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Allergy International

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Letter to the Editor

Investigating Japanese cedar pollen-induced allergic rhinitis and related terms using Google Trends

Dear Editor,

Not only in Japan but worldwide, the number of patients with allergic diseases is increasing. In Japan, large numbers of Japanese cedar trees have been planted, producing pollen between February

and April.¹ Japanese cedar pollinosis—widely referred to simply a “pollinosis” in Japan—is now a major disease. To gain knowledge of the needs of patients, select key research topics, and also from a public health perspective, capturing the trends of these changing and growing allergic diseases in this manner is important.

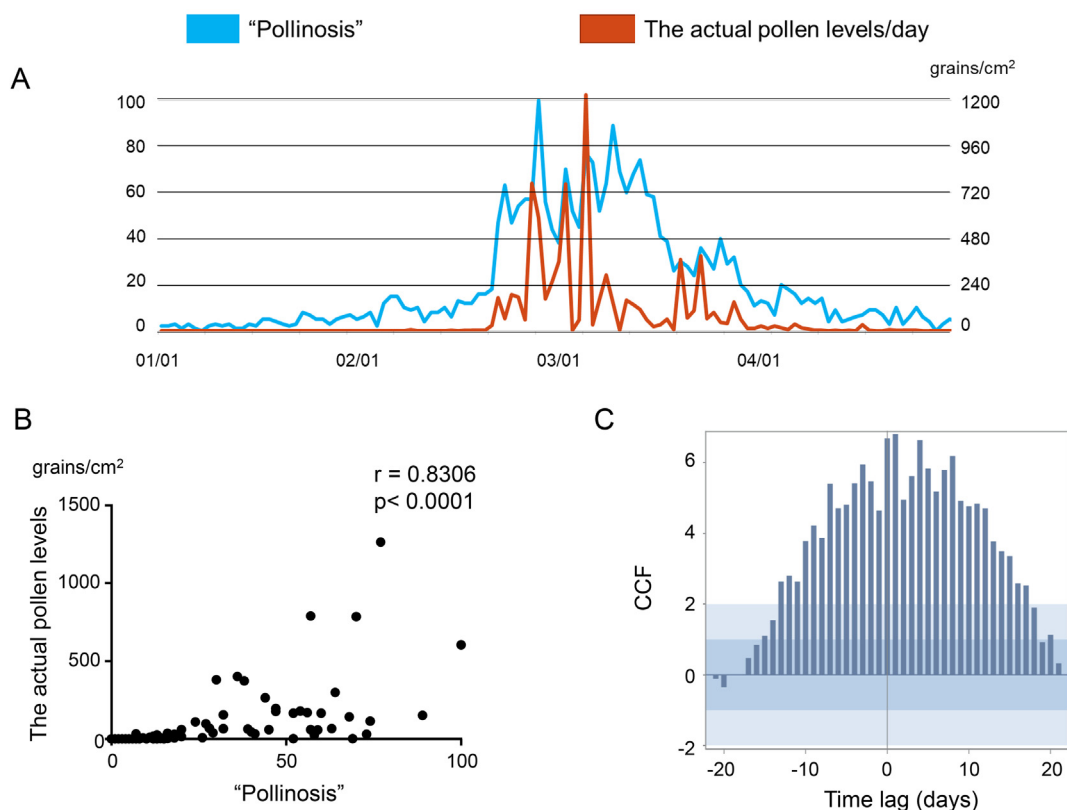


Fig. 1. Comparison of actual level of JCP and number of searches for “pollinosis” in Japan. **A:** In Chiba, we performed a comparison of the number of pollinosis searches (blue line) and cedar pollen dispersal (red line) during the pollen dispersal season of January 01 to April 30, 2019. The horizontal axis represents dates, the left vertical axis represents relative number of searches in Google Trends, and the right vertical axis represents level of pollen dispersal. **B:** Direct correlation between the actual level of JCP dispersal and the number of searches for “pollinosis” in the Chiba area. On the vertical axis we show the actual level of pollen dispersal and on the horizontal axis, the number of pollinosis searches, with each date plotted to analyze the correlation coefficient. **C:** Time-series cross-correlation analysis. Blue ranges represent standard errors, and significant differences are indicated when CCFs exceed the range in blue. The horizontal axis shows the time lag. It was most significantly correlated at time lag of Day 0 or plus Day 1. Regional differences in searches for “pollinosis” in Japan in 2019.

Peer review under responsibility of Japanese Society of Allergy.

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Google Trends evaluates how many times a particular “keyword” has been searched for in the Google search engine, also providing visual references and changes over time and based on regional differences for the number of searches for specific keywords. The highest value in the number of searches within a particular period is set to 100, and others are displayed relative to this value. In recent years, reports regarding applications in research in the medical field have surfaced.^{2,3} Here, in confirming the utility of investigating allergic diseases using Google Trends, we also utilized this service to evaluate the relationship between high interest in the topic and season, and to correlate upper airway symptoms and asthma.

