

the risks of bias, for example, funding from pharmaceutical industry, might exist. Our findings suggest that dupilumab is a promising anti-AD medication, due to its specific action directed at the underlying mechanisms of AD, resulting in its good efficacy and safety profile in patients with severe AD. However, further investigations still need to be performed in future studies to evaluate the long-term efficacy and safety of dupilumab for the treatment of AD.

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Assessment of thunderstorm-induced asthma using Google Trends



To the Editor:

Google Trends (GT), a Web-based surveillance tool, uses Google to explore the searching trends of specific queries. GT may predict the outbreak of many diseases. In Germany, correlations between the patient-based, combined symptom medication score and GT data are stronger than those with the regionally measured pollen count data.¹ Search activities using GT for terms such as “allergy,” “allergies,” and “pollen” correlate strongly with observed pollen counts.^{2,3} GT reflects the real-world epidemiology of symptomatic allergic rhinitis and could potentially be used to monitor allergic rhinitis.⁴ Seasonality of allergic rhinitis was found using Internet searches and correlated with pollen counts.³ Twitter data, Google search interests, and environmental sensor data can also be used to predict the number of asthma-related emergency department visits in an area.⁵

Studies on thunderstorm-induced asthma have convincingly shown that grass pollen can induce severe asthma exacerbations when climatic conditions and pollen exposure are associated.^{6,7} It is possible that such outbreaks can be observed using GT. Two recent outbreaks with several asthma deaths were observed in Melbourne, Australia, November 20, 2016, and in Kuwait, December 2, 2016.

In the present study, we used GT to compare terms related to asthma, allergy, and rhinitis in 10 countries from 2004 to December 20, 2016. The aims of the study were (1) to assess whether GT could report the recent thunderstorm asthma outbreak in Australia and Kuwait and (2) to determine whether such an outbreak could be found in other countries over the past 13 years.

The following terms were used: “rhinitis,” “allergic rhinitis,” “hay fever,” “asthma,” “pollen,” and “allergy” (disease and term). However, only “allergy,” “allergic rhinitis,” “asthma,” and “pollen” were analyzed because “rhinitis” as a term or “hay fever” were labeled as “allergic rhinitis disease.” Only “diseases” and “subjects” are translated by GT, whereas “terms” are not translated. Major antirhinitis (eg, loratadine and cetirizine) or antiasthma (eg, Salbutamol and Seretide) medications were studied. Intranasal and inhaled corticosteroids could not be differentiated using GT and were not used in the study.

We examined GT queries from January 1, 2004 (starting date of GT), to December 20, 2016, for “all countries” and from January 2011 to December 20, 2016, for the 5 most populated European Union countries (ie, France, Germany, Italy, Spain, and the United Kingdom), as well as Australia, Canada, New Zealand, and the United States. Only temperate and continental climatic zone countries were studied because allergen exposure may vary with other climatic zones. We added Kuwait because a severe thunderstorm-induced asthma outbreak occurred on December 2, 2016.

The prediction of the asthma outbreak using “allergic rhinitis,” “allergy,” “pollen,” or “rhinitis medications” queries was not tested because a more detailed analysis should be carried out focusing on the region of the thunderstorm.

