



# Cervix Uteri Cancer in Lebanon: Incidence, Temporal Trends, and Comparison to Countries From Different Regions in the World

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## Abstract

**Background:** Invasive cervix uteri cancer is the fourth most common malignancy in women globally. This study investigates the incidence and trends of cervix uteri cancer in Lebanon, a country in the Middle East, and compares these rates to regional and global ones.

**Methods:** Data on cervix uteri were obtained from the Lebanese national cancer registry for the currently available years 2005 to 2016. The calculated age-standardized incidence and age-specific rates were expressed as per 100,000 population.

**Results:** From 2005 to 2016, cervix uteri cancer was the tenth most common cancer among women. Its age-standardized incidence rate fluctuated narrowly between 3.5 and 5.7 per 100,000, with the lowest rate in 2013 and the highest rate in 2012. The age-specific incidence rate had 2 peaks, the highest peak at age group 70–74 years and the second at age group 50–59 years. The annual percent change (+.05%) showed a non-statistically significant trend of increase. The age-standardized incidence rate of cervix uteri cancer in Lebanon was comparable to that of the Western Asia region that has the lowest incidence rate worldwide. The rate was intermediate as compared to other countries in the Middle East and North Africa Region and relatively similar to the ones in Australia, North America, and some Western European countries.

**Conclusion:** The incidence rates of invasive cervix uteri are low in Lebanon. This could be attributed to the low prevalence of human papilloma virus infection and other sexually transmitted infections among Lebanese women, and the opportunistic screening practices. It is important to adopt a comprehensive approach to decrease the potential burden of cervix uteri, especially with the rising patterns of risky sexual behaviors. This includes improving awareness, enhancing access to preventive services, developing clinical guidelines, and training health care providers on these guidelines.

## Keywords

cervical cancer, epidemiology, cancer screening, incidence, prevention, cancer detection, risk factors

## Background

Cervix uteri cancer (CUca) is estimated to be the fourth most common cause of cancer-related morbidity and mortality in women worldwide.<sup>1,2</sup> The number of CUca new cases increased over the years; however, its projected age-standardized incidence rate adjusted to the world population (ASR<sub>w</sub>) per 100,000 person-years decreased in 2018 and 2020, compared to 2012 and 2008 (ASR<sub>w</sub> 13.3 in 2020, 13.1 in 2018, 14.0 in 2012 and 15.2 in 2008).<sup>1–5</sup>

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CUca shows a substantial geographic disparity worldwide.<sup>1,2</sup> Conversely to the topmost common cancers worldwide, the estimated ASRw of CUca varies inversely to the population standard human development index<sup>1-5</sup> (HDI, a measure of the average achievement of a country in three main human development dimensions: long and healthy life, being knowledgeable, and having a decent standard of living<sup>6</sup>). Countries with very high and high HDI had the lowest estimated CUca incidence rates in 2020 (9.1 and 12.7, respectively) as compared to countries with medium and low HDI (16.5 and 27.2, respectively).<sup>1,2</sup> The highest estimated ASRw of CUca are in Africa (>30.0), while the lowest rates are in Australia/New Zealand (5.6) and Western Asia (4.1).<sup>1,2</sup> The estimated ASRw of CUca varies extensively among countries, ranging from 2.2 in Iraq to 84.5 in Eswatini.<sup>1,2</sup> Moreover, mortality ASRw attributed to CUca is much higher in less developed regions.<sup>1,2</sup>

CUca is principally attributable to human papillomavirus (HPV) infection.<sup>7,8</sup> Additional contributing risk factors include other sexually transmitted infections (STIs), mainly human immunodeficiency virus (HIV) and *chlamydia trachomatis*, smoking, excess weight, high parity, and oral contraceptive use.<sup>9,10</sup> The epidemiology of CUca and the current evidence indicate that its pathogenesis is predominantly linked to persistent infection with high-risk HPV (hrHPV) types.<sup>11</sup> This led to the introduction of new primary (prophylactic HPV vaccination) and secondary prevention practices (screening with validated HPV assays ± cytology and treatment of cervical precancerous lesions). The implementation of both preventive measures can widely reduce the long-term burden of CUca. The World Health Organization<sup>12</sup> (WHO) Cervical Cancer Elimination Modeling Consortium aims at reducing the ASR of CUca to less than 4.0 per 100 000 women worldwide by 2030, through following the 90-70-90 targets.<sup>12</sup> This means vaccinating 90% of all girls by age 15 years, screening 70% of women with a high-performance test at least twice (at age 35 and 45 years), and treating at least 90% of all precancerous lesions detected during screening.<sup>12</sup> However, progress in prevention is often unsatisfying and challenging, with relatively low access to vaccines,<sup>13</sup> and narrow use of CUca screening,<sup>14</sup> mostly in low and lower-middle-income countries.

