

Impact assessment of the COVID-19 pandemic on varicella incidence across Europe using digital epidemiology methods

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Introduction

- Although commonly considered a mild disease, varicella may be life-threatening, especially in adolescents and adults, as the risk of severe outcomes rises steadily with age¹⁻³
- Varicella is a seasonal vaccine-preventable disease; the vaccine provides up to 98% effectiveness against moderate and severe varicella.⁴ At the time of analysis, universal varicella vaccination (UVV) had only been introduced in 7 European countries (Finland, Latvia, Hungary, Germany, Italy, Spain, and Greece)^{2,5-7}
- Infection control measures implemented during the COVID-19 pandemic have potentially created an “immunity debt” – time during which transmission of varicella was substantially reduced, increasing the risk for future rebound of the infection due to decreased herd immunity, particularly in countries without UVV⁸
- The burden of varicella is underestimated across Europe due to inadequate varicella surveillance and underreporting, hindering evaluation of any potential changes in varicella dynamics following the COVID-19 pandemic
- Google search query data has previously been used to evaluate trends in the incidence of pediatric infections in the absence of adequate surveillance data and was found to accurately predict the epidemiologic patterns⁹⁻¹¹

Objective

To describe Google search query trends for varicella-related keywords in Europe as a proxy for varicella incidence before and during the COVID-19 pandemic in countries with/without UVV.

Methods

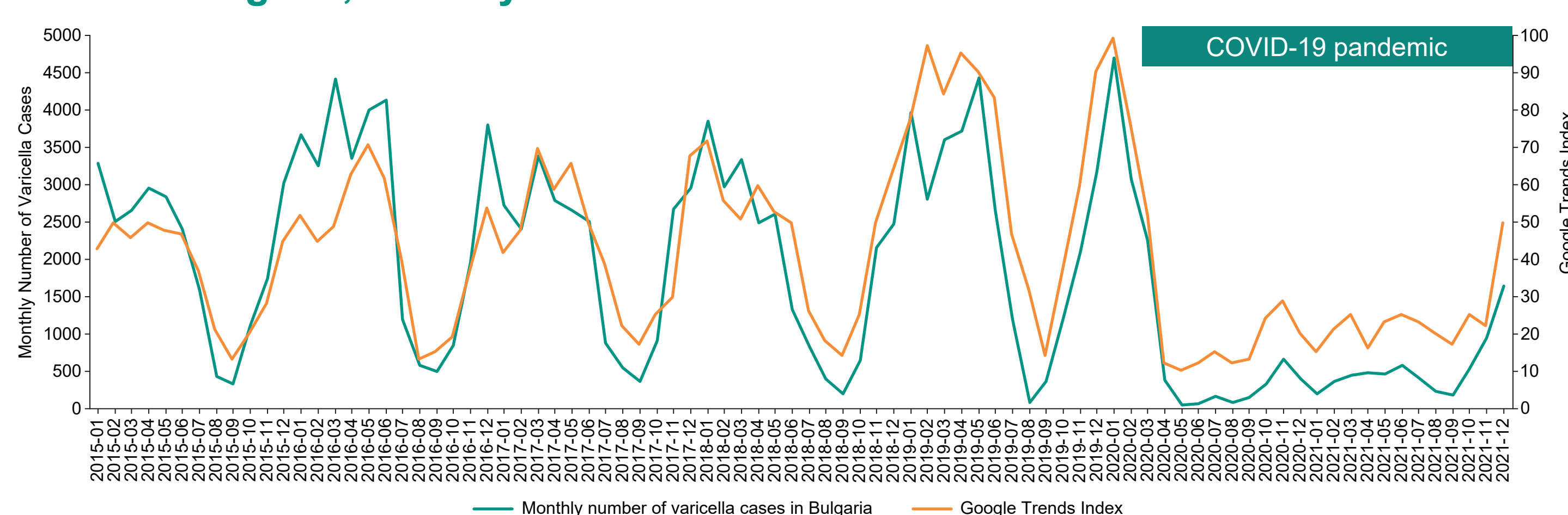
- This study used the publicly accessible keyword research tool Google Trends to evaluate trends in time-series of the relative search query popularity (graded from 0 to 100) of language-specific varicella-related keywords in 28 European countries from January 2015 through December 2021.¹² The Google Ads Keyword Planner tool was used to evaluate absolute search volumes from March 2018 through December 2021¹³
- Long-term trends were assessed for each country individually as well as by country clusters based on UVV status (with UVV vs without UVV)
- Graphs were developed to evaluate the percentage change in absolute query volumes just before and during the pandemic (March 2020 through December 2021) compared with 2-year average volumes during the same months in the pre-pandemic years of 2018 and 2019
- A univariate linear model, which regressed reported varicella cases in Bulgaria, a country where varicella is a mandatory reportable disease and that has no UVV, against relative search query volumes, was developed to assess if search query data can be used as a proxy informing trends in varicella infection rates¹⁴

