Spatial and temporal trends of cervical cancer, Uganda, 2012-2021: A descriptive analysis of surveillance data

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ABSTRACT

Introduction: Cervical cancer is the leading cause of cancer-related deaths among women in Uganda. The Uganda Ministry of Health (MoH) has adopted a number of strategies to address the burden of cervical cancer, including cervical cancer screening in public health facilities. However, the impact of these interventions on cervical cancer incidence is not documented. We described the spatial and temporal trends of cervical cancer screening and incidence among women attending health facilities in Uganda from 2017 to 2021. **Methods:** We extracted surveillance data for screening and incident cervical cancer cases per month during 2017-2021 by district, region and country. We calculated the screening and incidence rate by district, region and country level using the Uganda Bureau of Statistics population projections of total female population aged 15+ years as the denominator. We calculated significance of the trends over time using logistic regression. **Results:** A total of 439,230 women were screened for cervical cancer from 2017 to 2021. The highest screening rate was in 2020 (1,420/100,000) and the lowest was in 2017 (18/100,000). There was a 2.4% increase in the screening rate from 2017 to 2021. Nationwide, 7,073 newly diagnosed cervical cancer cases were observed from 2017 to 2021.The peak incidence of cervical cancer was 1,978 (18/100,000) in 2017 and the lowest incidence was 1,143 (5/100,000) in 2021. There was an overall 3% decrease in incidence of cervical cancer from 18/100,000 in 2017 to 5/100,000 in 2021 ($p<0.001$). Regionally, there was a significant decrease in the incidence of cervical cancer over the years. Northern Uganda had the least decline of 9%. Eastern Uganda had the biggest decrease of 25% over the years. **Conclusion:** Despite the significant increase in cervical cancer screening, fewer cases of cervical cancer was registered in Uganda over the years. Only Northern Uganda had an increase in incidence of cervical cancer over the years. We recommend expansion of screening to cover all eligible female populations and strengthening of strategies to sustain the decline in cervical cancer cases. Further investigations are needed to understand the reasons for the increasing incidence in Northern Uganda.

KEYWORDS: Cervical cancer, trend, Uganda

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Introduction

In 2020, cervical cancer was the fourth commonest cancer worldwide with 604,000 new cases and 342,000 deaths; the Low and Middle Income Countries (LMICs) bearing the brunt at 84% of new cases and 90% of deaths [1]. East Africa had the highest age standardized cervical cancer mortality of 30 per 100,000 and second highest incidence rate of 40/100,000 in 2018 [2]. In Uganda, cervical cancer was the commonest cancer among women with an age standardized rate (ASR) incidence of 56.2 per 100,000 and cancer related death rate of 41.4 per 100,000 in 2020 [3].

Most of the cervical cancer cases (at least 95%) are due to infection with human papillomaviruses (HPV) that are transmitted through sexual intercourse [4]. Majority of sexually active women are infected with HPV in their lifetime but nearly all clear the infection in a year [5]. Unfortunately, 12% of acute HPV infections become persistent and may progress to precancerous lesions or invasive cervical cancer over decades [6]. This known cause plus the long natural history of HPV infection allows an opportunity for effective interventions to manage cervical cancer [7]. Cervical cancer can be prevented by HPV vaccination. Additionally, screening for cervical cancer aids timely intervention to treat precancerous lesions [8].

Papanicolaou (PAP) smear testing has been used as a screening tool for cervical cancer for more than 50 years in Uganda [9]. The Uganda Ministry of Health (MoH) recommends screening with Visual Inspection with Acetic acid (VIA) for all women aged 25-49 years. The screening is scheduled every year for HIV positive women and every 3 years for HIV- negative women [9]. However, screening uptake has been low due to limited resources or unwillingness to commit financial resources [10]. HPV vaccination was scaled up in Uganda in 2015 after 2 successful pilot studies in 2008 and in 2012, and is now part of the national routine immunisation program [11].

Despite these measures, the incidence of cervical cancer is still unacceptably high. There is limited documentation of trends and geographical distribution of cervical cancer in Uganda. We describe the spatial and temporal trends of cervical cancer screening and incidence among women attending health facilities in Uganda, 2017-2021 to support development of cervical cancer interventions in Uganda.