Lebanon is a small developing country in the Middle East (population estimated at 6 million in 2016) with health indices close to the western world,<sup>15</sup> and a high HDI based on the standard HDI formula (.757 in 2017).<sup>6</sup> CUca was the seventh most common cancer in women in the country, and it accounted for 2.3% of cancer cases amongst females in 2004 with an ASRw of 4.3.<sup>16</sup>

This study aims at analyzing the 12-year incidence rates and temporal trends for invasive CUca in Lebanon. It also compares the incidence rates in Lebanon to its geographic region, that is, the Middle East and North Africa (MENA) region, and other countries and regions worldwide. This study will also discuss the various factors attributing to the ASRw of CUca in Lebanon, concluding with recommendations for effective CUca prevention and screening.

## Materials and Methods

The Lebanese national cancer registry (NCR) was restarted formally in 2002, after the war; this registry includes the absolute count of all incident cancer cases nationally. NCR data is continuously collected from 2 systems: the capture system (data collected passively from physicians' reports), and the recapture system (data collected actively from histopathological and hematological laboratories), which validates and complements the capture system.<sup>16,17</sup> The NCR includes most cancer cases (more than 90%) in Lebanon<sup>16</sup>; however, it lacks in-situ lesions. The NCR data are published on the Ministry of Public Health (MoPH) Website; with the currently available data covering the period extending from 2005 to 2016.<sup>17</sup>

### Twelve-Year Trend Analysis From 2005 Until 2016

In this study, CUca data include diagnosis with the code C53 (i.e., invasive CUca) of the International Classification of Diseases, 10th revision (ICD-10). The age-standardized incidence rate adjusted to the world population ASRw (using the modified world standard population by Doll as the reference population)<sup>18</sup> and the age-specific incidence rates, expressed per 100 000 population,<sup>19</sup> were retrieved from the Lebanese NCR data published on the MoPH website<sup>17</sup> for twelve consecutive years (from 2005 to 2016).

For the ASRw and the age-standardized rates, the annual percent change (APC) and the average annual percent change (AAPC) of CUca incidence rates over the years were computed by the Joinpoint Regression Program (JRP) 4.7.0.0 with a statistical significance level defined at a *P*-value <.05.<sup>20</sup>

### Projections of the ASRw of CUca in Lebanon for the Years 2020 and 2025

Using the currently available CUca data over the 12-year period (2005–2016), linear and log-linear regression models were computed to find the best-fit model for the ASRw of CUca in Lebanon and to estimate the future patterns of CUca incidence. Linear and log-linear regression models, which assume a Poisson distribution for the observed number of incident cases, are the most practical methods used to estimate future patterns of cancer incidence for periods up to 10 years, while assuming that there is no change in underlying trends.<sup>21</sup> A log-linear model is preferred when the cancer is rare, and the rates are from a small population. Under a log-linear model, the rates change at a constant percent per year (i.e., a fixed annual percent change or APC). Joinpoint, which assumes a log-linear model, can be used to project cancer incidence rates into the future years through extrapolating the APC of the final segment (when statistically significant), computing the standard errors of the projection, and using the betas displayed in the output.

### Comparison of CUca Incidence Rates in Lebanon to Regional and Western Countries

The CUca ASRw and age-specific rates in Lebanon were subsequently compared with age-standardized and age-specific incidence rates from selected regional and worldwide countries that have cancer data available for a comparable period. These data were extracted from the Cancer Incidence in Five Continents Time Trends (CI5plus),<sup>22</sup> Cancer Incidence in Five Continents Volume XI (CI5XI),<sup>23</sup> or from the Regional or Country National Cancer Registry.<sup>24-29</sup> The rates mentioned in CI5plus and CI5XI are built on high-quality population-based cancer registries. For comparison, we included countries that surround Lebanon geographically, as well as randomly selected countries from the MENA region and other regions of the world.

### Results

In Lebanon, CUca is ranked tenth among cancer in women over the 12-year study period (2005–2016). A total of 1183 incident cases of CUca were reported during the study period, with 75.0% of cases affecting women aged 45 years or more and 28.7% affecting women aged 65 years or more. During the study period, ASRw of CUca fluctuated between 3.5 and 5.7 (average: 4.7) per 100,000. The historical dynamics of CUca in Lebanon reveal that this cancer has a low endemicity. In the 1960s, Abou-Daoud estimated ASRw of CUca at 19.7<sup>30</sup>; however, the ASRw decreased remarkably between the 1960s and 2005. The number of new cases was consistently low for the years 2005–2016, with an average number of 99 new cases of CUca per year. The maximum number of cases was in the age group 55–59 years, followed by 50–54 years; yet, the

age-specific incidence rate had 2 peaks, the first peak in the age group 50–59 years and the second, higher peak in the age group 70–74 years (Figure 1).

