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Comparison of epidemiologic surveillance and Google Trends data on asthma and allergic rhinitis in England

To the Editor,

Epidemiologic surveillance is the '*ongoing systematic collection, analysis, and implementation of health data essential to the planning, implementation and evaluation of public health practices, closely integrated with the timely dissemination of these data*'.[1] Recently, the use of data from internet users' activity—measured with tools such as Google Trends (GTs)—has been proposed to complement 'classical' surveillance approaches.[2] In this context, infectious diseases have been widely studied,[2] but allergic diseases have not, as they are less often targeted by surveillance programmes. In England, however, the Oxford-Royal College of General Practitioners Research Surveillance Centre (RSC) monitors asthma, allergic rhinitis (AR) and respiratory infections, publishing weekly surveillance reports on their incidence. Such reports are based on '*the number of patients* [of all ages] *consulting* [a set of regionally representative primary care centres in England] *with new episodes of illness*', differentiating incident from follow-up consultations[3]; methods for ensuring data quality are routinely applied.[3] English general practice is a highly computerized registration-based system, with computerized medical records following the patient when they move practice, ensuring a reliable rate of disease to be reported.

In this study, we assessed the correlation of English surveillance and GTs data on asthma, rhinitis and upper respiratory tract infections (URTI) to assess whether similar patterns can be observed with these two different approaches.

We retrieved weekly surveillance data from the RSC reports on the incidence in England per 100,000 inhabitants of 'AR', 'asthma', 'URTI' and 'common cold' (a subset of URTI) for a period of 4 years (January 2016–January 2020).[3]

We then used GTs to retrieve relative search volume data for the topics 'AR', 'pollen', 'asthma' and 'common cold' (topics are groups of search terms concerning the same concept) for England during the same time period. Some of these topics had been previously used.[4] Weekly surveillance and GTs data were correlated using Spearman correlation coefficients (ρ).

Using English surveillance data, 'asthma' incidence was strongly correlated with 'common cold' incidence (ρ = 0.800) and 'URTI' (ρ = 0.765), but negatively correlated with 'AR' incidence (ρ = −0.517) (Table 1; Figure 1).

GTs data on 'asthma' were moderately correlated with GTs data on 'common cold' (ρ = 0.556) and negatively correlated with GTs on 'AR' (ρ = −0.361). GTs data on 'AR' and 'pollen' were strongly correlated (ρ = 0.915).

GTs data on 'common cold' displayed a strong correlation with English surveillance data on 'asthma' (ρ = 0.716), 'common cold' (ρ = 0.780) and 'URTI' (ρ = 0.722). 'AR' incidence was strongly correlated with GTs data on 'AR' (ρ = 0.902) and 'pollen' (ρ = 0.866).

This study has some limitations, the most important being its ecological design and the assessment of single-country data. We analysed 2016–2019 data, as the COVID-19 pandemic could have influenced our results (in March 2020, there was a media-driven GTs peak for asthma,[5] and increased inhalers prescriptions). However, we obtained similar results when analysing 2016–2021 data (Table S1).

Correlation does not imply causation, so we must be careful when interpreting results. Nevertheless, applying the Granger causality test for positive correlations (which assesses whether one time series is useful in forecasting another), we mostly observed biologically plausible results, with time series on URTI/common cold being useful to forecast asthma, and asthma time series not being useful to forecast URTI/common cold (Table S2).

The incidence of 'asthma' was strongly and positively correlated with that of 'URTI', but negatively correlated with that of 'AR' and with GTs data on 'pollen'/'AR'. These results are mostly explained by the different seasonality of AR and asthma, and suggest that, even though AR and pollen exposure may be linked to worsening asthma, viral infections may be a more relevant trigger for asthma exacerbations (as previously shown using GTs for 'common cold' and asthma hospitalizations in five countries[6]).

Strong correlations were also observed between surveillance and GTs data on 'AR' incidence, suggesting the potential of GTs as a complementary tool in rhinitis monitoring.

On the other hand, GTs data on 'pollen'/'AR' displayed negative correlations with GTs and surveillance data on 'common cold', suggesting that patients and primary care teams may know how to distinguish seasonal allergies from URTI (which are less common during pollen season) despite some common symptoms.

Taken together, these results point to the complementarity of classical surveillance and of GTs data (even though GTs does not solely assess incident disease and may be influenced by media coverage[5]). For example, for each topic, GTs displays a list of the top-related queries searched by internet users, possibly helping to context epidemiologic fluctuations and to raise new hypotheses (eg, on exacerbations

TABLE 1 Spearman correlation coefficients [95% confidence intervals] between surveillance data (cases *per* 100,000 inhabitants) and Google Trends data for England (3 January 2016–6 January 2020)

