengths and limitations**

Based on estimated national data in incidence and mortality from GBD 2017 study, we overview the burden of cervical cancer in Vietnam under the circumstance lacking data instead of only providing the issue in big cities or provinces in the previous studies [20]. Furthermore, we also provided the evidence of achievement received in Korea where National Cancer Screening Program has implemented for the targeted population at risk, under the circumstance having population-based central cancer registry [6, 32].

A limitation in our study is that we used the secondary data from GBD 2017 study, estimates of incidence and mortality for cervical cancer in Vietnam, that was gathered from various sources, such as cancer registry data, previous studies, surveillance data and others [15]. We know that the estimates from GBD 2017 study are changing based on the source of each country, but using those is the best choice to overview the cervical cancer burden under this circumstance in
Vietnam. Furthermore, we provided both the estimated and reported data in incidence and mortality of Korea, that could not be done in Vietnam due to the lack of national data. In the comparison with estimates and reported rates in Korea, a similar pattern of trends in reported and estimated incidence as well as mortality was observed but the reported incidence of cervical cancer was higher than the estimated incidence. That implies the current trends of incidence for cervical cancer in Vietnam might be higher than the estimates of incidence rates. Thus, a population-based cancer registry should be established to accurately evaluate the nationwide burden of cervical cancer in Vietnam and also monitor the activities of national cancer screening program.

Conclusion

In conclusion, ASR incidence and mortality rates for cervical cancer in Vietnam have slightly declined, whereas the trends in reported incidence and mortality of Korea rapidly declined since a national cancer screening operated. Under the circumstance in Vietnam, the introduction of a national cancer screening program for Vietnamese women aged from 30 years may maintain a steady decrease in trend of incidence and mortality for cervical cancer. Furthermore, this study also implies developing a nationwide cancer registry and enhancing its coverage can support monitor the effectiveness of the program.

Acknowledgement

Kim Ngoc Tran was supported by the “International Cooperation & Education Program (NCCRI·NCCI 52210-52211, 2020)” of National Cancer Center, Korea.

REFERENCES


15. The Institute for Health Metrics and Evaluation (IHME). GBD 2017 Tools Overview; 2018


Table 1. Counts, crude rates and age-standardized rates for estimated incidence and mortality for cervical cancer annually in Vietnam, 1999-2017

<table>
<thead>
<tr>
<th>Year</th>
<th>Incidence</th>
<th></th>
<th></th>
<th>Mortality</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases</td>
<td>Crude (per 100,000)</td>
<td>ASR¹ (per 100,000)</td>
<td>Cases</td>
<td>Crude (per 100,000)</td>
</tr>
<tr>
<td>1999</td>
<td>6559</td>
<td>16.44</td>
<td>21.23</td>
<td>2964</td>
<td>7.43</td>
</tr>
<tr>
<td>2000</td>
<td>6643</td>
<td>16.47</td>
<td>20.82</td>
<td>2993</td>
<td>7.42</td>
</tr>
<tr>
<td>2001</td>
<td>6752</td>
<td>16.57</td>
<td>20.52</td>
<td>3037</td>
<td>7.45</td>
</tr>
<tr>
<td>2002</td>
<td>6874</td>
<td>16.70</td>
<td>20.29</td>
<td>3087</td>
<td>7.50</td>
</tr>
<tr>
<td>2004</td>
<td>7204</td>
<td>17.18</td>
<td>20.10</td>
<td>3225</td>
<td>7.69</td>
</tr>
<tr>
<td>2005</td>
<td>7369</td>
<td>17.42</td>
<td>19.93</td>
<td>3292</td>
<td>7.78</td>
</tr>
<tr>
<td>2006</td>
<td>7554</td>
<td>17.70</td>
<td>19.90</td>
<td>3368</td>
<td>7.89</td>
</tr>
<tr>
<td>2007</td>
<td>7710</td>
<td>17.91</td>
<td>19.74</td>
<td>3430</td>
<td>7.97</td>
</tr>
<tr>
<td>2008</td>
<td>7861</td>
<td>18.10</td>
<td>19.54</td>
<td>3487</td>
<td>8.03</td>
</tr>
<tr>
<td>2009</td>
<td>8047</td>
<td>18.37</td>
<td>19.41</td>
<td>3556</td>
<td>8.12</td>
</tr>
<tr>
<td>2010</td>
<td>8230</td>
<td>18.61</td>
<td>19.25</td>
<td>3625</td>
<td>8.20</td>
</tr>
<tr>
<td>2011</td>
<td>8318</td>
<td>18.63</td>
<td>18.95</td>
<td>3647</td>
<td>8.17</td>
</tr>
<tr>
<td>2012</td>
<td>8447</td>
<td>18.73</td>
<td>18.72</td>
<td>3686</td>
<td>8.17</td>
</tr>
<tr>
<td>2013</td>
<td>8601</td>
<td>18.88</td>
<td>18.54</td>
<td>3738</td>
<td>8.20</td>
</tr>
<tr>
<td>2014</td>
<td>8785</td>
<td>19.09</td>
<td>18.41</td>
<td>3805</td>
<td>8.27</td>
</tr>
<tr>
<td>2015</td>
<td>8982</td>
<td>19.32</td>
<td>18.29</td>
<td>3876</td>
<td>8.34</td>
</tr>
<tr>
<td>2016</td>
<td>9187</td>
<td>19.57</td>
<td>18.22</td>
<td>3955</td>
<td>8.43</td>
</tr>
<tr>
<td>2017</td>
<td>9375</td>
<td>19.77</td>
<td>18.12</td>
<td>4034</td>
<td>8.51</td>
</tr>
</tbody>
</table>

