



Research Report

Global online interest in cervical cancer care in the time of COVID-19: An infodemiology study

Michelle Ann B. Eala, Ourlad Alzeus G. Tantengco*

College of Medicine, University of the Philippines, Manila, Philippines

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ABSTRACT

Introduction: Internet search trends may gauge public awareness and interest in cancer and help identify key areas for improvement in public health interventions and awareness campaigns. During the COVID-19 pandemic, cervical cancer screening significantly decreased, and we hypothesized that this would be mirrored by a decreased online interest in cervical cancer care.

Methods: Using the Google Trends database, we analyzed 2018–2021 global search trends in the following topics: cervical cancer, human papillomavirus, HPV vaccine, Cervarix, Gardasil, Pap test, HPV test, and colposcopy. Search trends were reported in the unit search volume index (SVI), which correlated with country-specific socioeconomic and epidemiologic characteristics.

Results: We found a sharp decline in global online search interest in cervical cancer following the declaration of the COVID-19 pandemic, after which interest gradually increased. During the pandemic, SVI for “cervical cancer” and “Pap test” significantly decreased, while SVI for “HPV vaccine” significantly increased. Higher online search interest in cervical cancer care was found in low- and middle-income countries, and countries in Latin America and the Caribbean, Asia, and Europe, reflecting their burden of disease and recent developments in cervical cancer control.

Conclusion: When the COVID-19 pandemic was declared, global online search interest in cervical cancer care decreased, reflective of the significant decline in cervical cancer screening rates during this time. Country-specific socioeconomic and epidemiologic characteristics correlated with online search interest in cervical cancer care. These global online search trends in cervical cancer may guide future public health interventions and awareness campaigns to eradicate this preventable disease worldwide.

1. Introduction

Patients with cancer desire to learn as much as they can about their disease (Huang & Penson, 2008), and the internet has been an extensive resource for patients to gather information about cancer and related health topics. Internet use has soared among patients with cancer – almost 80% of cancer patients in Germany (Ebel et al., 2017) and more than 70% of cancer patients in Canada (Bender et al., 2021) use the internet to get cancer information and support.

Internet search trends may gauge public awareness and interest in cancer and help identify key areas for improvement in public health interventions and awareness campaigns (Schootman et al., 2015). During the COVID-19 pandemic, there was a surge in public internet use for health information (Tantengco, 2021). With limited opportunities for face-to-face consultations with healthcare providers, patients turned to

the internet.

Recently, infodemiological analysis has been used in public health to investigate the online health-seeking behavior of the public. This method assesses the determinants and distribution of health information in an electronic medium (Eysenbach, 2009). The most common method of studying online search trends is Google Trends™. This platform provides data on the geographical and temporal trends of online interest in a certain topic (Nuti et al., 2014). We used this analysis to investigate the global online search interest in cervical cancer care during the pandemic. Cervical cancer is the fourth most common cancer in women, and in 2020, more than 900 women died every day from this preventable disease (World Health Organization, 2022). The COVID-19 pandemic saw a significant decrease in cervical cancer screening rates (Mayo et al., 2021), and we hypothesized that global online search interest in cervical cancer care mirrored this decline.

* Corresponding author at: College of Medicine, University of the Philippines, 547 Pedro Gil Street, Manila 1000, Philippines.

E-mail address: ogtantengco@up.edu.ph (O.A.G. Tantengco).

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2. Materials and methods

Google Trends™ database (<https://trends.google.com>) was used to measure the global online search interest for cervical cancer care topics. Search trends are reported using the search volume index (SVI). SVIs are

normalized based on the location and time and are given a value from 0 to 100, with 100 representing peak interest for a search topic. SVI has been used as a proxy measure for the health-seeking behavior of the public (Perez et al., 2021; Tantengco, 2021, 2022).