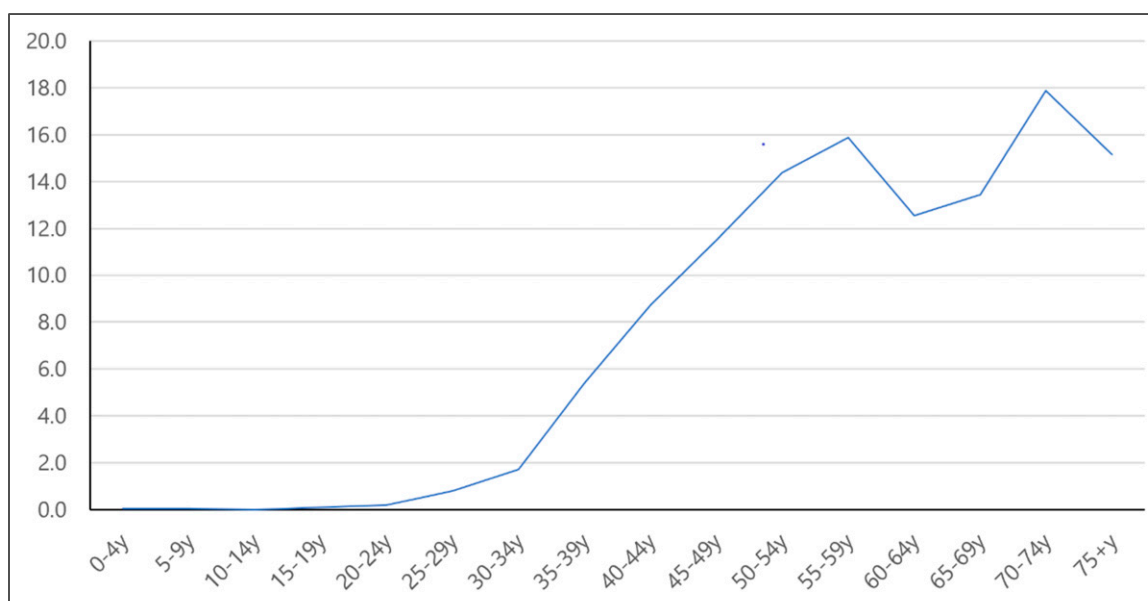
The APC and AAPC were computed for all study participants to reflect the trends in ASRw of CUca over the 12-year study period; they were also calculated for various age groups detailed in Table 1. The final selected model for ASRw of CUca (0 Joinpoint) (Figure 2) revealed an APC (equal to AAPC) of +.05%, not significantly different from zero ( $P$ -value > .05).

### Projected ASRw of CUca in 2020 and 2025

The final selected model for CUca incidence cases (0 Joinpoint) revealed an APC of +2.58%, which is not significantly different from zero ( $P$ -value > .05); therefore, having the projections or extrapolations of future CUca incidence rates in Lebanon was not feasible.

### Comparison to Countries in Different Regions of the World

The ASRw of CUca among women in Lebanon was found to be lower than the average worldwide ASRw in 2008 (5.6 vs 15.2, respectively) and 2012 (5.8 vs 14.0, respectively).<sup>4,5</sup> Lebanon is geographically located in West Asia, the region with the lowest ASRw of CUca globally (Figure 3). In 2012, Lebanon's ASRw of CUca was intermediate as compared to other countries in the MENA region (Table 2). It was almost similar to the rates recorded in Australia, New Zealand, North America, and some Western European countries (e.g., Spain and France). However, it was lower than the rates recorded in Northern Africa, Nordic European countries and the United Kingdom, different East and South-east Asian countries (e.g.,

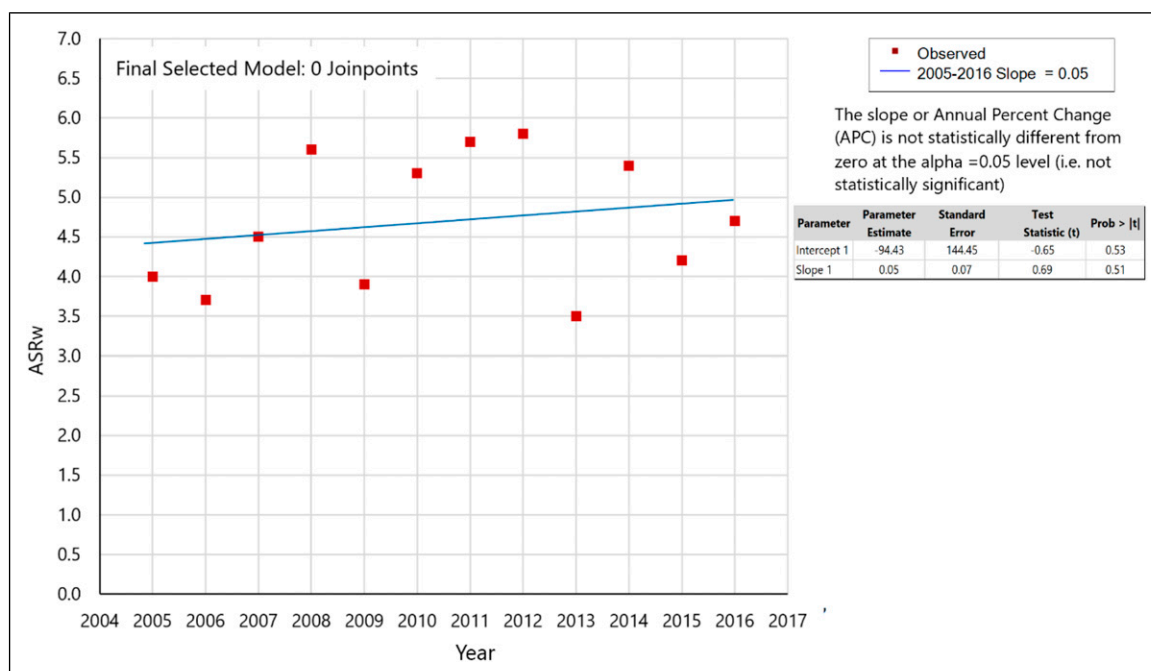


**Figure 1.** Age-specific incidence rates (per 100,000 female population) for cervix uteri cancer, Lebanon 2005–2016.

**Table 1.** Trend analysis for cervix uteri cancer age-specific rate (per 100 000) in females by age group per year in Lebanon from 2005 to 2016.