Source from Institute for Health Metrics and Evaluation (IHME), Global Burden of Disease Study 2017 (GBD 2017) Results.

¹ASR, age-standardized rates (per 100,000): age-specific rates calculated by using the Vietnamese female population (1999-2017) from World Population Prospects 2019 Project and then, adjusted by using WHO standard population.
A. Estimated incidence rates in Vietnam
B. Reported incidence rates in Korea
C. Estimated incidence rates in Korea

*APC (Annual Percent Change) is statistically significant with p-value < 0.05.

Figure 1. Trends in (A) estimated age-standardized incidence in Vietnam, and (B) reported and (C) estimated age-standardized incidence in South Korea for cervical cancer, 1999-2017.

Age-adjusted rates: ASR per 100,000 women. ASRs were calculated using the estimates of incidence for cervical cancer in Vietnam and Korea obtained from GBD 2017, annual population from World population prospects 2019; reported ASRs were calculated using incidence data, and annual population of Korea from KOSIS; and WHO new world standard population.

ASR and APCs were computed by using Joinpoint Regression Analysis program provided by the Surveillance Research Program of the US National Cancer Institute.
Figure 2. Age-Specific Incidence Rates (per 100,000 females) for Cervical Cancer, Vietnam, between 1999 and 2017. Source from Institute for Health Metrics and Evaluation (IHME), Global Burden of Disease Study 2017 (GBD 2017) Results. Age-adjusted by using the Vietnamese female population in 1999 and 2017.
A. Estimated mortality rates in Vietnam

- APC (1999-2008) = -1.01*
- APC (2008-2017) = -1.35*

B. Reported mortality rates in Korea

- APC (1999-2003) = 10.55*
- APC (2003-2008) = -6.63*
- APC (2008-2017) = -3.78*

C. Estimated mortality rates in Korea

- APC (1999-2003) = -3.60*
- APC (2003-2008) = -5.97*
- APC (2008-2017) = -4.05*

*APC (Annual Percent Change) is statistically significant with p-value < 0.05.

**Figure 3.** Trends in (A) estimated age-standardized mortality in Vietnam, and (B) reported and (C) estimated age-standardized mortality in South Korea for cervical cancer, 1999-2017.

Age-adjusted rates: ASR per 100,000 women. ASRs were calculated using the estimates of mortality for cervical cancer in Vietnam and Korea obtained from GBD 2017, annual population from World population prospects 2019; reported ASRs were calculated using mortality data, and annual population of Korea from KOSIS; and WHO new world standard population.

ASR and APCs were computed by using Joinpoint Regression Analysis program provided by the Surveillance Research Program of the US National Cancer Institute.
Figure 4. Age-Specific Mortality Rates (per 100,000 females) for Cervical Cancer, Vietnam, between 1999 and 2017. Source from Institute for Health Metrics and Evaluation (IHME), Global Burden of Disease Study 2017 (GBD 2017) Results. Age-adjusted by using the Vietnamese female population in 1999 and 2017.