We used the topics cervical cancer, human papillomavirus, HPV

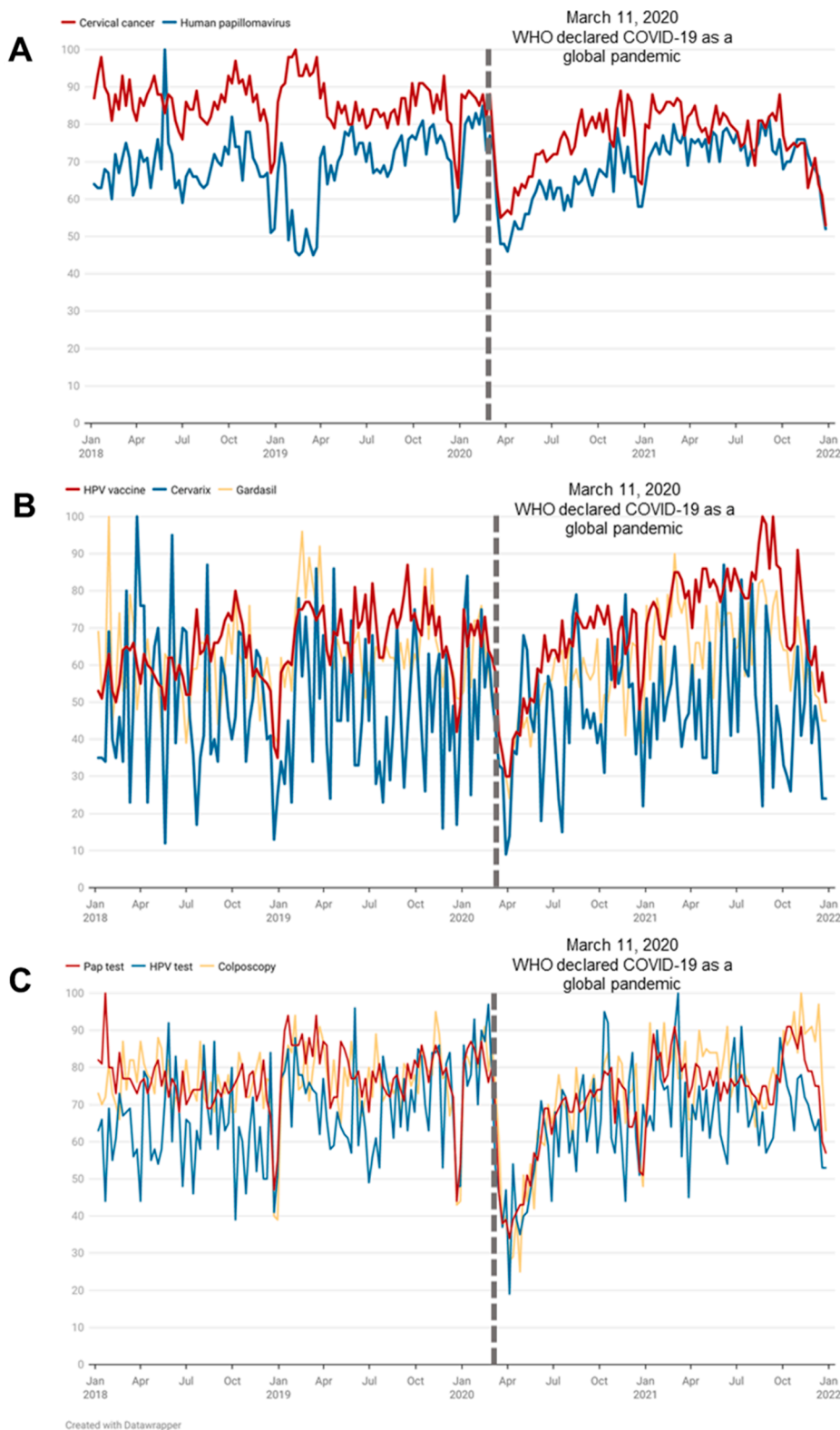


Fig. 1. Search volume indices for the search terms related to cervical cancer care, (A) cervical cancer and human papilloma virus, (B) cervical cancer prevention topics, and (C) cervical cancer screening and diagnosis topics, from 2018 to 2021.