Methods

Study design, data source, and study population

We conducted a cross sectional descriptive analysis of surveillance data on screening and newly diagnosed cervical cancer among women attending health facilities in Uganda, 2012-2021 from the District Health Information System version 2 (DHIS2). There are approximately 7,000 health facilities in Uganda where 1% are community-owned, 14% are private-not-for-profit (PNFP), 40% are private-for-profit (PFP), and 45% are government-owned. The health facilities are categorized as clinics, health centre II, health centre III, health centre IV, general hospitals, regional referral hospitals, and national referral hospitals [12]. DHIS2 is a platform for reporting, analysis, and dissemination of health data reported through the health management information system [13]. Cervical cancer screening and diagnosis in Uganda is routinely carried out in family planning clinics in health facilities from Health Centre III (HC III) upwards. However, since 2020, cervical cancer screening is also being carried out in HIV clinics. At the healthy facilities, cervical cancer individual level patient data on screening and diagnosis is recorded in outpatient department registers. The individual level patient data is then summarised in the outpatient department monthly report among other parameters in the report. The reports from HC III facilities are then submitted to the HC IV and then to the district level.

At the district, data for health facility levels III and IV are entered into the DHIS2 by the district biostatistician. Regional and national referral hospitals send data directly to DHIS2. At the MoH headquarters, data from all health facilities are collated and the national performance on each indicator is determined.

The DHIS2 specifically contains data regarding cervical cancer screening, total cases, and newly diagnosed cases. We considered all records of women who tested positive for cervical cancer from 2017-2021 and all women who screened for cervical cancer from 2017-2021 as reflected in the DHIS2.

Study variables, data abstraction, and analysis

We extracted district, regional, and national data from the DHIS2 on: Newly diagnosed cancer of the cervix cases from the HMIS 108-GC01a in the new DHIS2 (2020-2021) and HMIS 108-6 in the old DHIS2 (2012-2019) and cases of cervical cancer screening done from HMIS 105-MC11a in the new DHIS2 (2020-2021) and LMIS in the old DHIS2 (2012-2019). We also abstracted data on outpatient reporting rates from the HMIS 105:01 from the new DHIS2 (2020-2021) and HMIS 105:1 in the old DHIS2 (2012-2019) to show accuracy of the trend. We abstracted data on adult women aged 15+ from the Uganda National Bureau of Standards from 2017-2021.

We extracted surveillance data for screening and incident cervical cancer cases per month during 2017-2021 regionally, nationally, and per district. We calculated the screening and incidence rate at the national, regional, and district level. The screening and incidence of cervical

cancer was calculated using the total number of cases as the numerator and the population projections of total female population aged 15+ as the denominator for the country, region, or district by the Uganda Bureau of Statistics. We calculated significance of the cervical cancer trends over time using logistic regression in Epi-info version 7. We calculated and report odds ratios (OR) and 95% confidence intervals (CI) and set statistical significance at p-value <0.05. We interpreted the odds ratios as the odds of increase or decrease in the incidence of cervical cancer or cervical cancer screening per 100,000 women per year. Choropleth maps were drawn using QGIS version 3.6.3 to show the regional and district-level distribution of cervical cancer.

Availability of data and materials

The data upon which our findings are based belongs to the Ministry of Health. However, the data can be availed by the corresponding author with permission from the Uganda Public Health Fellowship Program.

Ethical considerations

Our study utilized routinely collected aggregated program surveillance data that did not have any personal identifiers. We obtained permission to use the HMIS data from the Ministry of Health, Division of Health Information, which has the overall mandate to collect and store health-related information. Additionally, the US Centers for Disease Control and Prevention (CDC) Center for Global Health determined our study was non-research whose primary intention was to address public health problems. We stored data in password-protected computers and data was not shared with anyone outside the investigation team.

Results

Trends of incidence, screening rate, and outpatient reporting rate of cervical cancer, Uganda, 2012 -2021

Overall, a total of 439,230 women were screened for cervical cancer from 2017 to 2021. The highest screening rate was in 2020 (1,420/100,000) and the lowest was in 2019 (10/100,000). Nationwide, 7,073 newly diagnosed cervical cancer cases were registered from 2017 to 2021. The peak incidence of cervical cancer was 1,978 (18/100,000) in 2017 and the lowest incidence was 1,143 (5/100,000) in 2021. There was a 2.4% (95%CI 2.39 - 2.41) general increase in the screening rate over the years. The outpatient reporting rates increased across the years from 75.3% in 2017 to 99.8% in 2021. There was an overall 3% (95%CI 0.731 - 0.755) decline in incidence of cervical cancer while there was an increase in outpatient reporting rates and screening rates (**Figure 1**).