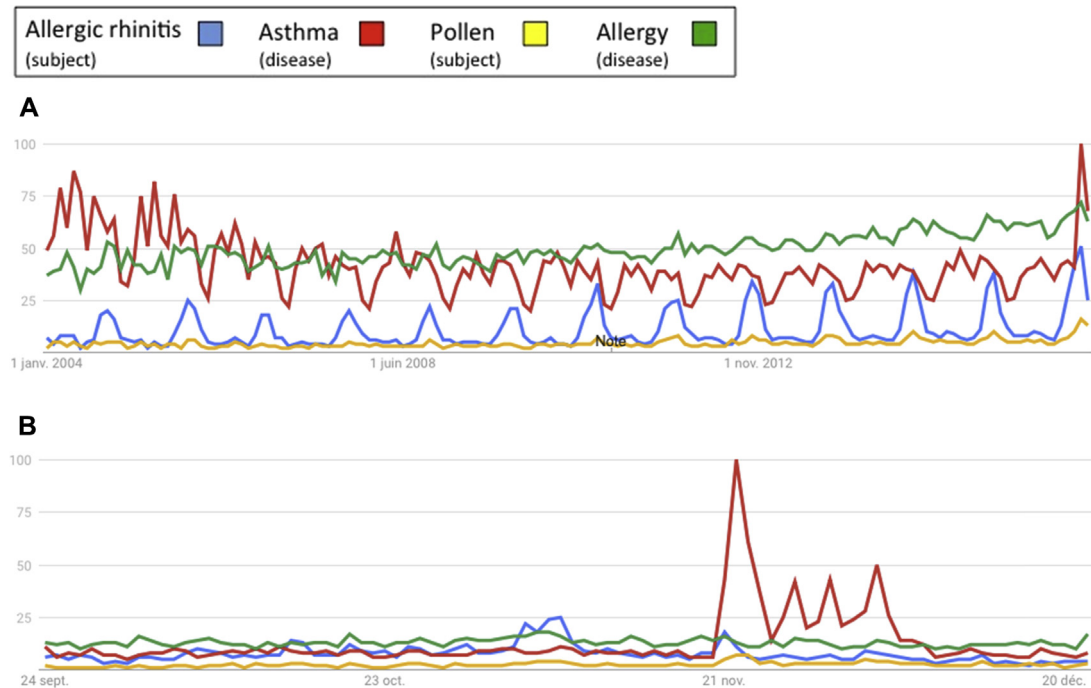


FIG 1. Queries reported by GT in Australia. **A**, Five-year trend: January 1, 2004, to December 20, 2016. **B**, Ninety-day trend: September 24, 2016, to December 20, 2016.

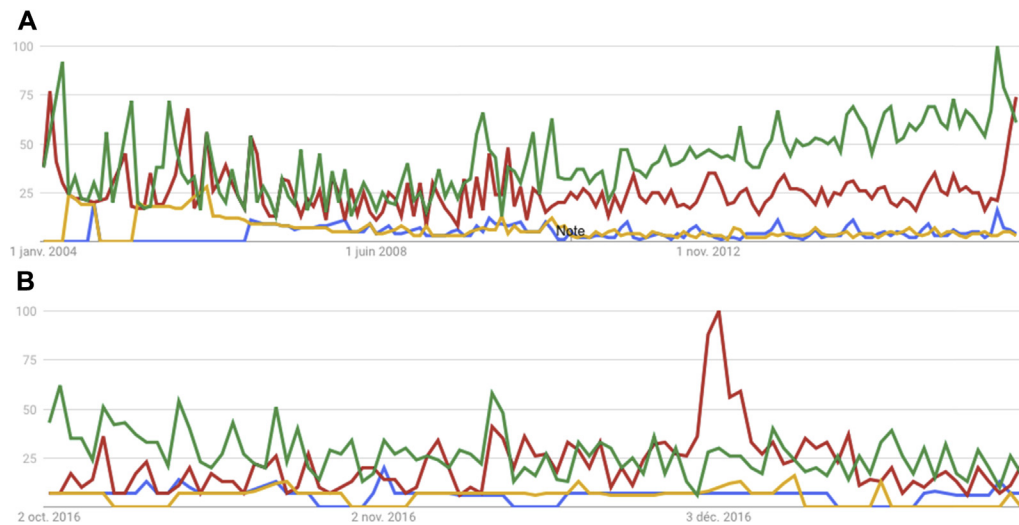


FIG 2. Queries reported by GT in Kuwait. **A**, Five-year trend: January 1, 2004, to December 20, 2016. **B**, Ninety-day trend: September 24, 2016, to December 20, 2016.