vaccine, Cervarix, Gardasil, Pap test, HPV test, and colposcopy. We searched these topics using all categories from 2018 until 2021 from all countries included in Google Trends™. The top related queries to the cervical cancer care topics were also obtained from Google Trends™. The information about cervical cancer prevalence was obtained from the World Health Organization International Agency for Research on Cancer (<https://gco.iarc.fr/today/home>), while the GDP (current US\$), GDP per capita (current US\$), individuals using the Internet (% of the population), physicians (per 1,000 people), unemployment, female (% of the female labor force), poverty headcount ratio at \$1.90 a day, and the literacy rate, adult female (% of females ages >15) were obtained from the World Bank.

We performed Spearman's rank-order correlation using GraphPad Prism software version 7 (GraphPad Software, San Diego, CA) to determine the correlation between country-specific indicators and SVI. A p-value of less than 0.05 was considered significant.

3. Results

The SVI for cervical cancer care search terms from 2018 to 2021 is shown in Fig. 1. There was a marked decrease in interest in cervical cancer care when WHO declared COVID-19 a global pandemic, but interest gradually increased afterward. Among the search terms cervical cancer and human papillomavirus, cervical cancer had a higher SVI. Among search terms related to cervical cancer prevention, the HPV vaccine had a higher SVI than vaccine brand names Gardasil and Cervarix. Among search terms related to cervical cancer screening and diagnosis, the Pap test had the highest SVI, followed by colposcopy, then HPV test.

To show the impact of the COVID-19 pandemic on the global online interest in cervical cancer care, we compared the average SVI before the pandemic (2018–2019) and during the pandemic (2020–2021). The average SVI for “cervical cancer” ($p < 0.0001$) and “Pap test” ($p = 0.0002$) significantly decreased during the pandemic, while the average SVI for “HPV vaccine” ($p = 0.0001$) significantly increased (Table 1).

Internet users searching for the term “cervical cancer” also searched for “cervical mucus” and “hpv”. Other top associated search terms were search terms for cervix and cervical cancer in foreign languages such as in Chinese, Japanese, and Indonesian. Search terms that had the highest increase in online interest included “cervical mucus timeline”, “cervical cancer treatment”, and “cervical check ireland”. There were also search terms in foreign languages such as “cervix” in Korean, “cervical cancer vaccine” and “uterine cancer screening” in Japanese, and “cervical cancer screening” in Vietnamese (Table 2).

A world map showing the countries with their respective SVI for search terms for cervical cancer care was shown in Fig. 2 and Supplementary Table 1. Highest online interest in cervical cancer was found in low- and middle-income countries (LMICs) such as Zambia, Jamaica, Ghana, Kenya, and Uganda. Human papillomavirus, Pap test, and colposcopy were popular in Latin America and the Caribbean, such as Nicaragua, Mexico, Guatemala, Honduras, Dominican Republic, Uruguay, Paraguay, and Bolivia. The HPV vaccine was popular in Asian countries such as Hong Kong, China, Singapore, and Taiwan. The HPV

Table 1

Comparison of search volume indices for cervical cancer care search terms before the pandemic (2018–2019) vs during the pandemic (2020–2021).