Year	Age-specific rates												
	ASRw	20–24y	25–29y	30–34y	35–39y	40–44y	45–49y	50–54y	55–59y	60–64y	65–69y	70–74y	75+y
2005	4.0	0.0	0.6	2.0	4.0	11.4	6.4	15.8	7.9	16.6	8.3	15.8	6.2
2006	3.7	0.0	0.6	0.7	4.6	6.0	5.4	15.6	15.5	8.2	16.3	11.1	8.2
2007	4.5	0.0	0.6	2.0	8.8	5.0	7.6	18.2	15.1	13.9	14.9	18.2	9.0
2008	5.6	1.0	2.2	1.7	7.1	14.0	7.8	18.7	16.9	23.0	12.0	22.0	6.1
2009	3.9	0.0	0.5	2.8	5.6	5.2	9.8	9.8	19.2	4.2	13.8	9.6	13.9
2010	5.3	0.0	0.0	1.6	4.1	11.8	16.1	18.0	20.1	12.5	13.5	14.1	21.4
2011	5.7	0.0	2.1	3.2	11.5	8.3	19.0	18.9	12.4	9.6	17.1	13.9	19.2
2012	5.8	0.5	0.5	1.1	4.7	11.4	14.5	16.2	21.9	9.4	18.7	29.6	28.3
2013	3.5	0.4	0.0	1.4	2.4	6.6	9.4	11.7	6.7	8.8	7.1	25.8	14.2
2014	5.4	0.0	0.4	2.1	2.7	5.3	14.2	10.6	27.0	16.5	16.7	22.5	27.0
2015	4.2	0.4	1.5	0.4	7.3	9.8	8.2	6.6	12.3	13.9	13.1	20.0	14.9
2016	4.7	0.0	0.4	1.6	2.1	9.9	19.4	12.5	15.6	14.1	9.9	12.1	13.4
Average (2005–2016)	4.7	0.2	0.8	1.7	5.4	8.7	11.5	14.4	15.9	12.6	13.5	17.9	15.2
APC	.05	.01	-.02	-.04	-.20	-.01	.84 <sup>a</sup>	-.65 <sup>a</sup>	.31	-.06	-.02	.52	1.21 <sup>a</sup>

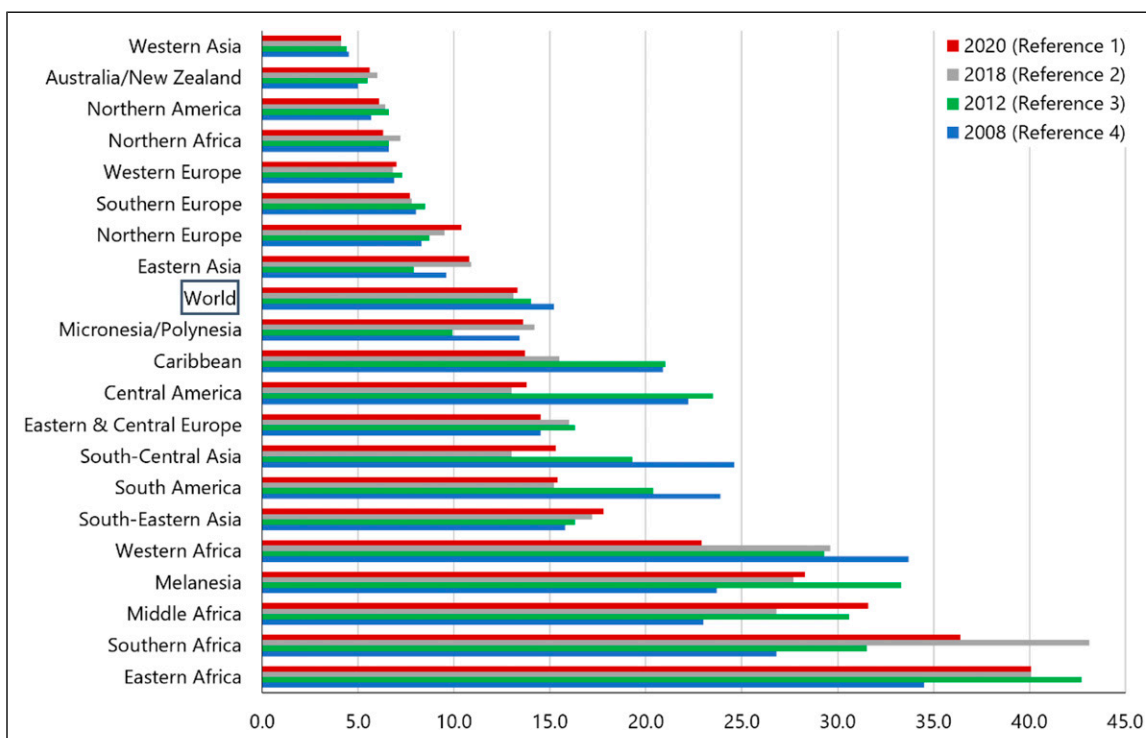
ASRw: Age-Standardized Rate (world)

<sup>a</sup>Indicates that the slope or Annual Percent Change (APC) or Average APC (AAPC) is significantly different from zero at the alpha = .05 level.**Figure 2.** Age-standardized incidence rates of cervix uteri cancer, Lebanon 2005–2016.