Results

Search query data – a reasonable proxy to inform dynamics in varicella incidence

- A validation analysis using data from Bulgaria showed a close relationship between the relative search query popularity of varicella keywords and incident cases of clinical varicella (Figure 1)
- In univariate modeling, reported varicella cases corresponded well with values predicted using Google Trends data; the model's adjusted R² was 0.75, indicating that Google Trends data account for a sizable proportion of the variability of reported case data

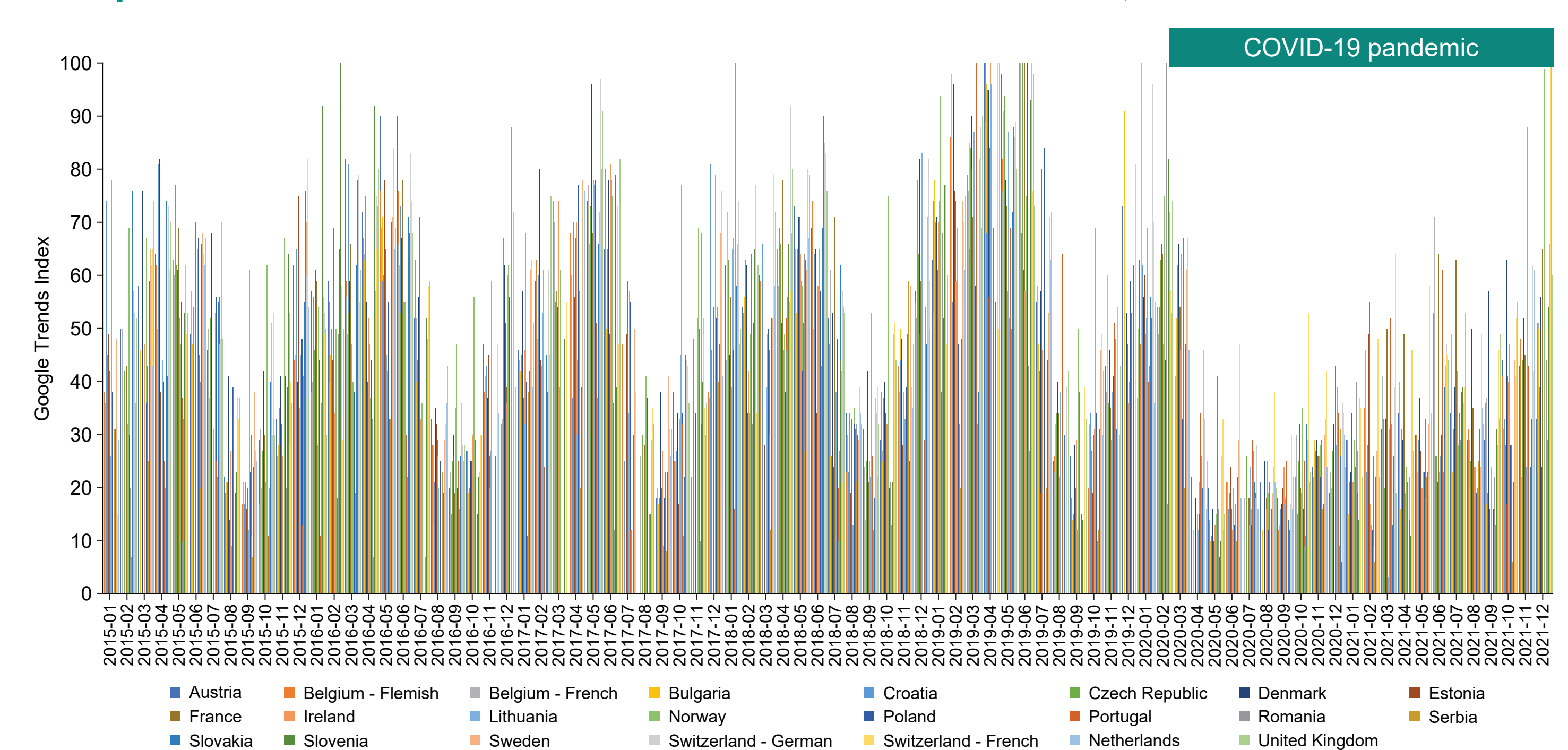
Figure 1. Relative search query popularity of varicella keywords and varicella cases in Bulgaria, January 2015 to December 2021