As we limited our investigation to within Japan, in the search in Google Trends, all words used were Japanese terms.

We investigated and compared the actual level of JCP measured at Chiba University School of Medicine and the number of searches for “pollinosis” between January and April 2019 in Chiba (Fig. 1A). While the number of searches had been gradually increasing prior to the start of measurements of cedar pollen levels, we found the number of searches rose significantly once pollen dispersal actually

started (on Feb/19/2019). We also noted that, on days when the level of pollen dispersal was high, the number of searches increased. In our statistical analysis, we initially investigated the correlation without considering the time-series, finding the correlation coefficient to be 0.8306, showing a strong and positive correlation between the level of JCP dispersal and the number of times “pollinosis” was searched (Fig. 1B). Next, taking the time lag between the actual level of JCP dispersal and the number of “pollinosis” searches into consideration, we performed a time-series cross-correlation analysis (Fig. 1C). In the figure, the higher the cross-correlation function (CCF) on the vertical axis, the stronger the positive correlation, and the blue area indicates a significant difference above the standard deviation. The horizontal axis shows the days of time lag. We observed a significant correlation for both as we observed the time-series data—even if the time lag was set to a peak of 0 days or 1 day later.

Setting the area as Japan and the time period as 2018, the number of searches for “pollinosis” peaked bimodally in February to April 2018 (data not shown). When compared over a one-year period in 2018, the number of searches for “rhinorrhea” increased