Philippines, Thailand, Korea, and Japan), and much lower than Central America, South America, Middle Africa, Eastern Africa, Western Africa, and South Africa (Table 2).<sup>3</sup>

Projections from the published reports of the International Agency for Research on Cancer/Global Cancer Statistics (IARC/Globocan) revealed that the ASRw of CUca in the Western Asia region did not change between 2012 and 2020 (Figure 4). Lebanon's estimated figure in 2020 was relatively

low (ASRw: 3.4) compared to other countries in the MENA region and the world. The highest estimated figures in the MENA region were in Morocco and Algeria (ASRw: 10.4 and 7.9, respectively) (Figure 4). It is worth noting that the lowest estimated CUca ASRw worldwide were in countries in the MENA region, namely, in Iraq, Iran and Yemen (ASRw: 2.2, 2.3, and 2.5, respectively). Lebanon's Globocan projection ASRw of CUca for the year 2020 (ASRw: 3.4) is slightly lower



**Figure 3.** Projected Age-Standardized Incidence Rates per 100,000 females for Cervix Uteri Cancer by Regions based on Globocan 2008, 2012, 2018, and 2020.

than our projection for the same year, which was based on the NCR data (ASRw: 4.7, 95% Confidence Interval: 2.8, 6.5).

## Discussion

Lebanon had a relatively low ASRw of CUca (maximum ASRw in 2012: 5.7), mirroring its geographical region, “Western Asia.” According to WHO, most of CUca cases in the Eastern Mediterranean Region (EMR) were discovered at advanced stages with bad prognosis and minimal recovery rate, particularly in Egypt and Saudi Arabia,<sup>31</sup> while only 35% of CUca cases were reported at early stages.<sup>31</sup> Lebanon, a country of in the EMR, is not an exception.<sup>32</sup>

Several factors could have contributed to the disparity in the ASRw of CUca among different regions, countries, and even areas within high-income countries like the United States of America. First, the difference that exists in the rates of persistent infections with hrHPV, and the presence of important contributing factors like other STIs (HIV and *Chlamydia trachomatis*), smoking, a higher parity, and long-term use of oral contraceptives.<sup>1-3</sup> Second, the difference that exists in the rates of implementation of preventive measures, that is, the rates of primary prevention (prophylactic HPV vaccination) and secondary prevention (screening/early detection with validated HPV assays ± cytology and treatment of cervical precancerous lesions).<sup>1-3</sup> In fact, the progress in applying preventive measures in less developed countries is often

modest, with relatively low access to the expensive HPV vaccines<sup>13</sup> and narrow use of CUca screening and early detection practices.<sup>14</sup>

HPV, generally acquired shortly after initiation of sexual relations, is one of the most frequent STIs worldwide.<sup>8,33,34</sup> Women infected with hrHPV (including hrHPV 16 and 18) are at high risk of developing persistent infections and precancerous lesions that could progress to invasive CUca within 15 to 20 years in immunocompetent women and 5 to 10 years in immunocompromised women.<sup>8,35,36</sup>