| Search Terms | Pre-pandemic Mean SVI (95% CI) | Pandemic Mean SVI (95% CI) | % Change in SVI | p-value |
|----------------------|--------------------------------|----------------------------|-----------------|----------|
| Cervical cancer | 85.89 (84.74–87.05) | 75.74 (74.01–77.48) | –11.82% | <0.0001* |
| Human papillomavirus | 68.98 (67.27–70.69) | 68.15 (66.40–69.90) | –2.62% | 0.5758 |
| HPV vaccine | 64.70 (62.94–66.47) | 70.31 (67.31–73.32) | +8.67% | 0.0001* |
| Cervarix | 49.42 (45.95–52.88) | 47.88 (44.49–51.27) | –3.12% | 0.7126 |
| Gardasil | 62.26 (60.13–64.40) | 60.44 (57.80–63.09) | –2.92% | 0.5587 |
| Pap test | 77.02 (75.45–78.59) | 71.42 (68.89–73.96) | –5.99% | 0.0002* |
| HPV test | 67.56 (65.14–69.98) | 65.65 (62.77–68.53) | –2.83% | 0.4041 |
| Colposcopy | 76.22 (74.47–77.97) | 73.25 (70.15–76.35) | –3.90% | 0.2955 |

Table 2

Top and rising associated search terms used by people searching for cervical cancer (2018–2021).

| Top Related Search Terms | SVI | Rising Related Search Terms | % increase in SVI |
|--------------------------|-----|-----------------------------------|-------------------|
| cervical cancer | 100 | cervical mucus timeline | 600% |
| | 80 | 자궁 경부 | 250% |
| cervical cancer cervix | 55 | cervical meaning in hindi | 250% |
| | 33 | cervical cancer treatment options | 250% |
| 子宮頸 | 23 | 子宮頸癌 ワクチン | 250% |
| 子宮頸が ん | 16 | tầm soát ung thư cổ tử cung | 200% |
| cervical mucus serviks | 15 | tiêm ung thư cổ tử cung | 190% |
| hpv | 10 | 子宮 癌 検診 | 170% |
| | 9 | chích ngừa ung thư cổ tử cung | 170% |
| kanker serviks | 8 | cervical check ireland | 170% |

test was popular in European countries such as Romania, Italy, Ireland, Serbia, Bosnia, and Herzegovina.

We analyzed country-specific socioeconomic and epidemiologic indicators and correlated these with online interest in cervical cancer care. Poverty headcount ratio at \$1.90 a day and cervical cancer prevalence were positively correlated with online interest in “cervical cancer”. The percentage of individuals using the internet and the GDP per capita were significantly correlated with higher online interest in “HPV vaccine”. Poverty headcount ratio at \$1.90 a day, adult female literacy rate, and cervical cancer prevalence were positively correlated with online interest in “Pap test”. On the other hand, female unemployment, adult female literacy rate, and physicians per 1000 people were negatively correlated with online interest in “cervical cancer”. Female unemployment was negatively correlated with online interest in “HPV vaccine”, and GDP was negatively correlated with online interest in “Pap test” (Table 3).

4. Discussion

We found a sharp decline in global online interest in cervical cancer care when the COVID-19 pandemic began, after which interest gradually increased. Average SVI for “cervical cancer” and “Pap test” significantly decreased during the pandemic, while average SVI for “HPV vaccine” significantly increased. Commonly searched terms in addition to “cervical cancer” were “cervical mucus”, “hpv”, and search terms in other languages. Higher online interest in cervical cancer care terms was found in LMICs, Latin America and the Caribbean, Asia, and Europe. We also found correlations between country-specific socioeconomic and epidemiologic characteristics with online interest in cervical cancer care.

Cervical cancer screening significantly dropped by 84% soon after the COVID-19 pandemic was declared (Centers for Disease Control and Prevention, 2021). This is mirrored by our study's findings, where we also found decreased online interest in cervical cancer and the Pap test after the pandemic was declared. Expectedly, as interest in COVID-19 increased (Effenberger et al., 2020), online interest in other health