Regionally, the incidence varied greatly across all the regions over the years. The Northern regions had the highest incidence in 2017 and 2021 while the Western region had the highest incidence in 2019. The Northern region had the highest overall incidence (7.4/100,00) while the Central region had the lowest overall incidence (5.4/100,000). The cervical cancer screening rate was generally low from 2017 to 2019 and then rose dramatically in 2020 and continued to rise in 2021. There was a general increase in reporting rate across all regions from 2017 to 2021 with the Central region having the lowest reporting rates over time (**Figure 2**).

Regional trends analysis shows that there was a decrease in cervical cancer across all the regions. Northern Uganda had the least decrease of 9% and Eastern Uganda having the biggest decrease of 25% over the years (**Table 1**).

The incidence of cervical cancer was highest in Northern Uganda over the years. Western Uganda also had some districts with high incidences of cervical cancer over the years and Central Uganda having one district in 2021. There were variations of incidence rates over the years by districts nationwide. In 2017, five districts reported the highest cervical cancer incidence of 81 and above. These were Kitgum, Gulu and Amolatar in the northern Uganda region and Kapchorwa and Mbale in eastern Uganda. Notably, from 2018 to 2020, all districts that reported the highest cervical cancer incidence of 81+ were in the northern region of Uganda. Kitgum, Obongi and Napak districts in 2018, Obangi, Lira and Napak districts in 2019, and Moroto and Amolatar districts in 2020. In 2021, Dokolo district in northern Uganda and Kalangala district in central region of Uganda reported cervical cancer incidence of 81+ (**Figure 3**).

Discussion

Our findings showed overall decreasing incidence of cervical cancer in the country from 2017 to 2020. They also showed a significant increase in the cervical cancer screening rate incidence of from 2017 to 2021. Regionally, there was a decrease in the incidence of cervical cancer over the years with Northern Uganda having the least decrease. The Eastern region had the most significant decrease in incidence of cervical cancer over time. The Central region had the lowest overall incidence over time. The trends are similar to many other studies done globally for the past 2 decades that have shown decreasing incidence of cervical cancer [14, 15]. However, a study in Kampala by Jedy-Agba et al., showed an increase in incidence of cervical cancer from 1991 to 2015 [16]. The reasons for the decreasing trend in Uganda could be due to implementation of safe male circumcision policy since 2010 which encourages all males to be circumcised [17].

Safe male circumcision was initially introduced as a means of reducing HIV transmission. However, many studies have demonstrated that uncircumcised men have an increased risk of HPV infection which is localised at the glans penis or corona increasing the risk of HPV infection [18, 19]. Furthermore, in 2015, the Government of Uganda under Ministry of Health scaled up HPV vaccination in the whole country as a way of helping to reduce cervical cancer and it can be done in different health facilities for girls aged 9 - 14 years [11].

The initial decline from 2017-2019 could have been be due to low screening rates: however, the incidence in 2020 and 2021 declines even further despite the increase in screening rates. This could be because of the decline in reporting rates and the lock down and other restrictions on transport and increase in transport charges in 2020 and 2021 may have prevented women who really needed screening services from accessing them. The increase in screening noted in 2020 and 2021 was due to an increase in screening for cervical cancer among eligible women living with HIV [20].

The Northern region had the lowest decline in the incidence of cervical cancer over time. This could be because Northern Uganda had the highest reporting rate over time compared to other regions. In addition, Northern Uganda has a high prevalence of childhood marriages [21] which exposes the young girls to sexual intercourse at an early age which increases their risk of cervical cancer. This supports the need for HPV vaccination for eligible girls especially while they are still in school and the need to address childhood marriages as a means of preventing cervical cancer in addition to the existing ways of preventing cervical cancer in the country.

The central region had the lowest incidence of cervical cancer over time. This is contrary to what is expected since the Central region has the highest prevalence for HIV [22] which increases the risk of cervical cancer. However, this could be because of the improvement in antiretroviral treatment in Uganda which could have led to a decrease in cervical cancer [23]. Thus, despite the decrease in the incidence cervical cancer, there is still need to strengthen cervical cancer screening services in the region.