	Surveillance data				Google Trends data		
	Asthma	Upper respiratory tract infections	Common cold	Allergic rhinitis	Asthma	Common cold	Pollen
Surveillance data							
Upper respiratory tract infections	0.765[0.699;0.820]	–	–	–	–	–	–
Common cold	0.800 [0.733;0.845]	0.987 [0.980;0.990]	–	–	–	–	–
Allergic rhinitis	−0.517 [−0.601;−0.420]	−0.517 [−0.586;−0.433]	−0.580 [−0.650;−0.505]	–	–	–	–
Google Trends data							
Asthma	0.490 [0.380;0.593]	0.474 [0.352;0.573]	0.480 [0.349;0.586]	−0.426 [−0.535;−0.303]	–	–	–
Common cold	0.716 [0.644;0.773]	0.722 [0.659;0.774]	0.780 [0.729;0.819]	−0.835 [−0.868;−0.795]	0.556 [0.458;0.647]	–	–
Pollen	−0.639 [−0.706;−0.563]	−0.637 [−0.690;−0.573]	−0.701 [−0.750;−0.642]	0.866 [0.813;0.902]	−0.320 [−0.444;−0.197]	−0.816 [−0.849;−0.774]	–
Allergic rhinitis	−0.628 [−0.695;−0.549]	−0.634 [−0.697;−0.557]	−0.693 [−0.753;−0.628]	0.902 [0.859;0.930]	−0.361 [−0.474;−0.250]	−0.808 [−0.841;−0.772]	0.915 [0.875;0.943]

Colour code: Bright green – Spearman correlation coefficient ≥0.800; Dull green – Spearman correlation coefficient ≥0.600 and <0.800; Yellow – Spearman correlation coefficient ≥0.400 and <0.600; Bright orange – Spearman correlation coefficient ≥−0.400 and <0.400; Dull orange – Spearman correlation coefficient ≥−0.600 and <−0.400; Dull pink – Spearman correlation coefficient ≥−0.800 and <−0.600; Bright pink – Spearman correlation coefficient ≤−0.800.

