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Paging Dr. Google: What do patients search for when pollen counts are high?

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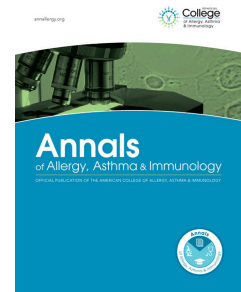
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Title: Paging Dr. Google: What do patients search for when pollen counts are high?

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Modern technology and search engines such as Google have allowed patients to instantly access an enormous database of information. Google Trends (GT) is a publicly-available, online tool that showcases the frequency of search requests made to Google over time. GT represents one of the world's largest real-time data sets with trillions of search requests annually. Research via GT provides a unique insight into the interests and concerns of the population. Over the past decade, an increasing number of healthcare studies have utilized GT to study topics including population behavior, epidemiologic surveillance, and infectious disease tracking.^{1,2} As allergic disease is commonly found in the U.S. population, we were interested in determining the pattern of online interest surrounding allergies. In 2018, Bousquet et al published a study in France assessing the agreement between GT search queries and pollen concentrations. The study reported clear seasonality of queries in France but did not find a relationship between peaks of GT queries and pollen concentrations.³ The aim of this study is to determine if tree, grass and weed pollen concentrations correlate with Google search terms related to allergic diseases in the Washington, DC area.

The GT portal was configured to include web searches in all categories in the Washington DC area for the full year of 2019. An extensive number of search terms and combinations of keywords were conducted in English. The following were the search terms used in analysis: "allergy", "pollen allergy", "sinusitis", "rhinitis", "asthma", "food allergy", "atopic dermatitis+eczema", "pollen", "tree pollen", "grass pollen", "ragweed pollen", "hayfever", "antihistamine", "cetirizine+Zyrtec", "fexofenadine+Allegra", "loratadine+Claritin+Alavert", "levocetirizine+Zyzal", "cetirizine+Zyrtec+loratadine+Claritin+Alavert+fexofenadine+Allegra",

“diphenhydramine+Benadryl”, “budesonide+Rhinocort”, “pseudoephedrine+Sudafed”,
“beclomethasone+Beconase+Qnasl+Qvar”, “Nasacort+triamcinolone”, “fluticasone+Flonase”,
“Nasonex+mometasone”, “Dymista”, “Azelastine+Astelin,” “allergist,” “allergy doctor”,
“otolaryngologist”, and “ENT”.

The GT data is automatically normalized to allow straightforward comparisons between search terms. According to Google, “each data point is divided by the total searches of the geography and time range it represents to compare relative popularity.”⁴ The resulting numbers are scaled from 0 to 100 based on the topic’s popularity relative to all searches on all topics. The data points corresponding to each week of the year were exported from the GT data.

Raw pollen concentrations in Washington, DC during 2019 were obtained from the National Allergy Bureau reports of measured pollen levels. Average and sum of weekly grass, tree and weed pollen grains per cubic meter of air were calculated. These weeks mirrored the weeks determined by GT. Subsequent calculation of the mean total pollen was performed. Statistical analysis via Spearman correlation was performed using Stata/IC 16.0 (StataCorp, College Station, TX) to assess the relationship between weekly mean pollen concentration in Washington, DC and Google keyword searches.

For the Washington, DC area, there was a strong positive correlation between average pollen levels and the search terms “allergy” and “pollen allergy”, which were statistically significant, $r_s=0.7290$, $p<0.001$ and $r_s=0.7953$, $p<0.001$, respectively (Figure 1). When GT searches for pollen

allergy were time-lagged from pollen levels by one week, there was a similar positive correlation, $r_s=0.7513$, $p<0.001$. Tree and grass pollen levels demonstrated a stronger correlation with “pollen allergy” searches than weed pollens. There was no relationship between pollen counts and searches for other atopic diseases such as food allergy, eczema, sinusitis, atopic dermatitis, and asthma. There was also a strong positive correlation between pollen levels and a search term for the brand and generic names of three common antihistamines (cetirizine, fexofenadine, and loratadine) which was statistically significant, $r_s=0.7658$, $p<0.001$. Pollen levels and the search term “antihistamine” alone did not have an association. There was a moderate correlation between pollen levels and searches for “Flonase” or “Fluticasone”. No other nasal sprays were associated with pollen levels. There was no correlation between pollen counts and the search terms “allergist”, “allergy doctor”, “ENT” and “otolaryngologist”.

This study assessing the correlation between GT searches and pollen counts provides insight into how our patients behave online during the pollen season. Our results indicate that the general public is searching for information about pollen allergies when the pollen counts are elevated. There is no association with searches for asthma, eczema or atopic dermatitis which may reflect a lack of knowledge regarding the potential role of pollen as a trigger for these diseases. GT data can serve as a complement to pollen concentrations to represent patient information and symptoms that pollen levels may not fully reflect.

With regard to treatment, the public is interested in specific antihistamines to treat symptoms; however, there appears to be less familiarity with intranasal steroids despite their role as first-line therapy for seasonal allergic rhinitis. This may reflect greater marketing, a longer duration of over-the-counter availability, or quicker onset of action for antihistamines compared to intranasal steroid sprays. This study illustrates the opportunity that allergists have to educate patients on treatment options, armed with their baseline knowledge of allergy therapeutics prior to their consultation.

Notably, there is no association between elevated pollen levels and searches for “allergist”, “allergy doctor”, “ENT”, or “otolaryngologist”. This would suggest that the public is searching for information on pollen allergies and over-the-counter treatment options but not seeking the care of an allergy medical professional. Pharmaceutical companies often evaluate consumer trends to target advertisements to patients regarding medications. This study showcases the opportunity for allergists to reach more patients using targeted online advertising via algorithms of pollen counts as well as frequently utilized search terms. Akin to use of consumer data by corporations, allergists can leverage trends in data to seek out patients or physician referrals regarding their services. While the current study assesses Google searches and pollen data in the Washington, DC area, it would be worthwhile to have this data stratified both regionally and nationally.

Through technology and increased access to the online world, our patients can connect and gather information through online platforms and search engines. Many Americans often

88 initially go online for health inquiries to learn more about medical conditions before seeking out
89 a healthcare professional. In the digital age, the allergy community can embrace technology as
90 a partner in better serving our patients and our practices.

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Figure 1: A. Google Trend Search Results in Washington, DC in 2019 B. Correlation between “Pollen Allergy” Google Searches Queries and Pollen Concentrations