Eastern Uganda had the most decrease in the incidence of cervical cancer. This could be due to practice of male circumcision. Studies have showed that women whose male partners are circumcised are less likely to get infected with HPV. In Eastern Uganda, there is a practice of male circumcision in the Bugisu Region. In addition, a study on the impact of safe male circumcision done in Uganda showed that Eastern Uganda had the highest uptake of safe male circumcision [24, 25]. Despite the lower incidence in Eastern Uganda, efforts are still needed to further reduce cervical cancer.

Despite the current decreasing incidence of cervical cancer, Uganda still has a long way to reach the WHO target of eliminating cervical cancer by the next generation. Therefore, there is need to strengthen cervical cancer screening in the entire population especially in Northern Uganda. There is also need to emphasize community education about cervical cancer screening to improve detection of cases especially in central Uganda where the incidence is expected to be higher.

The study had some limitations. Because DHIS2 data is aggregated and does not represent patient-level data like age, we could not describe the individual characteristics to show the change in cervical cancer incidence with age; yet based on literature, older age has been documented to be associated with cervical cancer. There is poor uptake of screening in Uganda as low as 4.8% in rural areas [9], hence a likely underestimation of the incidence in the country. Eastern Uganda had zero reporting for cervical cancer screening for the years 2018 and 2019, something unlikely to be true, hence a possible underestimation of the magnitude of cervical cancer in the region and the entire country.

Conclusion

Despite the significant increase in cervical cancer screening, fewer cases of cervical cancer were registered in Uganda over the years. Only Northern Uganda had an increase in incidence of cervical cancer over the years. We recommend expansion of screening to cover all eligible female populations and strengthening of strategies to sustain the decline in cervical cancer cases. Further investigations are needed to understand the reasons for the increasing incidence in Northern Uganda.

What is known about this topic

- Most of the cervical cancer cases (at least 95%) are due to infection with human papillomaviruses (HPV) that are transmitted through sexual intercourse
- In Uganda, cervical cancer has a high incidence of 56.2 per 100,000 and a high death rate of 41.4 per 100,000 in 2020
- The Uganda MOH recommends screening for cervical cancer for timely prevention and treatment

What this study adds

- Information on spatial and temporal trends of cervical cancer screening among women attending health facilities in Uganda
- Information on spatial and temporal trends of cervical cancer incidence among women attending health facilities in Uganda

Competing interests

The authors declare no competing interests.

Authors' contributions

RN did the conceptualization of the study idea, data analysis, writing, and editing of the manuscript. MN, EJN and LB did data analysis. BK, DK, LB, VN, NN, and ARA provided guidance in the writing and reviewing of the manuscript. All authors read and approved the final manuscript for publication.

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Tables and figures

Table 1: Significance of the trends of cervical cancer incidence from 2017 to 2020 at regional level in Uganda

Figure 1: Trends of incidence, screening rate of cervical cancer, and outpatient reporting rate, Uganda, 2017 -2021

Figure 2: Trends of incidence, screening for cervical cancer, and inpatient reporting rates by region, Uganda, 2017-2021

Figure 3: Spatial distribution of cervical cancer per 100,000 women, Uganda, 2012-2021

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Table 1: Significance of the trends of cervical cancer incidence from 2017 to 2020 at regional level in Uganda			
Region	**IR**	**95% CI**	**P-Value**
Central Region	0.828	0.800 – 0.857	< 0.001
Eastern Region	0.751	0.724 – 0.778	< 0.001
Northern Region	0.908	0.879 – 0.938	< 0.001
Western region	0.818	0.791 – 0.846	< 0.001