When the trends for “all countries” were analyzed over the 13-year survey, the yearly trends were comparable for the 4 terms between years (see Fig E1 in this article’s Online Repository at www.jacionline.org). Trends for “allergy” were far higher than for the other terms. Peaks were identified for “allergy” and “hay fever” but there was no clear trend for asthma. Seasonal trends were observed for “cetirizine,” “loratadine,” and “fexofenadine” from 2008 to 2016 (see Fig E2 in this article’s Online Repository at www.jacionline.org). However, there was no seasonality trend for

asthma linked with “allergy,” “pollen,” or “allergic rhinitis” terms or for antiasthma medications.

When trends for the different countries were analyzed, GT was able to clearly demonstrate a sharp and extremely important increase in “asthma” queries in Australia (Fig 1, A and B) and Kuwait (Fig 2, A and B). The peak of queries started on the day of the asthma outbreak and asthma queries returned to baseline within 3 weeks. There was no association between “asthma” and “asthma medication” queries.

The examination of trends from 2004 to 2016 showed no other apparent peak of asthma queries using GT from 2004 to December 20, 2016, in the 8 other countries selected (see Fig E3 in this article's Online Repository at www.jacionline.org). However, the analysis of the 5-year period (2011-2016) showed 2 peaks of asthma queries, one associated with "allergic rhinitis," "pollen," and/or "allergy" in New Zealand (November 2016) and a second apparently independent peak (see Fig E4 in this article's Online Repository at www.jacionline.org). The thunderstorm asthma outbreaks that occurred in Italy in 2004 and 2010 and in Australia in 2010 could not be identified using the country trends (13-, 5-, and 1-year graphs).

Trends for asthma outbreaks were of similar importance to those for flu outbreaks in Australia and Kuwait (see Fig E5 in this article's Online Repository at www.jacionline.org).

Seasonality can be found using 13- and 5-year GT graphs for "allergy," "hay fever," "pollen," and H₁-antihistamines. Some seasonality may be observed for asthma, but it is independent of "allergy" or "hay fever." Asthma outbreaks can be clearly identified.

This study cannot avoid the possible misclassification of asthma, allergy, and rhinitis, and reporting of the terms differs between countries. The 5-year queries regarding "hay fever" and "pollen" differed between countries and there may be country-specific queries. However, the same seasonal trends exist for "allergy," "hay fever," "pollen," and "rhinitis medications."

The 2016 Australia and Kuwait asthma outbreaks were clearly demonstrated using GT. Such a pattern was also possibly found in New Zealand. The thunderstorm asthma outbreaks that occurred in Italy in 2004 and 2010 and in Australia in 2010 could not be identified probably because of the small number of affected people. The asthma outbreak was at least more visible than flu.

Significant spikes in the Google search can be found with increased awareness of a disease by news media and marketing media.⁸ In Europe, late December 2016, spikes for "allergy," "asthma," "pollen," or "allergic rhinitis" were associated with the awareness of thunderstorm asthma in Australia and Kuwait.⁹

There is no correlation between "rhinitis" or "pollen" and "asthma" in any of the surveyed countries except for the 2016 November asthma outbreak of Australia and possibly for 1 year in New Zealand. However, the asthma outbreak in Kuwait appeared to be independent of "allergy," "hay fever," or "pollen." This study shows that seasonal asthma can be identified by GT when there is a severe asthma outbreak, but is not reported elsewhere. However, more precise analyses are needed to investigate subtle trends.

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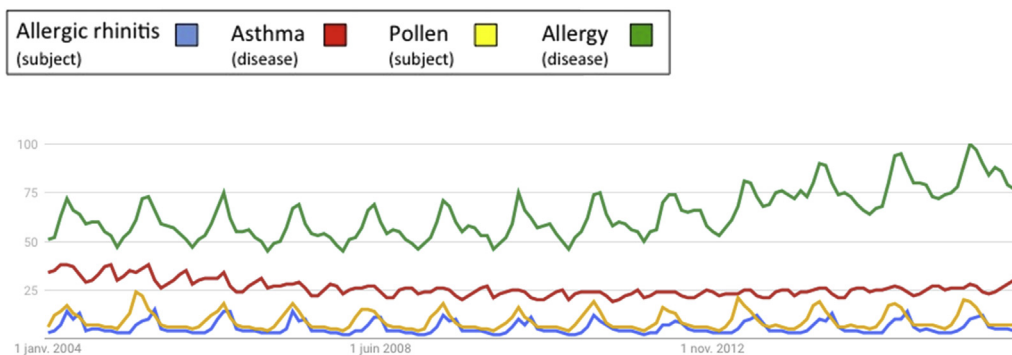