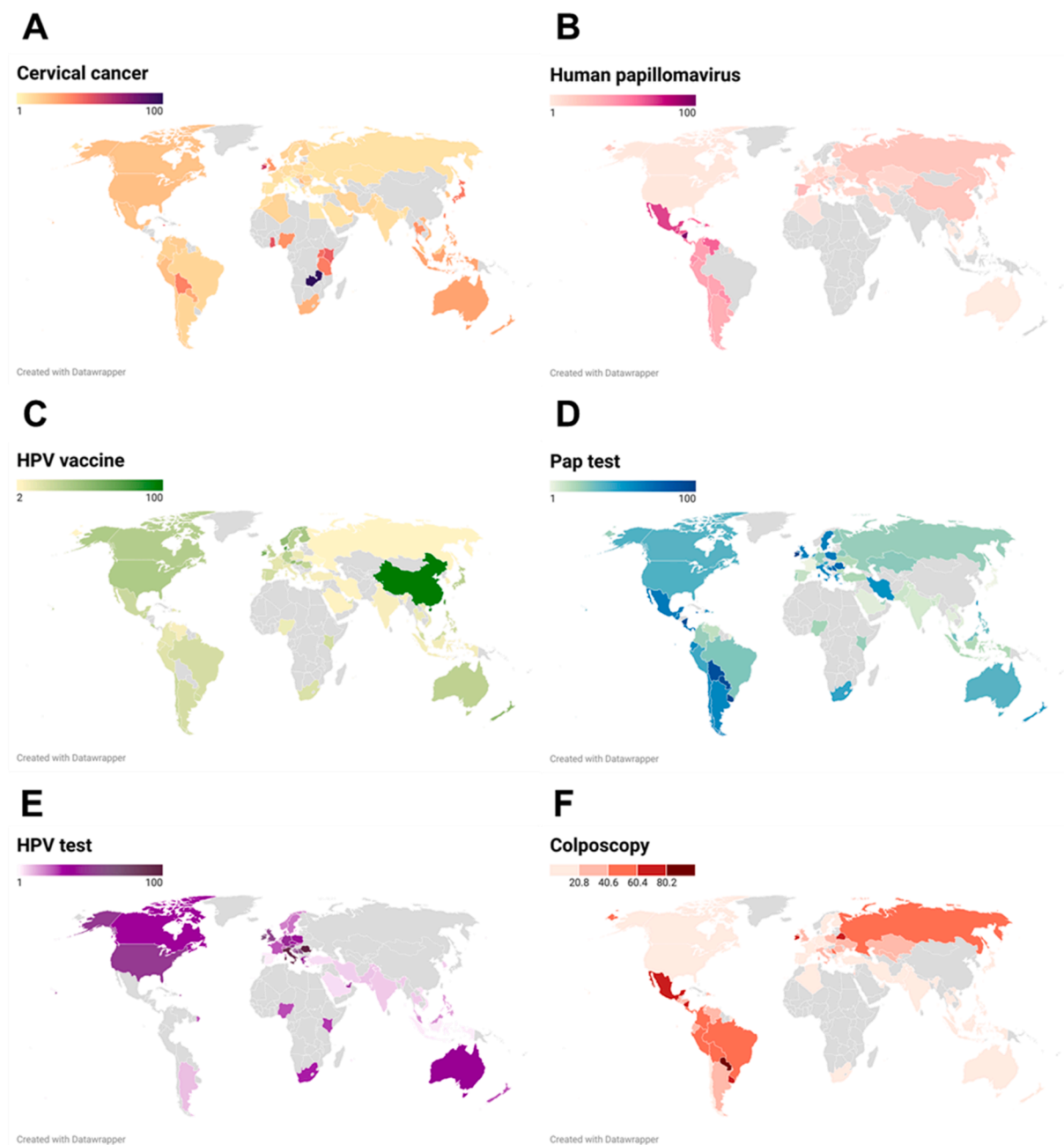


Fig. 2. Search frequencies for topics related to cervical cancer care by country from 2018 to 2021. The color intensity represents the percentage of searches for the leading search term in a particular region. Search term popularity is relative to the total number of Google searches performed from 2018 to 2021 within a specific location.