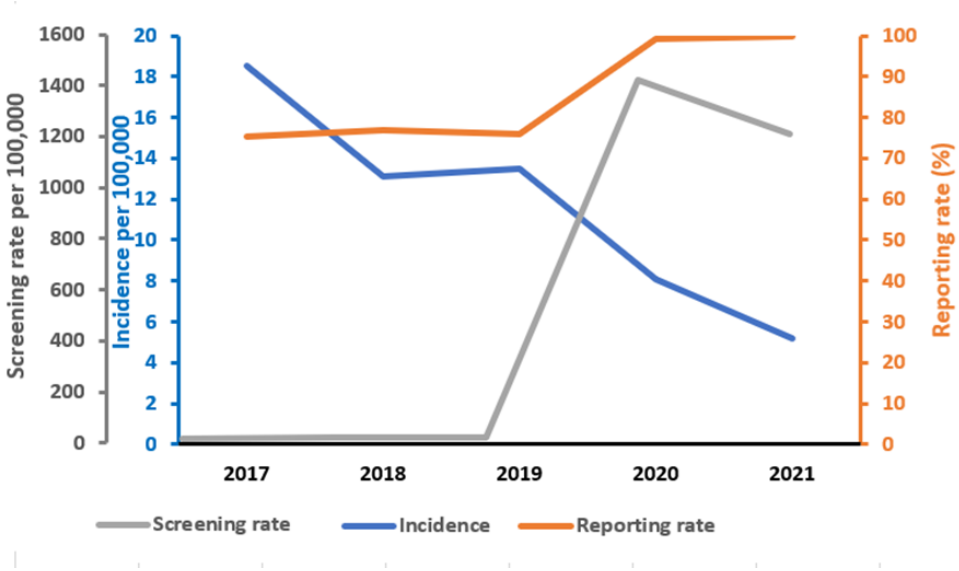

Figure 1: Trends of incidence, screening rate of cervical cancer, and outpatient reporting rate, Uganda, 2017 –2021

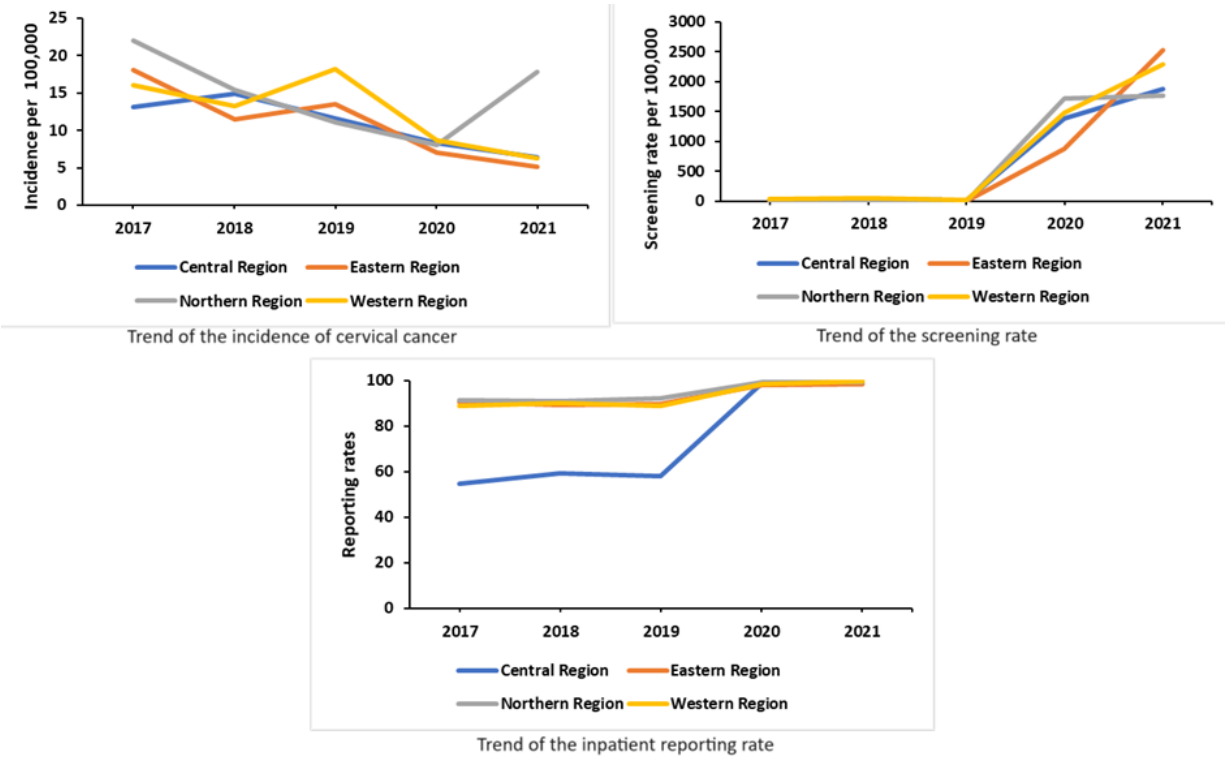

Figure 2: Trends of incidence, screening for cervical cancer, and inpatient reporting rates by region, Uganda, 2017–2021