FIG E1. Queries reported by GT in all countries (January 1, 2004, to December 20, 2016). This figure shows the queries concerning “allergic rhinitis,” “asthma,” “pollen,” and “allergy” for 13 years in all countries. There is an annual peak for all queries but asthma. The peak is at the same time in all countries. These data suggest that GT may be of help to inform patients about the allergy season in an alert system.^{E1}

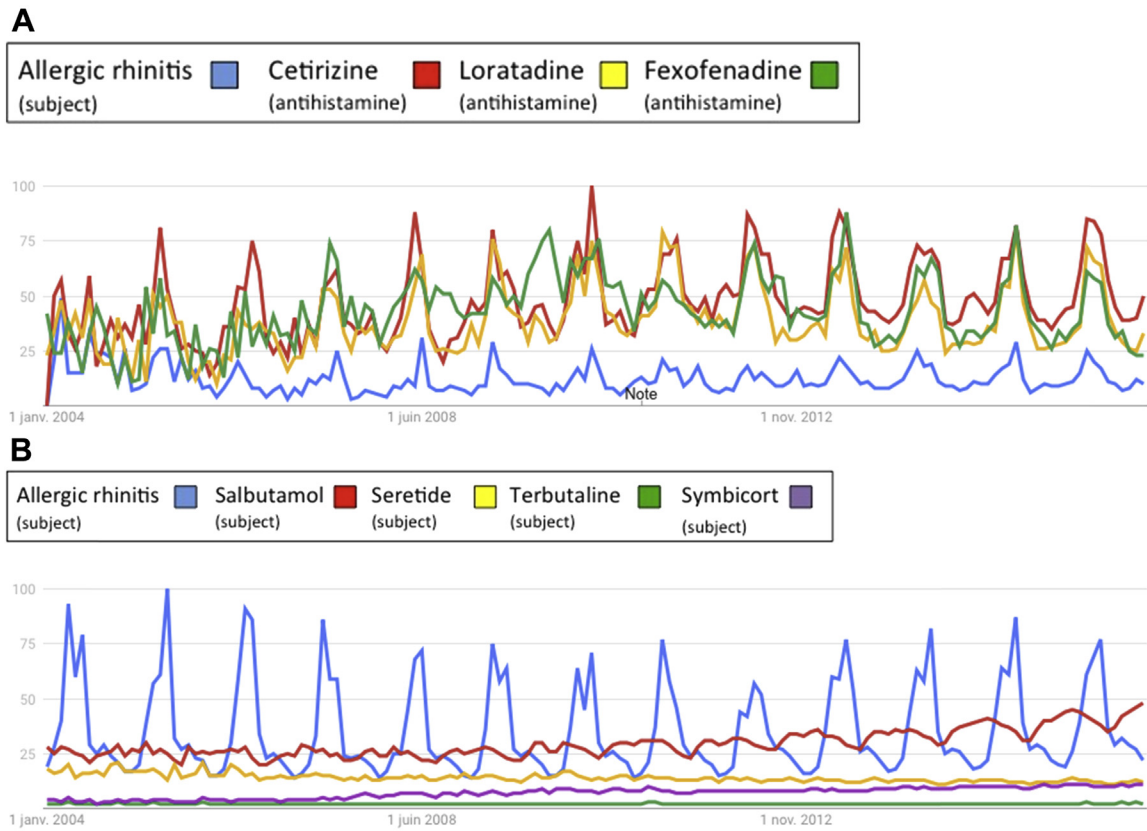


FIG E2. GT for medication in all countries (January 1, 2004, to December 20, 2016). This figure shows the queries concerning “allergic rhinitis,” “cetirizine,” “loratadine,” and “fexofenadine” (**A**: antihistamines) for 13 years in all countries. After 2007, there is an annual peak for all queries in most years. However, there are some peaks unrelated to allergic rhinitis for fexofenadine. The peak is at the same time in all countries. This figure indicates that medications represent a proxy for allergic rhinitis. For antiasthma medications (**B**), there is a peak for “salbutamol” that does not correspond to the annual peak of antihistamines.