Seasonal variation in the relative search query popularity of varicella keywords

- In the 5 years preceding the COVID-19 pandemic (2015 through 2019), the relative search query popularity of varicella keywords displayed pronounced seasonal variation in most countries without UVV (Figure 2)
- Seasonal peaks in relative search query popularity occurred in the autumn or winter (October to January) and in the spring (March to June). Seasonal variation was less pronounced in countries with established UVV

Figure 2. Monthly relative search query popularity of varicella keywords in European countries with no universal varicella vaccination, 2015-2021

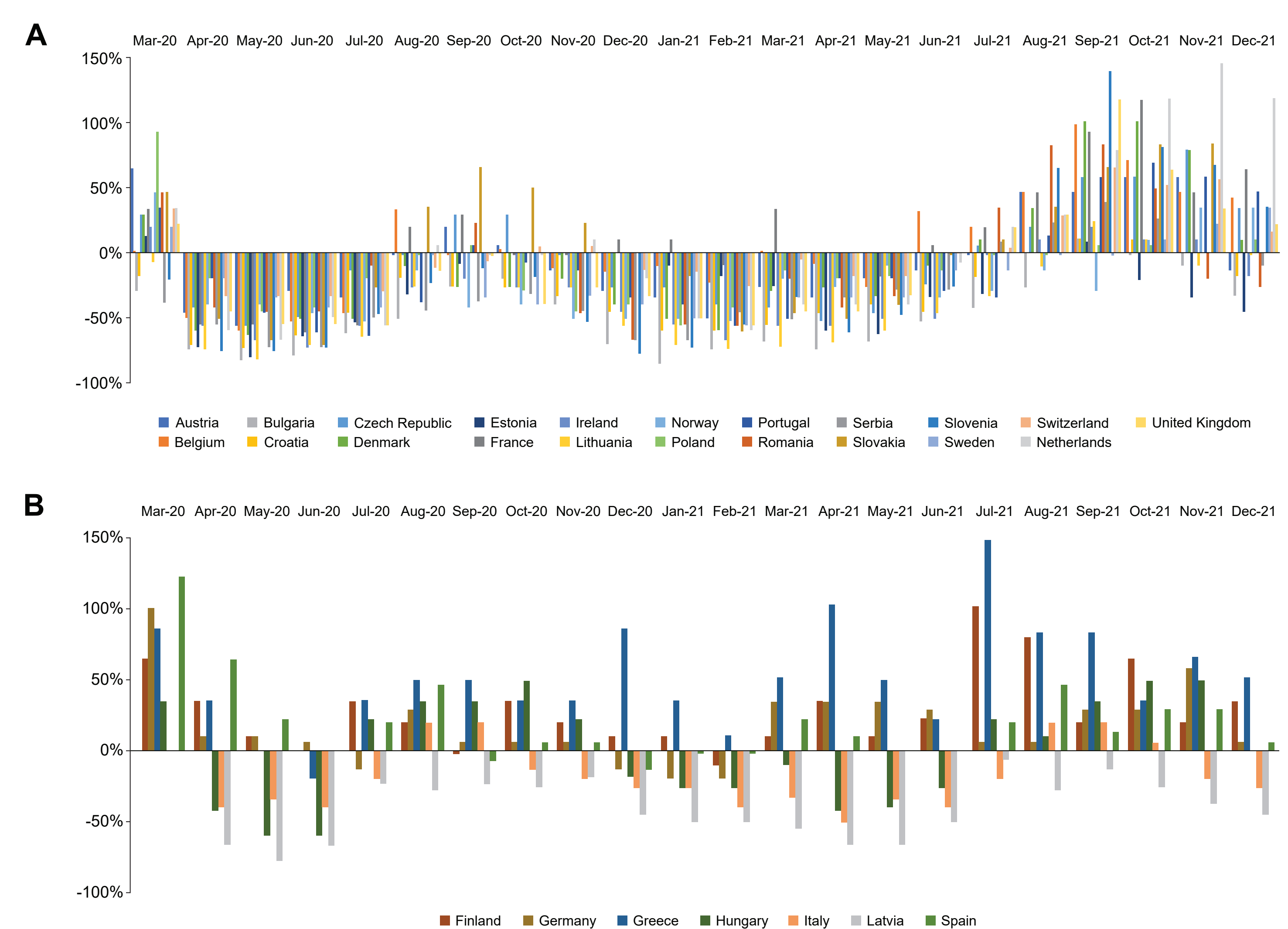


The Google Trends Index is calculated as the number of keyword searches divided by the total number of searches within a specific location and time period; it is standardized to range from 0 (no search activity) to 100 (peak search activity).

The effect of the COVID-19 pandemic on the volume of search queries for varicella keywords

- All 28 countries included in the study recorded abrupt and unseasonal declines in search queries for varicella keywords during the COVID-19 pandemic
- The declines during the first 3 months of the pandemic (April, May, and June 2020) were observed in all countries and in most countries intensified over time, with March to June declines ranging from 33% to 70% in countries with UVV and from 40% to 76% in countries without UVV