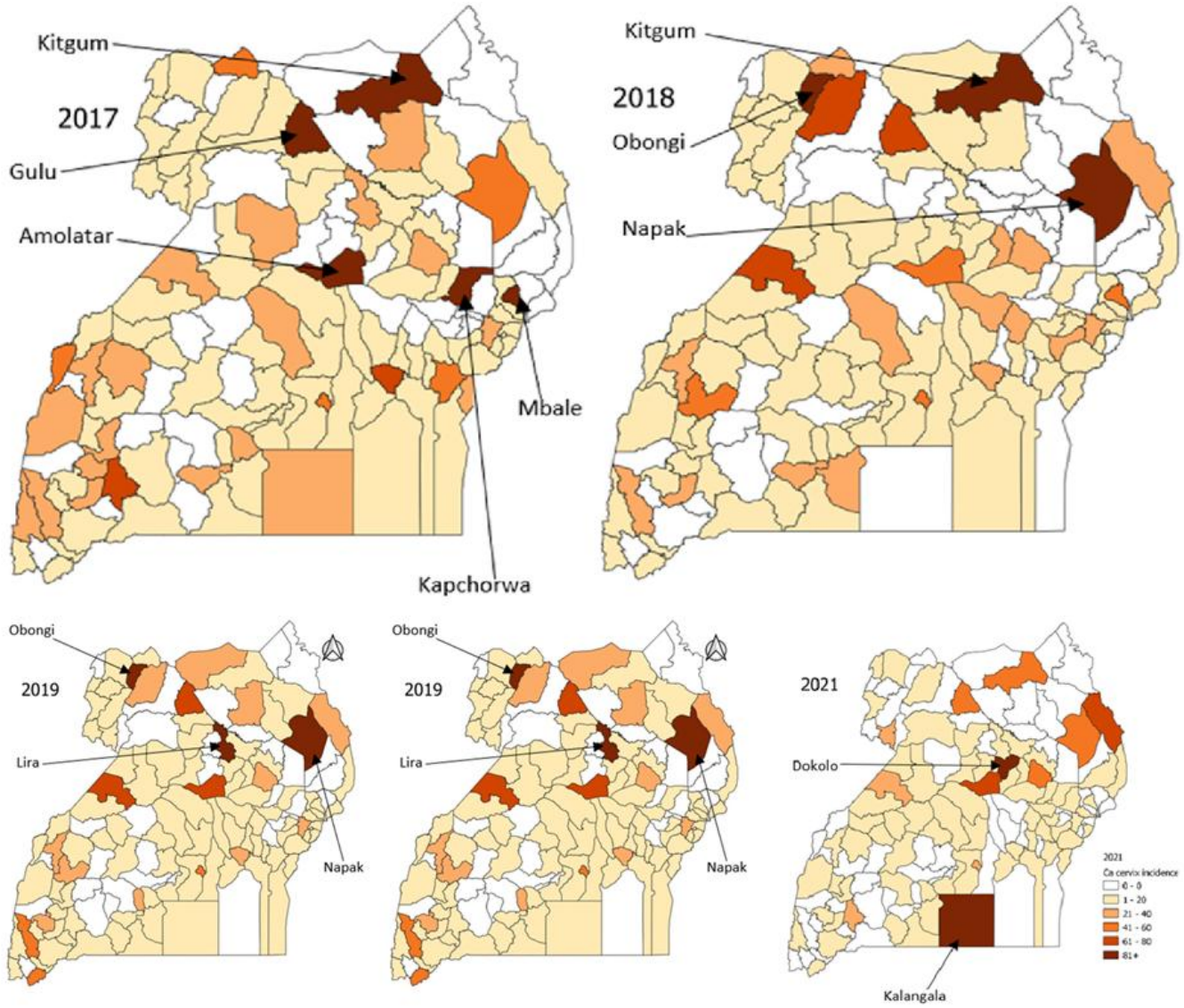

Figure 3: Spatial distribution of cervical cancer per 100,000 women, Uganda, 2012–2021