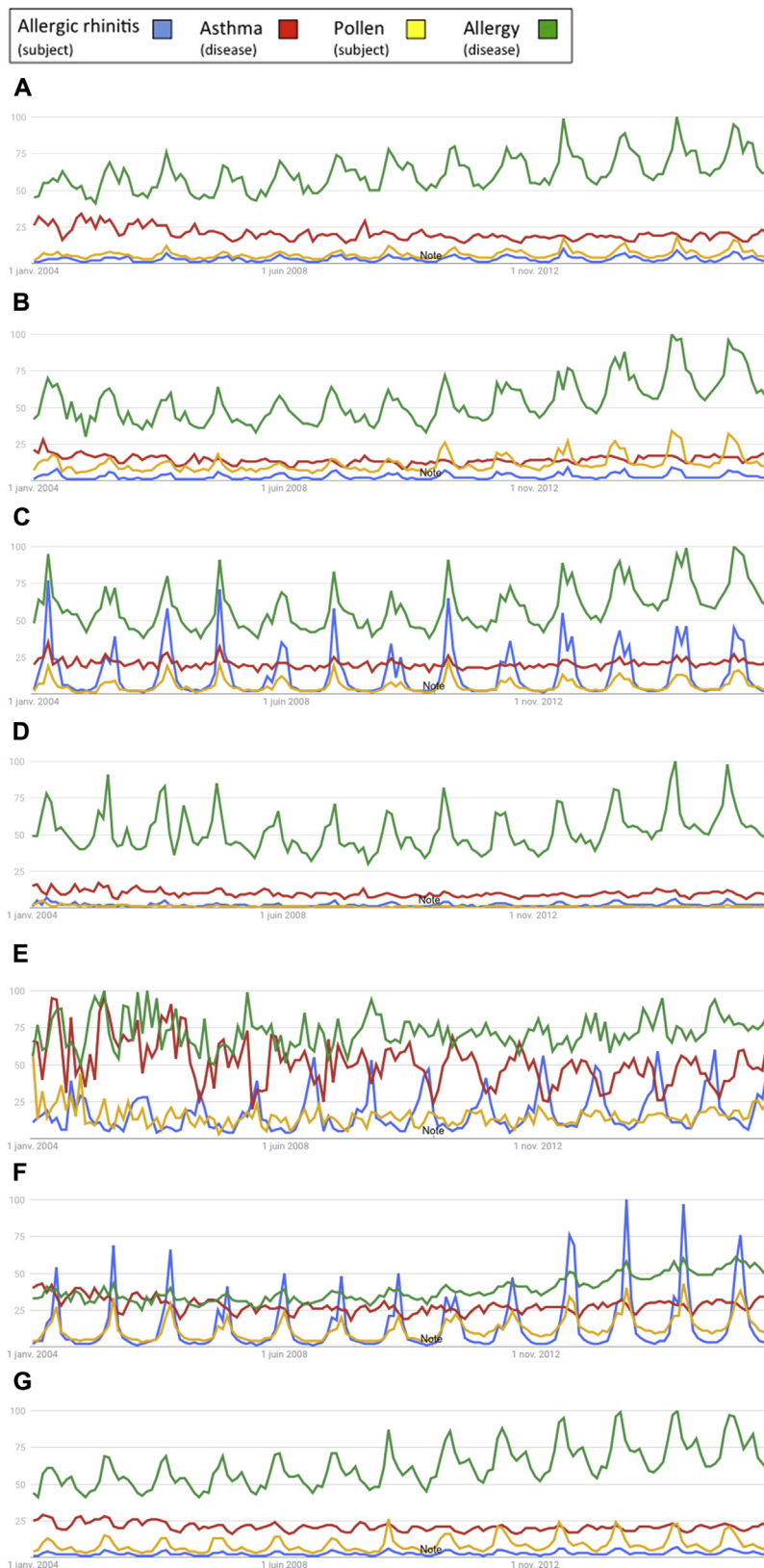


FIG E3. Google searches (January 1, 2004, to December 20, 2016). This figure shows the queries concerning “allergic rhinitis,” “asthma,” “pollen,” and “allergy” (A) for 13 years in all countries. After 2007, there is an annual peak for “allergy” in most years except in the United Kingdom. However, there are country-specific patterns for “pollen” or “allergic rhinitis.” These results accord with a recent article that showed that different terms were found to demonstrate seasonality depending on the country, namely, “hay fever,” “allergy,” and “pollen,” showing cultural differences. A single set of terms cannot be used across all European countries, but allergy seasonality can be compared across Europe provided the above 3 terms are used.^{E2} A, Canada. B, France. C, Germany. D, Italy. E, New Zealand. F, United Kingdom. G, United States.