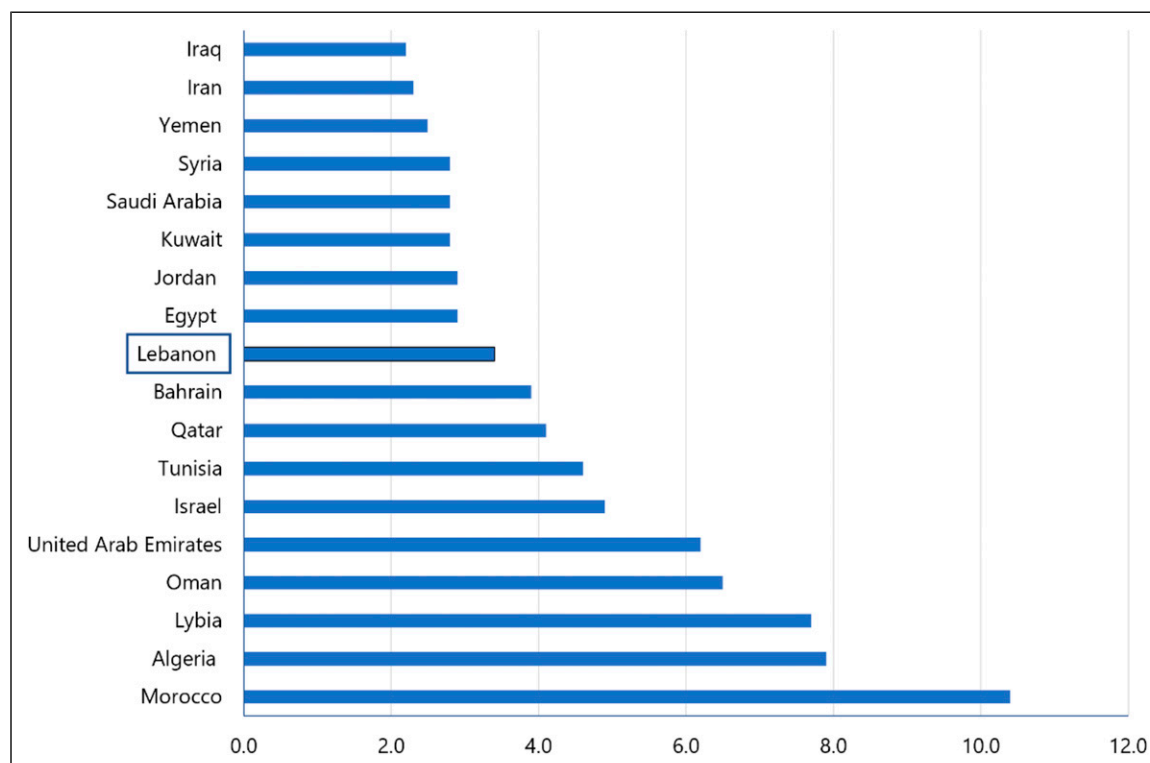
Like most countries in the MENA region, Lebanon remains relatively conservative, as dictated by culture, tradition and religion, especially with areas related to sex and sexuality. Data on the prevalence of genital HPV in Lebanon and the MENA region is scarce (Table 3). Studies conducted among sexually active women in Lebanon reported an HPV prevalence of 6.7% in 2017, 13.1% in 2005, and 4.9% in 2002. These studies also reported a prevalence of 5.7% hrHPV in 2017, 1.7% hrHPV in 2005, and 3.0% HPV 16 in 2002.<sup>37-39</sup> The most recent study on 505 women revealed that 5 (29%) out of 17 women with hrHPV had normal cytological results.<sup>37</sup> The age-specific prevalence of HPV in women with normal cytology was found to decrease with age in 1 study<sup>38</sup> and to increase with age (with a peak at 60–69 years) in another study.<sup>39</sup> The studies’ results are in concordance with a meta-analysis conducted in 2012 on HPV in the MENA region.<sup>40</sup>

**Table 2.** Age-Standardized Rate (world) (ASRw) per 100 000 Females of Cervix Uteri Cancer in Different Middle East and North Africa (MENA) and non-MENA Countries.

Country (year) <sup>reference</sup>			ASRw	
MENA Countries	West Asia	Lebanon (2012) <sup>17</sup>	5.8	
		Israeli non-Jews (2012) <sup>22</sup>	5.3	
		Israeli Jews (2012) <sup>22</sup>	5.2	
		Jordan (2012) <sup>24</sup>	1.3	
		Kuwait-Kuwaiti (2012) <sup>22</sup>	3.2	
		Bahrain (2008–2012) <sup>23</sup>	4.1	
		Saudi Arabia-Saudi (2013) <sup>25</sup>	1.5	
	Iran, Golestan (2008–2011) <sup>23</sup>	5.2		
	North Africa	Egypt, Minia Governorate (2009) <sup>26</sup>	1.5	
		Egypt, Damietta Governorate (2012) <sup>26</sup>	2.4	
		Algeria, Setif (2008–2011) <sup>23</sup>	7.0	
		Algeria, Batna (2008–2012) <sup>23</sup>	3.5	
		Morocco, Casablanca (2008–2012) <sup>27</sup>	16.3	
		Non-MENA Countries	Europe	Cyprus (2012) <sup>22</sup>
Turkey, 2 registries (2012) <sup>22</sup>				5.3
Italy, 8 registries (2010) <sup>22</sup>	4.9			
Switzerland, 6 registries (2012) <sup>22</sup>	3.7			
Germany, 2 registries (2012) <sup>22</sup>	8.4			
Belgium (2012) <sup>29</sup>	8.4			
France, 9 registries (2011) <sup>22</sup>	5.5			
Spain, 9 registries (2010) <sup>22</sup>	5.7			
Nordic Countries (2012) <sup>28</sup>	7.9			
UK, England (2012) <sup>22</sup>	7.5			
America	Canada, excl. Nunavut, Quebec and Yukon (2012) <sup>22</sup>		5.8	
	USA, SEER 9 registries (2012) <sup>22</sup>		5.2	
	Colombia, Cali (2012) <sup>22</sup>		12.5	
	Brazil, Goiania (2012) <sup>22</sup>		14.9	
Asia	India, Chennai (2012) <sup>22</sup>	15.7		
	China, 5 registries (2012) <sup>22</sup>	7.3		
	Thailand, 4 registries (2012) <sup>22</sup>	11.3		
	Philippines, Manila (2012) <sup>22</sup>	13.9		
	Korea, 5 registries (2012) <sup>22</sup>	10.0		
	Japan, 4 registries (2010) <sup>22</sup>	10.4		
	Africa	Uganda, Kyadondo County (2008–2012) <sup>23</sup>	49.1	
Kenya, Nairobi (2008–2012) <sup>23</sup>		40.2		
Zimbabwe, Harare: African (2010–2012) <sup>23</sup>		86.1		
Australia (2012) <sup>22</sup>	South African Republic, Eastern Cape (2008–2012) <sup>23</sup>	30.0		
		5.8		