topics decreased transiently (Alonto et al., 2022; Dzaye et al., 2021; Jella et al., 2020; Mohty et al., 2021). On the other hand, increased online interest in the HPV vaccine may be related to the general increased online interest in vaccines given the pandemic – global online interest in both pneumococcal and influenza vaccines also peaked in February and March 2020 (Paguio et al., 2020). However, another study found that despite increased interest in the COVID-19 vaccine because of the pandemic, online interest in other vaccines, including the BCG and polio vaccines, did not decrease (Sycinska-Dziarnowska et al., 2021).

In addition to “cervical cancer”, commonly used search terms were “cervical mucus” and “hvp”; the role of HPV in cervical cancer may explain the use of the latter. On the other hand, the search term “cervical mucus” may be more aligned with increased interest in ovulation status and peak fertility, rather than cervical cancer. The de-prioritization of

other health services during the pandemic resulting in limited access to contraceptives and reproductive healthcare may explain this search trend. (Aly et al., 2020).

We also observed geographical differences in online interest in cervical cancer care search terms. LMICs, including Zambia, Jamaica, Ghana, Nicaragua, Mexico, and Guatemala, had the highest online interest in cervical cancer and the human papillomavirus. These findings are reflective of the global burden of disease, as up to 90% of cervical cancer cases occur in LMICs (Hull et al., 2020).

All ten countries with the highest online interest in the human papillomavirus were from Latin America and the Caribbean. Additionally, Uruguay, Paraguay, Nicaragua, Bolivia, and Mexico were among the countries with the highest online interest in the Pap test and colposcopy. This is aligned with the disease burden and the latest

Table 3
Correlations between SVI for cervical cancer care search terms and country specific socioeconomic and epidemiologic characteristics.

| Country-specific Indicators | Search terms | r | p-value |
|---|-----------------|----------|------------------|
| Individuals using the internet | Cervical cancer | -0.1189 | 0.345 |
| | HPV Vaccine | 0.4082 | 0.002 |
| | Pap Test | -0.09321 | 0.467 |
| GDP | Cervical cancer | -0.233 | 0.054 |
| | HPV Vaccine | -0.00947 | 0.944 |
| | Pap Test | -0.471 | <0.001 |
| GDP per capita | Cervical cancer | -0.2033 | 0.094 |
| | HPV Vaccine | 0.5987 | <0.001 |
| | Pap Test | -0.01723 | 0.892 |
| Female unemployment | Cervical cancer | -0.349 | 0.003 |
| | HPV Vaccine | -0.2849 | 0.03 |
| | Pap Test | 0.1565 | 0.21 |
| Poverty headcount ratio at \$1.90 a day | Cervical cancer | 0.4098 | 0.006 |
| | HPV Vaccine | 0.07378 | 0.669 |
| | Pap Test | 0.4098 | 0.008 |
| Adult female literacy rate | Cervical cancer | -0.383 | 0.044 |
| | HPV Vaccine | 0.1434 | 0.524 |
| | Pap Test | 0.4526 | 0.02 |
| Physicians per 1000 people | Cervical cancer | -0.3455 | 0.013 |
| | HPV Vaccine | 0.2759 | 0.063 |
| | Pap Test | 0.05133 | 0.735 |
| Cervical cancer prevalence | Cervical cancer | 0.3353 | 0.005 |
| | HPV Vaccine | -0.1071 | 0.428 |
| | Pap Test | 0.3013 | 0.015 |

developments in the region – each year, there are more than a million new cervical cancer cases in Latin America and the Caribbean. Therefore, ministries of health have recently been evaluating HPV testing as a screening tool and have introduced HPV vaccines in their national immunization programs (Sichero et al., 2020).