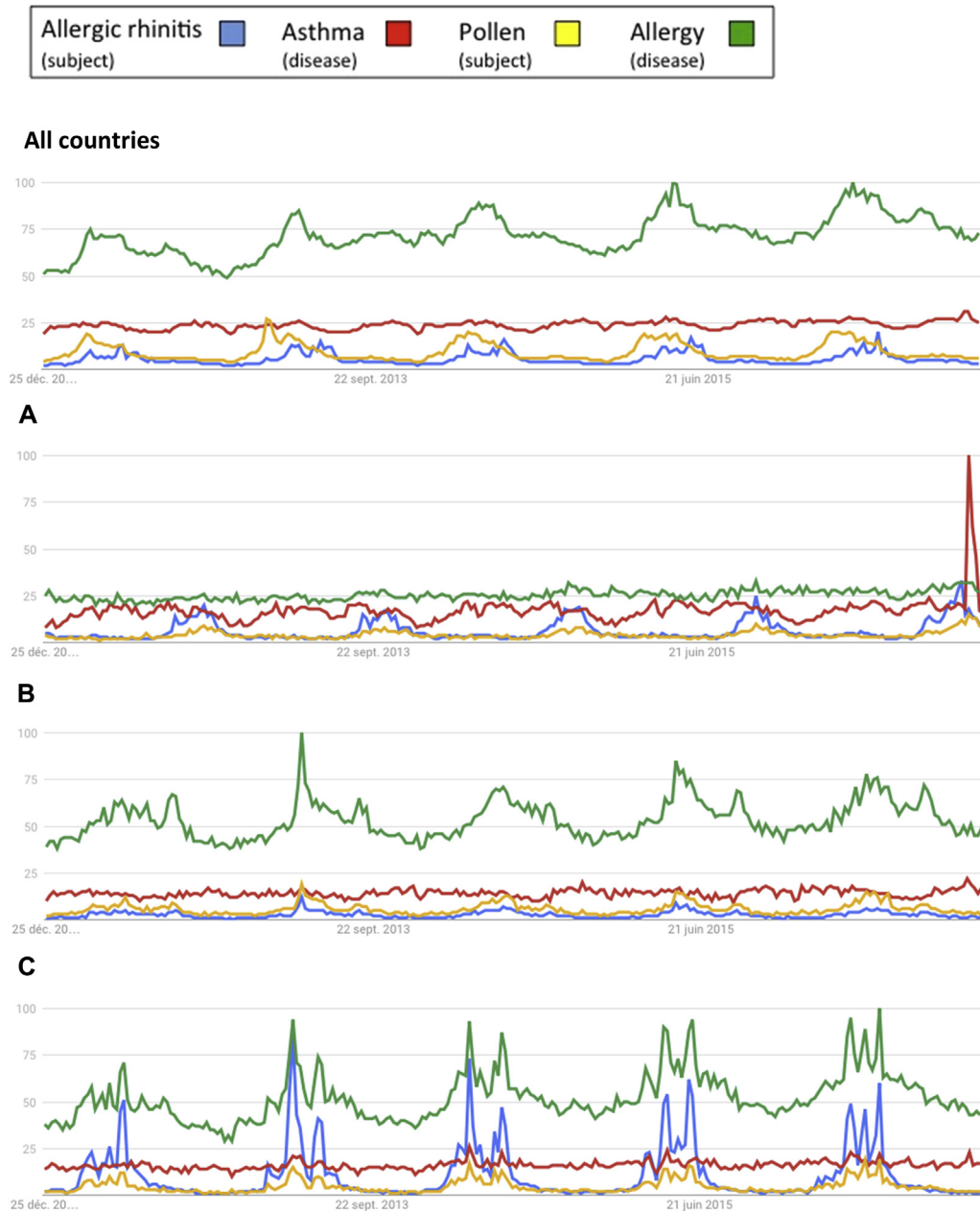


FIG E4. Google searches (December 25, 2011, to December 20, 2016). This figure shows the queries concerning "allergic rhinitis," "asthma," "pollen," and "allergy" for the past 5 years in all countries and selected countries. There is an annual peak for some queries on "allergic rhinitis" or "pollen" or "allergy" but none for asthma. However, at the time of the thunderstorm-induced asthma outbreak in Australia, there is a sharp peak for "asthma." It is clear that the only peak was found in Australia. **A**, Australia. **B**, Canada. **C**, Germany. **D**, Italy. **E**, New Zealand. **F**, United Kingdom. **G**, United States.