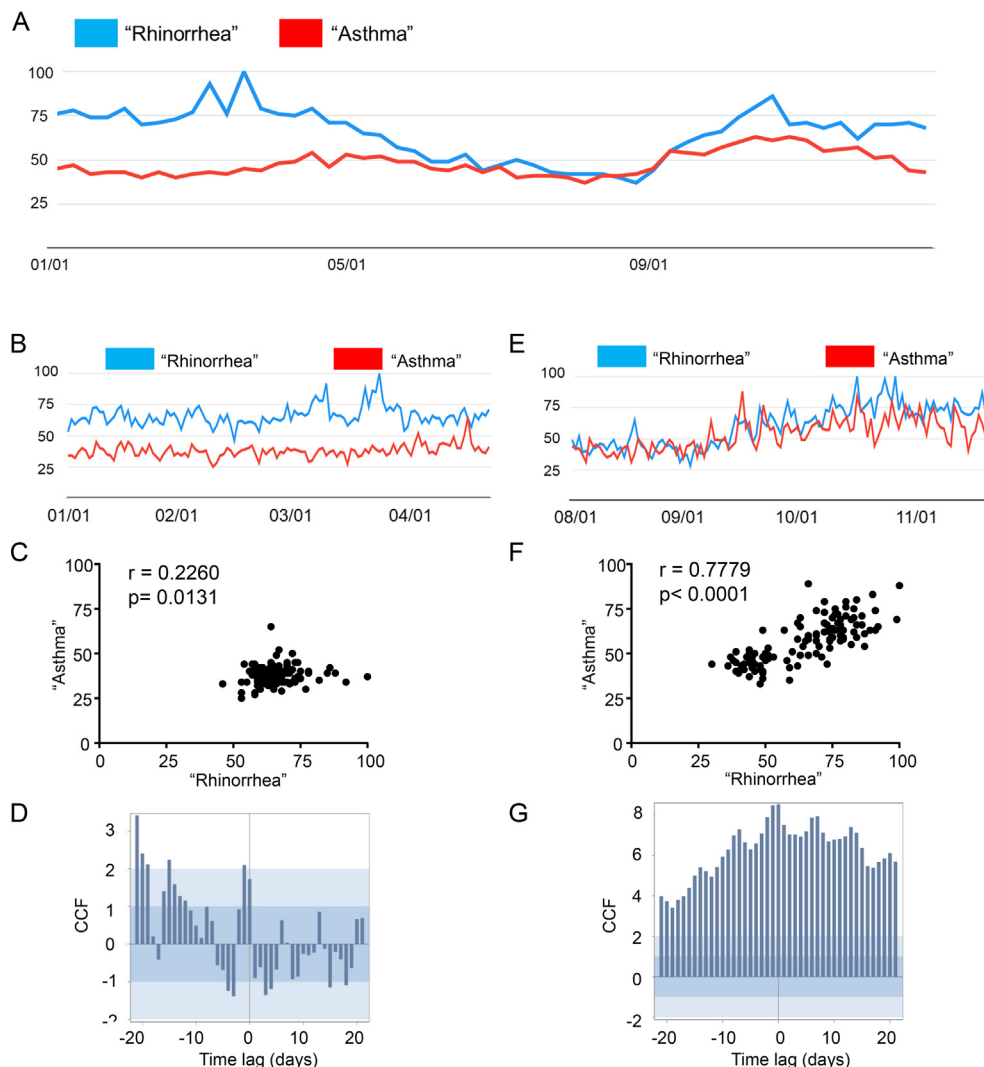


Fig. 2. Comparison of the number of searches for “rhinorrhea” and “asthma” in Japan over one year (2018). **A:** Number of searches for “rhinorrhea” and “asthma” for 1 year in 2018. **B:** Number of searches for “rhinorrhea” and “asthma” from January to April. **C:** Correlation coefficient between number of searches for “rhinorrhea” and “asthma” from January to April. **D:** Time-series cross-correlation analysis of number of searches for “rhinorrhea” and “asthma” from January to April. **E:** Number of searches for “rhinorrhea” and “asthma” from August to November. **F:** Correlation coefficient between number of searches for “rhinorrhea” and “asthma” from August to November. **G:** Time-series cross-correlation analysis of number of searches for “rhinorrhea” and “asthma” from August to November.

bimodally between February and April, whereas the trends for “asthma” exhibited no such trend (Fig. 2A). To elucidate the differences of seasonal change specifically, the focus of comparisons was between January and April (Fig. 2B–D) and between August and November (Fig. 2E–G). Between January and April, we observed no significant correlations, either in terms of non-matching visual changes (Fig. 2B), or via direct correlation (Fig. 2C), or by time-series cross-correlation analysis (Fig. 2D). However, between August and November, the variability was visually similar (Fig. 2E), an outcome confirmed by a strong direct correlation ($r = 0.7779$) (Fig. 2F). The time-series cross-correlation analysis (Fig. 2G), “asthma” and “rhinorrhea” also showed similar, statistically significant trends.

Here, using Google Trends, we found the variation in empirical levels of pollen and numbers of searches for “pollinosis” to be similar. Symptoms may occur in the days following pollen dispersal and the number of searches may increase. Our results showed the number of searches to increase on the day that pollen was dispersed or the following day. Based on our research results, the changes in levels of pollen dispersal and people’s interest in pollinosis appeared almost simultaneous, and that the severity of the symptoms was correlated with the people’s interest and the number of searches on the internet.

As suggested by the expression “one airway, one disease”,⁴ the relationship between upper and lower airway is profound. Various reports have expanded on the relationship between AR and asthma symptoms, and the relationship between both diseases is strong.^{5,6} Indirectly, the increase in nasal symptoms and the increase in mediators exacerbates airway inflammation; however, the direct effects of Japanese cedar pollinosis on asthma remain controversial. The reason given is that the size of JCP can be as large as 30 μm , which may cause the pollen to be trapped in the nasal cavity, unable to reach the lower respiratory tract. In this study, the number of searches for “asthma” did not increase during the JCP season between February and April and did not correlate with the number of searches for “rhinorrhea.” Our results may indicate that JCP does not directly affect the lower respiratory tract compared with phenomena in autumn such as flu, sinusitis, or mites, suggesting that the number of JCP-induced cases of asthma may be small. In this study, we used the search terms “rhinorrhea” and “asthma” in Fig. 2. We initially interrogated data from Google Trends using several characteristic upper respiratory symptoms, including “rhinorrhea,” “nasal obstruction,” and “sneezing.” “Rhino-rhea” was the term with the largest number of searches (data not shown). Therefore, it was believed to represent the most prominent upper respiratory tract symptoms.

There is a disparity between the interests of medical professionals and those of the general public. Recent years have witnessed the importance of health literacy.⁷ In this era of increasing interest in allergic diseases, digital tools such as Google Trends and smartphones may be helpful in investigating and improving health literacy and discrepancies among the advice of medical professionals.⁸

Limitations and situations outside of the scope of this study also exist. In this study, we cannot rule out the possibility of response

bias. We are aware that Internet use varies with age, and it is used primarily by individuals in their teens through those in their 60s in Japan. This study may not reflect the interests of all age groups. Although the age range includes many individuals who have been diagnosed with allergies or bronchial asthma, Internet-based surveys cannot completely eliminate the age-related bias. However, we believe the number of searches in Google is big data, indicating that the results are highly significant.

In conclusion, with Google Trends we were able to compare daily, yearly, or regionally, each symptom change. If search words are carefully selected, Google Trends could also be a useful tool in other medical fields, with a variety of methods for its utilization.

Acknowledgements

This work was supported by JSPS KAKENHI Grant Number 18K16874 and Japanese Society of Allergy Clinical Research Support Program.

We are grateful to Professor Jean Bousquet for giving me an idea.

Conflict of interest

The authors have no conflict of interest to declare.

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Received 5 November 2019

Received in revised form 17 February 2020

Accepted 4 March 2020

Available online xxx