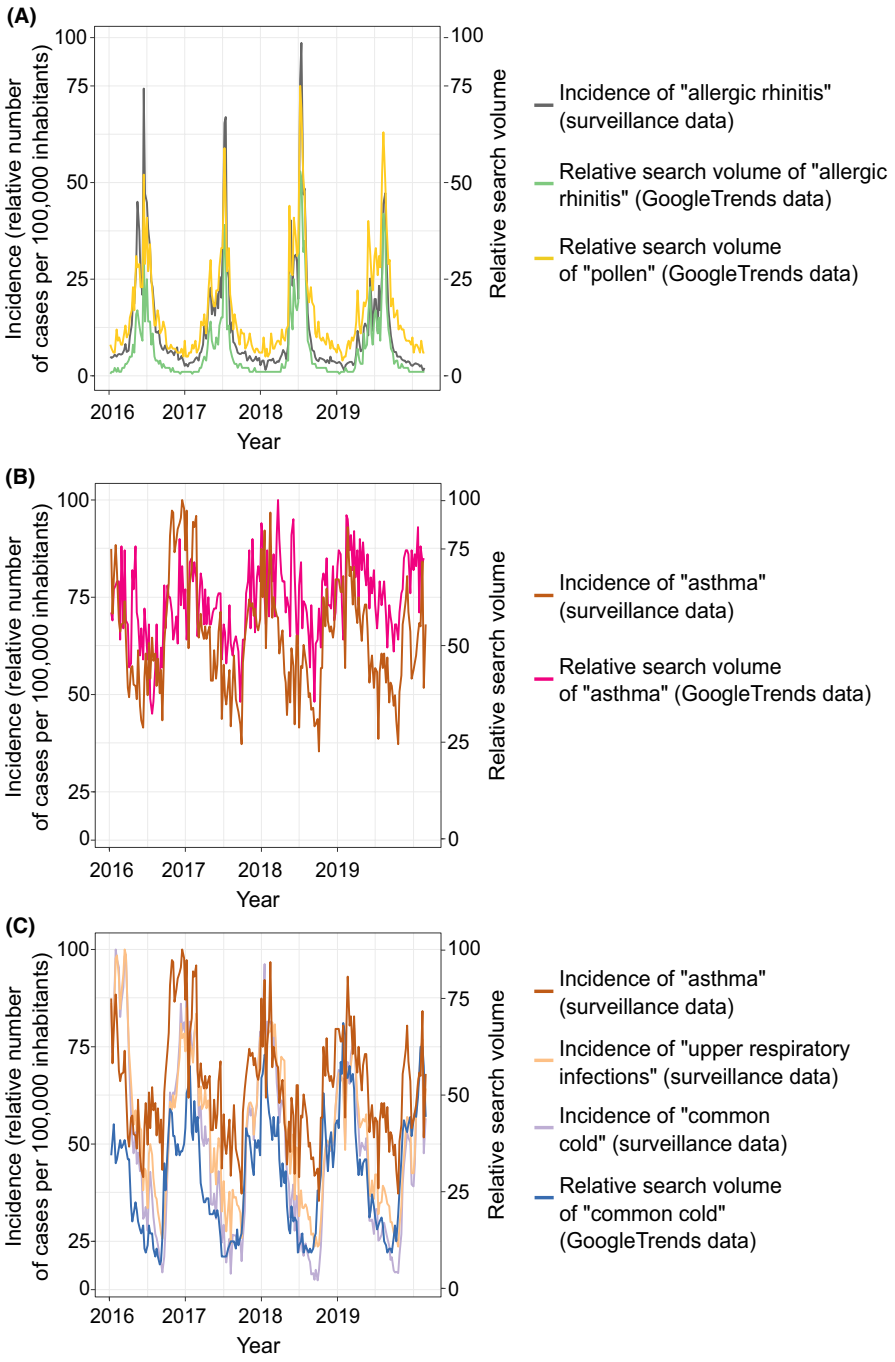

FIGURE 1 Surveillance and Google Trends data on allergic rhinitis (A), asthma (B) and upper respiratory infections for England (C) (3 January 2016–6 January 2020)

triggers). In addition, analysis of GTs data may possibly help planning health care needs for allergic respiratory diseases (as in most countries surveillance of asthma or AR does not occur).

KEYWORDS

asthma, epidemiology, respiratory infections, rhinitis, surveillance

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CONFLICT OF INTEREST

None declared.

Bernardo Sousa-Pinto[1,2]
Josep M. Antó[3,4,5,6]
Aziz Sheikh[7]
Simon de Lusignan[8,9]
Tari Haahtela[10]
João Almeida Fonseca[1,2]
Jean Bousquet[11,12,13,14]

[1]*MEDCIDS – Department of Community Medicine, Information and Health Decision Sciences, Faculty of Medicine, University of Porto, Porto, Portugal*
[2]*CINTESIS – Center for Health Technology and Services*

Research, University of Porto, Porto, Portugal
[3]*ISGlobal, Barcelona Institute for Global Health, Barcelona, Spain*
[4]*Universitat Pompeu Fabra, Barcelona, Spain*
[5]*IMIM – Hospital del Mar Medical Research Institute, Barcelona, Spain*
[6]*CIBER Epidemiología y Salud Pública – CIBERESP, Barcelona, Spain*
[7]*Usher Institute, University of Edinburgh, Edinburgh, UK*
[8]*Nuffield Department of Primary Care Health Sciences, University of Oxford, Oxford, UK*
[9]*Royal College of General Practitioners Research and Surveillance Centre, London, UK*
[10]*Skin and Allergy Hospital, Helsinki University Hospital, and University of Helsinki, Helsinki, Finland*
[11]*Charité, Universitätsmedizin Berlin, Humboldt-Universität zu Berlin, Berlin, Germany*
[12]*Department of Dermatology and Allergy, Comprehensive Allergy Center, Berlin Institute of Health, Berlin, Germany*
[13]*MACVIA-France, Montpellier, France*
[14]*University Hospital, Montpellier, France*

Correspondence
Jean Bousquet, CHU Arnaud de Villeneuve, 371 Avenue du Doyen Gaston Giraud, 34295 Montpellier Cedex 5, France.
Email: jean.bousquet@orange.fr

ORCID

Bernardo Sousa-Pinto https://orcid.org/0000-0002-1277-3401
Tari Haahtela https://orcid.org/0000-0003-4757-2156
Jean Bousquet https://orcid.org/0000-0002-4061-4766

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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Needle-free epicutaneous For t 2 DNA vaccine is effective for preventing and treating biting midge *Forcipomyia taiwana* allergy in a murine model

To the Editor,

Allergen-specific immunotherapy (ASIT) remains the only treatment capable of inducing immune tolerance to the corresponding allergen and potentially treating the root cause of the allergic disease.[1] As the treatment course of protein-based vaccines for ASIT is time-consuming, an easily administered epicutaneous anti-allergic DNA-based vaccine is an attractive method, especially in light of the COVID-19 pandemic.[2]

The biting midge, *Forcipomyia taiwana*, is the most prevalent cause of biting insect allergy in Taiwan. It is a tiny hematophagous midge that attacks en masse. As many as 60% of exposed individuals develop allergic reactions to the bites.[3] The midge is widely distributed throughout Taiwan and southern China. For t 2 is the most predominant, with 75% of midge-allergic patients showing specific IgE to For t 2.[4] Allergic reactions to midge bites are not limited to humans but also seen in livestock, such as horses, cattle, sheep, and donkeys, causing significant veterinarian problems.

Escherichia coli-expressed For t 2 recombinant protein (rFor t 2) was used as an allergen to sensitize and challenge the mice.[5] For t 2-encoding fragment (GenBank accession EU678971) was amplified by PCR. The PCR products were subcloned into pVAX1 (Life Technologies). The experiments were designed using two approaches: therapeutic and prophylactic (Figure 1). The therapeutic approach is to imitate ASIT in human with established allergy while the prophylactic approach to non-allergics. Twenty-five μg For t 2 DNA was determined as the optimal dose after dose-finding experiments (Figure S1). For each treatment, the hair of the abdominal area of the mice was removed using a depilatory, tape-stripped, then patched with 25 μg For t 2 DNA vaccine for 1 h and removed. A total of three treatments were given spaced 1 week