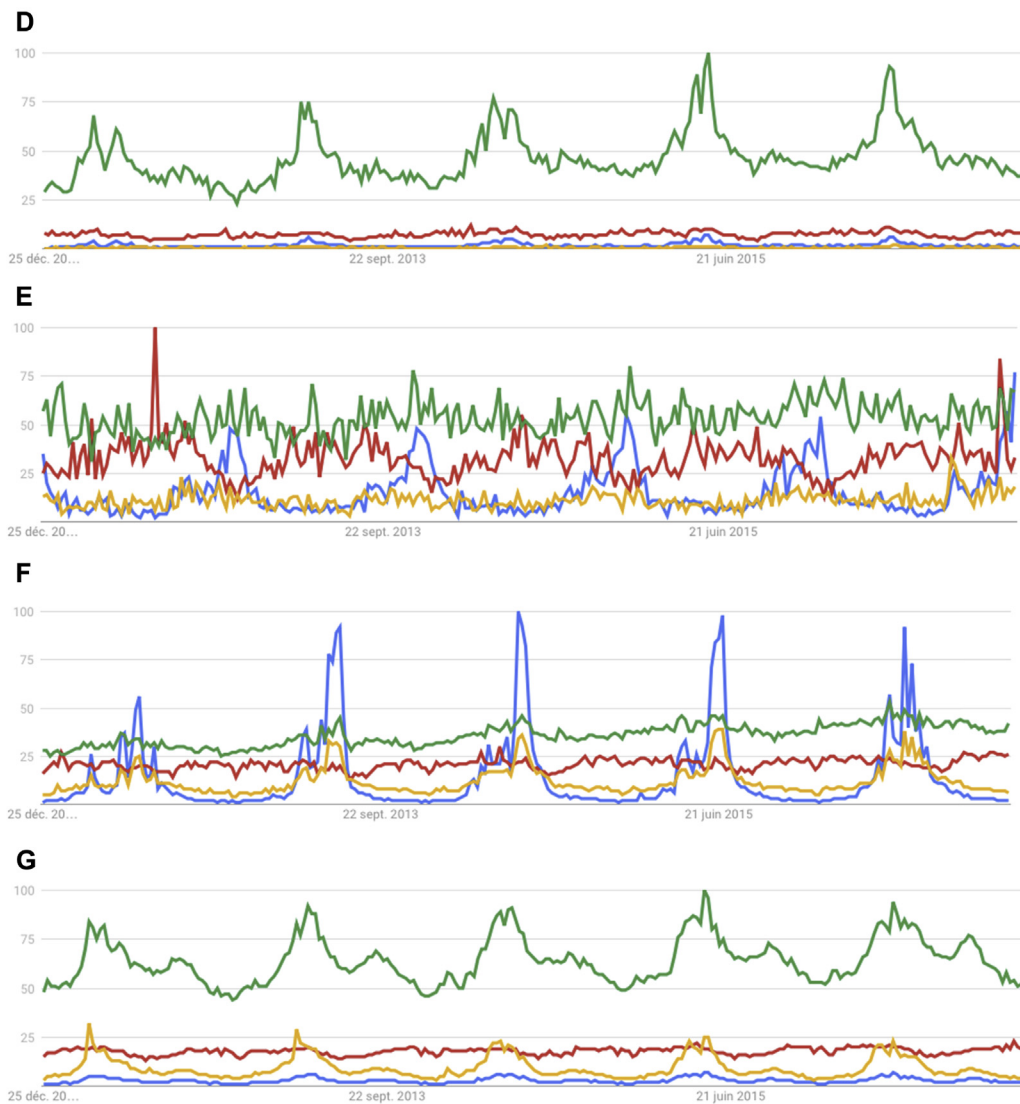


FIG E4. (Continued).

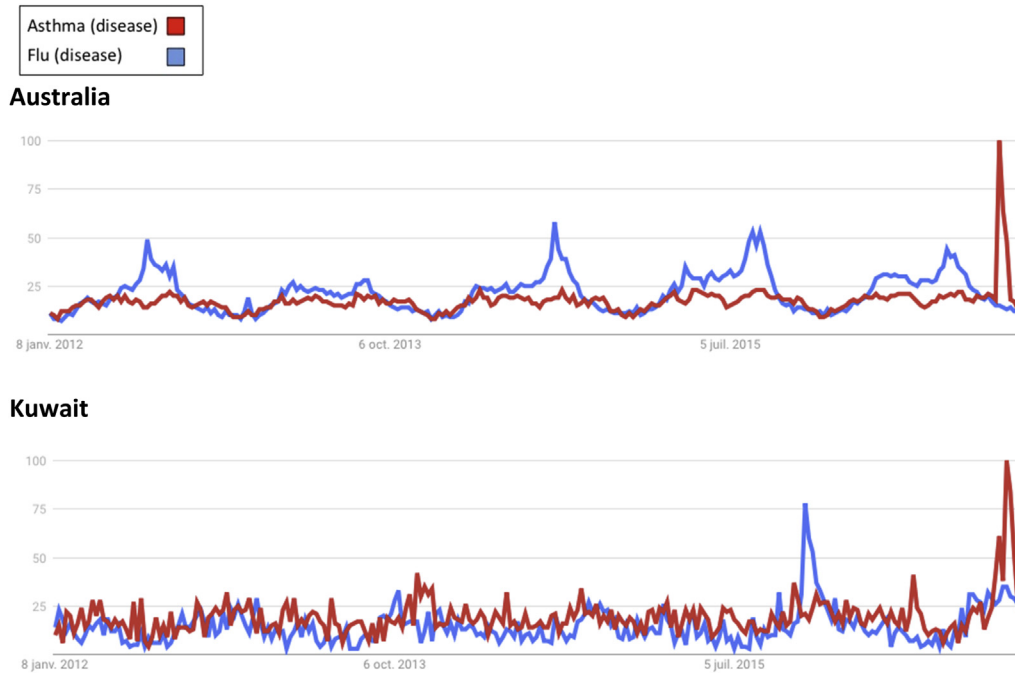


FIG E5. Google searches (January 4, 2012, to December 27, 2016). This figure shows the queries concerning “asthma” and “flu” for the past 5 years in Australia and Kuwait. There is an annual peak for “flu” in Australia. It is less pronounced in Kuwait except in the fall of 2015. Interestingly, the peak for asthma is sharper and higher. However, only trends are measured with GT. It is interesting to note that the “asthma” peak is sharper and higher than the “flu” peak. Although there are some drawbacks, it is known that GT was used to detect influenza epidemics.^{E3-E6}