Lebanon does not have a national CUca screening/early detection program or clear national guidelines on the subject. Few awareness campaigns were conducted in 2012 and 2017,<sup>41</sup> and screening for CUca is available in the MoPH network of primary health care centers as part of the reproductive health services;<sup>42</sup> however, the practice remains opportunistic in general. Most physicians use cytology screening for CUca (once every 1–3 years) instead of a high-priced hrHPV-based screening, which might affect early detection and treatment. The national prevalence of “ever used” Pap smear in Lebanon is considered low, reaching 35% only.<sup>37,43</sup> Moreover, HPV vaccines are not included in the national immunization calendar, which limit the general public access to these vaccines taking into consideration their high prices. Additional factors that limit the use of HPV vaccines in

Lebanon are the insufficient prescription rate by primary care physicians and the low public awareness rate. In fact, vaccine uptake was low among eligible girls in schools because of mothers’ lack of knowledge about HPV, CUca, and preventive methods.<sup>44</sup> Physicians and parents consider the price of HPV vaccination to be the main barrier (58.9% and 80.7%, respectively).<sup>45</sup> A cost-benefit analysis using the limited available data in Lebanon indicated that massive HPV vaccination targeting 11-year-old girls and using the cheapest vaccine would not be cost-beneficial under the circumstances that were existing in 2016.<sup>46</sup> However, in view of the increasing risky sexual behaviors among the Lebanese population in the past decade<sup>47–49</sup>, a periodic re-assessment of the cost-benefit analysis of a national HPV immunization program is recommended. Globally, there are huge disparities in women



**Figure 4.** Projected Age-Standardized Incidence Rates (World Population) per 100,000 females for Cervix Uteri Cancer in MENA countries Globocan 2020.

**Table 3.** Prevalence of HPV in Women in Lebanon, Based on Published Studies.

Studies	HPV	Total	Normal cytology	Abnormal cytology	Types of abnormal cytology			
					ASCUS	LSIL	HSIL	Other
Hanna et al., 2020 <sup>37</sup> (505 women 18–69 years)	Negative HPV DNA	471 (93.3%)						
	Positive HPV DNA	34 (6.7%)	7 <sup>a</sup>	10	2	2	1	5
	hrHPV	29 (5.7%)	5 <sup>a</sup>	9	2	2	1	4
	hrHPV 16 and 18	20						
Karam et al., 2005 <sup>38</sup> (274 women 20–67 years)	Negative HPV DNA	238 (86.9%)	221	16	11	5	0	
	Positive HPV DNA	36 (13.1%)	25	12	5	6	1	
	hrHPV	4 (1.5%)	0	4	0	3	1	
Mroueh et al., 2002 <sup>39</sup> (1026 women 18–76 years)	Negative HPV DNA	976 (95.1%)						
	Positive HPV DNA	50 (4.9%)						
	hrHPV16	31 (3.0%)		2				

<sup>a</sup>Only 17 HPV positive patients had PAP smear. Their age ranged between 21 and 39 years.

HPV immunization, with high prevalence in high-income and upper-middle-income countries and low prevalence in low-income and middle-income countries that have the highest CUca incidence and mortality.<sup>13</sup> A systematic review of peer-reviewed literature on HPV vaccine awareness and acceptability in the Arab states of the MENA region revealed that the vaccine acceptability would be high whenever cost concerns are resolved.<sup>50</sup> A cost-benefit analysis of increasing CUca screening/early detection coverage in Lebanon, published in 2016, concluded that increasing CUca screening coverage to

50% with extended intervals (to 3 and 5 years) provides more equitable cost-effective health benefits.<sup>32</sup>

There is little data about STIs among women in Lebanon and the MENA region. HIV infections have been increasing globally during the past 2 decades and at substantial rates in Eastern Europe, Central Asia, and in the MENA region.<sup>51</sup> The prevalence of HIV infection in Lebanon is less than .1% among adults 15 to 45 years.<sup>52</sup> The prevalence of *Chlamydia trachomatis* infection in the MENA region was found to be 3% in the population at large, that is, comparable to WHO

estimates for the region (3.0% in 2012 and 3.5% in 2016), and consistent with WHO estimates for the Western Pacific region (about 4% in 2016) and European region (about 3% in 2016) but higher than estimates for South-east Asia region (about 1.5%) and lower than estimates for the African region (about 5%) and the region of the Americas (about 5.5%).<sup>53,54</sup> Published studies about reproductive tract infections among women in Lebanon (2020 and 2016) reported a very low prevalence of genital *Chlamydia trachomatis* (.8% and 0%, respectively), that is, lower than other studies in the MENA region and countries.<sup>37,53-55</sup> This low prevalence may be explained by the fact that most women in these studies were married and probably in a monogamous relationship.<sup>37</sup> However, other studies revealed that premarital sexual intercourse and other risky sexual behaviors such as an increase in multiple partners and homosexuality practices are on the rise in Lebanon, thus increasing risks of STIs.<sup>47-49</sup>

