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Patterns in Google Trends Terms Reporting Rhinitis and Ragweed Pollen Season in Ukraine

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Keywords

Ragweed · Mugwort · Rhinitis · Allergy · Google Trends

Abstract

Background: Google Trends (GT) may represent a new approach to assessing pollen allergy. However, the development of a pan-European sentinel network has raised a problem of translating terms in different languages. A precise definition of the pollen season onset is crucial for the confirmation of a pollen allergy diagnosis and personalized treatment. Ragweed pollen allergy was investigated due to its high allergenicity and wide expansion in Europe. **Objectives:** The study aimed to examine translations of “ragweed” and “hay fever” in native Cyrillic languages, especially in Ukrainian and Russian, and to compare the seasonality of queries in Ukraine with ragweed and mugwort pollen counts. **Methods:** We used GT to search Google queries concerning ragweed allergy: “allergy,” “hay fever,” “running nose,” “ragweed,” “asthma,” and “pollen.” The Cyrillic terms in Ukrainian and Russian were used. Pollen collection for 2013–2015 was conducted using volumetric methods. Average daily tem-

peratures were obtained from the website <http://gismeteo.ua>. Correlations were studied by using Pearson and Spearman tests. **Results:** GT queries profile had the “B” pattern according to the classification developed by Bousquet et al. [Allergy. 2017 Aug;72(8):1261–6]. A peak of “ragweed” queries was observed after the maximum of average daily temperature. The terms “allergy,” “hay fever,” and “ragweed” in Cyrillic are required in Ukraine to calculate the ragweed pollen exposure by GT. The ragweed pollen season started with a concentration of pollen grains of 12.95 m⁻³. The *Artemisia* pollen season started between 19 and 25 days before the beginning of the *Ambrosia* pollen season. **Conclusions:** GT may be a useful tool in the differentiation of the pollen seasons, especially when they overlap as in the case of *Artemisia/Ambrosia*. Three terms, “allergy,” “hay fever,” and “ragweed” (in Cyrillic equivalents), are required in Ukraine to account for ragweed pollen exposure. The combination of GT tools with pollen counts may be used in large-scale epidemiological studies.

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Introduction

Pollen allergy is a considerable trigger for the development of widespread respiratory disorders – allergic rhinitis and asthma [1, 2]. A precise definition of the pollen season onset is crucial for the confirmation of a pollen allergy diagnosis and personalized treatment of patients with allergic rhinitis and asthma.

In order to determine the precise onset of the pollen season, the following strategies can be used: (1) meteorological data collection [3]; (2) assessment of allergen content in the ambient air [4]; (3) assessment of pollen counts in the air [5]; (4) the innovative Web-based surveillance tools which are provided by Google Trends (GT) [6, 7]. The most comprehensive approach is the development of a pan-European sentinel network, which combines all these strategies [8]. This approach has raised a problem of translating terms in different European languages [9]. As a next step to explore the use of GT in the epidemiological surveillance of allergic rhinitis, we assessed the Google search profiles for allergic rhinitis and related topics for ragweed (*Ambrosia artemisiifolia*) pollen allergy. The ragweed pollen allergy was investigated due to high allergenicity and wide expansion in Europe and possible overlap with mugwort (*Artemisia vulgaris*) pollen season [10]. Recently, it was shown that the term “ragweed” as a plant is required and the translation of “ragweed” in the native language is needed to investigate ragweed pollen allergy using GT [11]. There are difficulties in the choice of correct translations for “hay fever” and “ragweed” in the Cyrillic-based languages, especially Ukrainian and Russian.

The aim of the study was to examine which GT translations of “ragweed” and “hay fever” could be used in the native Cyrillic languages, especially in Ukrainian and Russian, and to compare the seasonality of queries in Ukraine with ragweed and mugwort pollen counts.