Online interest in the HPV vaccine was highest in Hong Kong, which may be explained by the Hong Kong government's effort to provide HPV vaccines to eligible female primary school students under their childhood immunization program starting the school year 2019–2020 (Centre for Health Protection, Department of Health, The Government of the Hong Kong Special Administrative Region, 2020). China ranked second in online interest in the HPV vaccine, which occurs in the context of a national immunization program that does not include HPV vaccination (World Health Organization, 2021a). Interestingly, a meta-analysis on HPV vaccine awareness, knowledge, and acceptability in the Chinese population showed high acceptability of vaccination despite low awareness and low knowledge levels, which may explain the increased online interest in the HPV vaccine (Zhang et al., 2016).

Romania had the highest online interest in the HPV test, which occurs in the context of them having the highest cervical cancer prevalence in Europe (Brinzac et al., 2019). Although HPV testing is more accurate and reliable (National Cancer Institute, 2020), Romania's primary screening method is limited to cytology, and only 30% of women have been screened in the last five years (World Health Organization, 2021b). Optimization of the cervical cancer screening program is urgently needed given their heavy disease burden (Todor et al., 2021), which may explain their increased online interest in the HPV test. On the other hand, the state of screening in Italy, which had the second-highest online interest in the HPV test, starkly contrasts Romania. Primary screening in Italy is cytology, with HPV testing starting at 30 years old. Moreover, 80% of women in Italy have been screened in the last five years (World Health Organization, 2021d). Singapore had the third-highest online interest in the HPV test, and they also use HPV testing for primary screening (World Health Organization, 2021c).

Ireland was among the top five countries with the highest online interest in cervical cancer, pap test, HPV test, and colposcopy. This finding is aligned with a previous infodemiology study in Ireland that showed an increase in online searches on cervical cancer and cervical testing following the CervicalCheck controversy which erupted in April 2018, where negative tests under Ireland's national cervical smear

screening program were questioned for their accuracy (Ryan & Ryan, 2019). Over the years, various cases were filed against the government health agency of Ireland, which may explain the high online interest in cervical cancer. Notably, when the COVID-19 pandemic was declared in March 2020, the Supreme Court gave its final ruling on the case of a woman whose CervicalCheck screening result was incorrectly reported (McKeown BL, 2020). Incidentally, HPV testing was also introduced in Ireland in March 2020 (Health Service Executive, Department of Health, Republic of Ireland, 2019).

This study has several limitations. Although we used Google, the most popular search engine, there are countries without access to Google, and there are also many other search engines available for use. Secondly, Google Trends data is subject to the inherent nonrepresentative sampling bias in Google search trends. Thirdly, this study only included data from people with internet access, potentially excluding populations from lower-income brackets and regions with curtailed freedom of speech. Nevertheless, we have successfully shown the global online interest trend for cervical cancer care during the COVID-19 pandemic through this study.

5. Conclusion

This study showed a sharp decrease in global online search interest in cervical cancer care when the COVID-19 pandemic was declared, reflective of the significant decline in cervical cancer screening rates during this time. SVI for “cervical cancer” and “Pap test” significantly decreased, while SVI for “HPV vaccine” significantly increased. In addition to “cervical cancer”, common search terms were “cervical mucus”, “hvp”, and search terms in other languages. LMICs and countries in Latin America and the Caribbean, Asia, and Europe had higher online search interest in cervical cancer care, aligned with the burden of disease and recent developments in cervical cancer control. Country-specific socioeconomic and epidemiologic characteristics correlated with online search interest in cervical cancer care. These global online search trends in cervical cancer may guide future public health interventions and awareness campaigns to eradicate this preventable disease worldwide.

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Ethics approval

Not applicable.

CRediT authorship contribution statement

Michelle Ann B. Eala: Conceptualization, Writing – original draft, Writing – review & editing, Project administration. **Ourlad Alzeus G. Tantengco:** Conceptualization, Methodology, Software, Writing – original draft, Writing – review & editing, Visualization, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.gore.2022.100998>.

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