High parity and use of oral contraceptives<sup>9,10</sup> are not prevalent in Lebanon. In fact, female reproductive indices are different from those in the regional Arab countries, and they are more similar to those in Western developed countries. In 2016, the total fertility rate per woman in Lebanon was 2.1 compared to a regional average of 2.9 and a global average of 2.4<sup>56</sup>; the median age of marriage among females was reported to be 28.9 years and the number of single nulliparous women in Lebanon is relatively high.<sup>57,58</sup>

The rate of contraceptive use among women in Lebanon is relatively low despite the availability of several contraceptive methods at low prices and without the need for a doctor's prescription.

Lebanon's 53.7% contraceptive use rate in 2009 among women 15 to 49 years is relatively low compared to the MENA region (63.3% in 2010), some regional countries (e.g., Egypt: 60.3 in 2008, Iran: 77.4% in 2010 and Morocco: 67.4% in 2011), and Western countries (e.g., France: 78.4%, United Kingdom: 84.0%, and United States of America: 76.4% in 2010).<sup>58,59</sup> Moreover, only around 44.8% of Lebanese women use non-traditional contraceptive methods (mostly oral contraceptives followed by intrauterine devices 22.2% and 17.4%, respectively).<sup>58</sup> These rates are higher than the ones reported by WHO in 2008 where only around 20.0% of Lebanese women reported using non-traditional contraceptive methods (mostly intrauterine devices followed by oral contraceptives, 8.0%, and 7.4%, respectively).<sup>60</sup>

Smoking tobacco increases the risk of CUca, and this effect is independent of the risk associated with viral infection.<sup>9,10</sup> It is estimated that 2% of deaths from CUca worldwide are

attributable to smoking tobacco.<sup>9</sup> The prevalence of tobacco smoking among women in Lebanon has been rising over the years,<sup>61-64</sup> increasing from 26% in 2009 to 29% in 2016.<sup>63,64</sup> Another study showed high consumption of cigarette packs (12.4 packs per person per month) among adult Lebanese.<sup>65</sup> Moreover, unsafe indoor air pollution levels due to smoking were detected in several public places in Lebanon,<sup>66</sup> putting people at risk of passive smoking.

Finally, being overweight or obese might also increase the risk of CUca.<sup>9</sup> A 12-year study period showed an alarming rise in obesity prevalence in the Lebanese population.<sup>62</sup> Another study conducted in 2016 showed that 27.5% of women aged 18–69 years are obese, and 31.4% are overweight.<sup>64</sup>

Our study is based on the cancer data published by the MoPH on its official website. Despite the improvements done in data collection for the NCR, information on collected cases is still incomplete lacking precancerous and in-situ conditions, risk factors, as well as mortality and survival rates. Another limitation of this study is the comparison of our results with those in studies that are not representative of the entire population in some countries.

## Conclusion

Invasive CUca is the tenth cancer among women in Lebanon with a low ASRw over the studied 12-year period. This can be due to the low prevalence of HPV and other STIs as well as low CUca screening rate. However, the rise in risky sexual behaviors in the country would probably increase the risk of HPV infection and incidence of CUca in the future.

We recommend a comprehensive approach for CUca control in Lebanon, which includes the following: provision of sex education to adolescents and youth; promotion of safe sexual behaviors; improving public awareness on HPV vaccine and CUca risk factors; studying the possibility of including HPV vaccine in the national immunization calendar, which might address the cost barriers; developing national guidelines for CUca prevention and early detection, which include screening recommendations of the United States Preventive Services Task Force (USPSTF)<sup>67</sup> (i.e., screening women aged 21 to 29 years with cervical cytology alone every 3 years; screening women aged 30 to 65 years with cervical cytology alone every 3 years, hrHPV testing alone every 5 years, or with hrHPV testing in combination with cytology [co-testing] every 5 years); and educating health care providers on these guidelines.

## Appendix

### Abbreviation

APC	Annual Percent Change
AAPC	Average Annual Percent Change

ASRw	Age-Standardized Incidence adjusted to the world population
CI5Plus	Cancer Incidence in Five Continents Time Trends
CI5XI	Cancer Incidence in Five Continents Volume XI
CUca	Invasive Cervix Uteri Cancer
EMR	Eastern Mediterranean Region

HDI	Human Development Index
HIV	Human Immunodeficiency Viruses
HPV	Human Papilloma Virus
hrHPV	high-risk Human Papilloma Virus
IARC	International Agency for Research on Cancer
ICD-10	International Classification of Diseases, 10th revision
IGF-I	Insulin-like growth factor-I
JRP	Joinpoint Regression Program
MENA	Middle East and North Africa
MoPH	Ministry of Public Health
NCR	National Cancer Registry
STI	Sexually Transmitted Infection
USPSTF	United States Preventive Services Taskforce
WHO	World Health Organization

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### Availability of Data and Materials

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