Methods

Google Trends Terms and Analyses

GT, a public web facility of Google Inc. based on Google Search, shows how often a particular search term is entered relative to the total search volume across various regions of the world and in various languages (https://en.wikipedia.org/wiki/Google_Trends). The following terms were used: “allergy,” “hay fever,” “runny nose,” “ragweed,” “asthma,” and “pollen.” We used the Cyrillic terms in Ukrainian and Russian. In GT, data are normalized to the highest number of searches for each topic. A score of 100 means that on that day, the topic had the highest number of searches over

the reference period included in the search (in the present study – 5 years) in Ukraine. For further comparison of Ukrainian data with the data from other countries, we determined the country pattern as previously proposed [12]. We used the 5-year GT graphs to examine GT queries from January 1, 2013 till January 1, 2018 in Ukraine to determine a pattern of Ukraine. We also compared the ragweed and mugwort pollen counts with GT queries during the 2013–2015 pollen seasons.

Ragweed Pollen Count

Pollen collection for 2013–2015 was conducted using volumetric methods employing a Burkard trap of a Hirst type [13]. The pollen count was performed by the twelve vertical transects method. Pollen grains were identified by using the pollen reference slides of Ukraine, the Pollen Identification Key Program, and the Pollen Atlas edited by the American National Aerobiology Bureau [14]. Pollen sampling and identification were harmonized with the requirements of the European Aerobiology Society and the European Aeroallergen Network. The mean daily pollen count data was used for analysis of the airborne pollen spectrum in 2013–2015. Average daily temperatures were obtained from the website <http://gismeteo.ua>.

Statistical Analysis

Correlations were studied by Pearson (*r*) or Spearman (*R*) test, where appropriate. A probability of <0.05 was considered statistically significant.

Results

We examined the GT queries which could be used as Cyrillic equivalent terms for “hay fever” in order to determine country patterns. The queries statistics for “hay fever” were estimated by probable equivalent Cyrillic terms, such as “sennaya likhoradka” (Cyrillic); “seasonal rhinitis” (English) – “sezonnny nasmork” (Cyrillic); “runny nose” (English) – “nasmork” (Cyrillic), and “sezonnny rinit” (Cyrillic).

The 5-year GT for “hay fever” and Cyrillic equivalent terms are reported in Figure 1a. Usually, the Ukrainian Google users apply the term “runny nose.” Examination of seasonality of the GT queries for “runny nose” revealed the peaks with typical dates for start, maximum, and end dates: 2013-09-08 (07-14 to 10-27), 2014-08-31 (08-10 to 11-09), 2015-09-13 (07-26 to 11-22), 2016-09-11 (06-26 to 11-06), and 2017-09-24 (06-25 to 10-22). Usually, these data go in parallel with a seasonal pattern of ragweed pollination in Ukraine with minor differences between regions (data not shown). For further analysis, we used the term “ragweed” to display GT queries for the Cyrillic equivalent “ambrosia.”

The 5-year GT for “allergy,” “hay fever,” “pollen,” and ragweed, using manually translated terms, is shown in