- From April 2020 to July 2021, a period of intense COVID-19 transmission and infection control, absolute search volumes for varicella keywords were lower than pre-pandemic levels in most countries with no UVV but rebounded after July 2021, when infection control measures were relaxed. In countries with established UVV, the impact of the COVID-19 pandemic on search behavior was less pronounced than in countries with no UVV (Figure 3)
- An unusual increase in search intensity in the second half of 2021 compared to respective pre-pandemic months potentially indicates a shift in varicella seasonality, especially in countries with no UVV (Figure 3)

Figure 3. Percentage change in monthly absolute search volumes for varicella keywords, March 2020 through December 2021, compared with average search volumes during respective months in 2018 and 2019 in countries A) without UVV and B) with UVV



Percentage change was calculated by comparing the monthly search volumes recorded from March 2020 to December 2021 with the 2-year average of search volumes recorded during respective months in 2018 and 2019.

Disclosures

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Conclusions

Our study demonstrated the potential of internet search query data to evaluate trends in varicella incidence in Europe. Study results suggest that varicella incidence decreased and subsequently rebounded in response to COVID-19 pandemic interventions. Evaluation of search query data may be useful to assess changes in varicella incidence over seasons as well as following major events, such as the COVID-19 pandemic, particularly in countries that lack robust varicella surveillance.