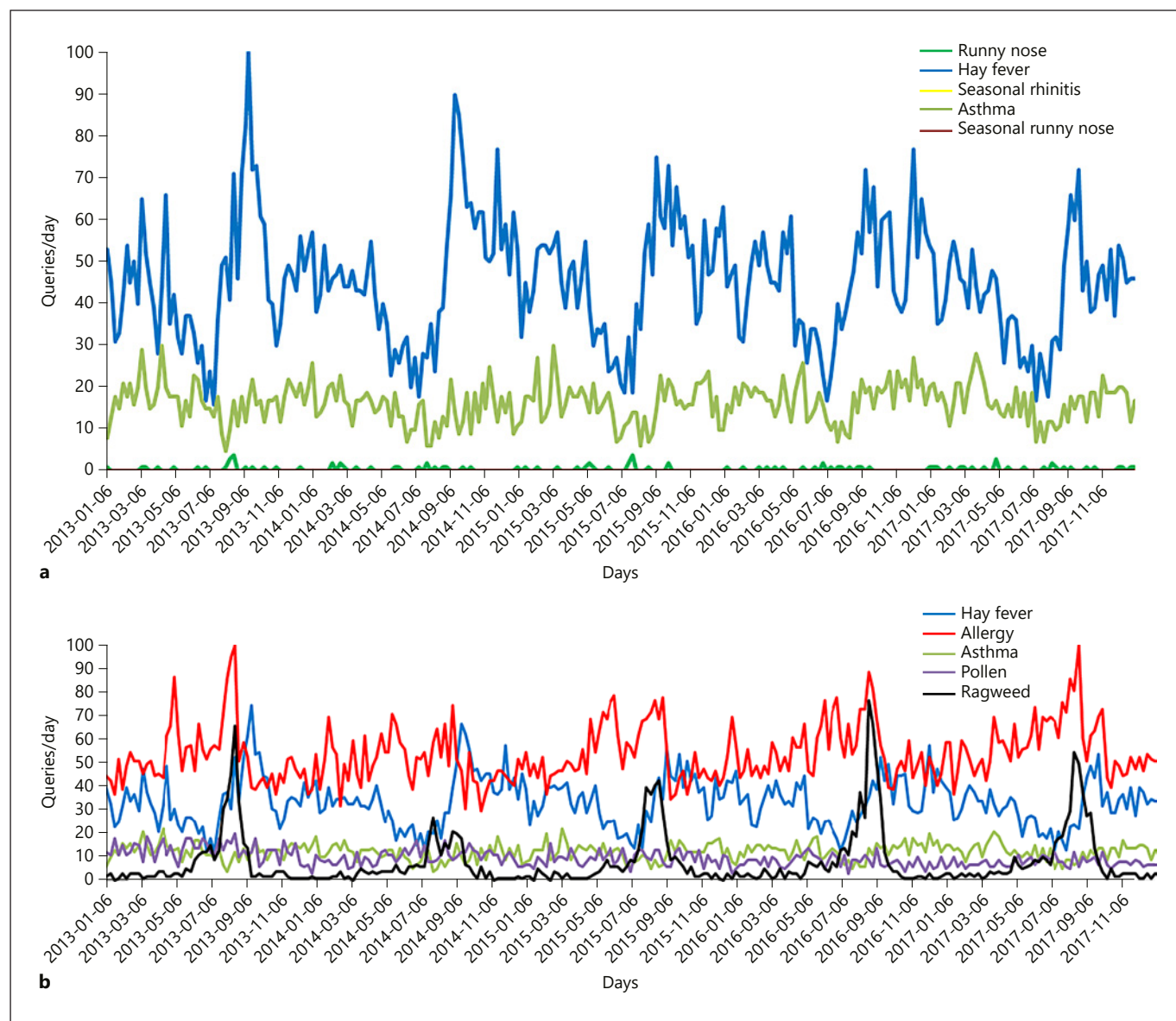


Fig. 1. Five-year Google Trends for allergy-related queries using manually translated terms (Cyrillic) in Ukraine. **a** “Hay fever,” “runny nose,” “seasonal rhinitis,” “asthma,” and “seasonal runny nose.” **b** “Hay fever,” “allergy,” “asthma,” “pollen,” and “ragweed.”

Figure 1b. The peak of “hay fever” queries was lower than “allergy” and higher than “asthma.” Thus, Ukraine had the “B” pattern. Moreover, this seasonality was similar for 5 years. The analysis of GT graphs revealed the correlation between maximum peaks of “ragweed,” “hay fever,” and “allergy” queries. On the “allergy” graph, there were two major peaks – the first one (early summer), characteristic of grass pollen allergy, and the second one (late summer–early autumn), representative of mugwort/rag-

weed pollen allergy. The peak of “hay fever” was 10 days later than “allergy” and “ragweed.” We have found strong positive correlations in the pairs “allergy-pollen” ($r = 0.54$; $p = 0.01$), “allergy-ragweed” ($r = 0.62$; $p = 0.01$), and “pollen-ragweed” ($R = 0.58$; $p = 0.01$), and moderate correlations in “allergy-hay fever” ($r = 0.26$; $p = 0.01$), “hay fever-pollen” ($r = 0.49$; $p = 0.01$), and “hay fever-ragweed” ($r = 0.49$; $p = 0.01$).

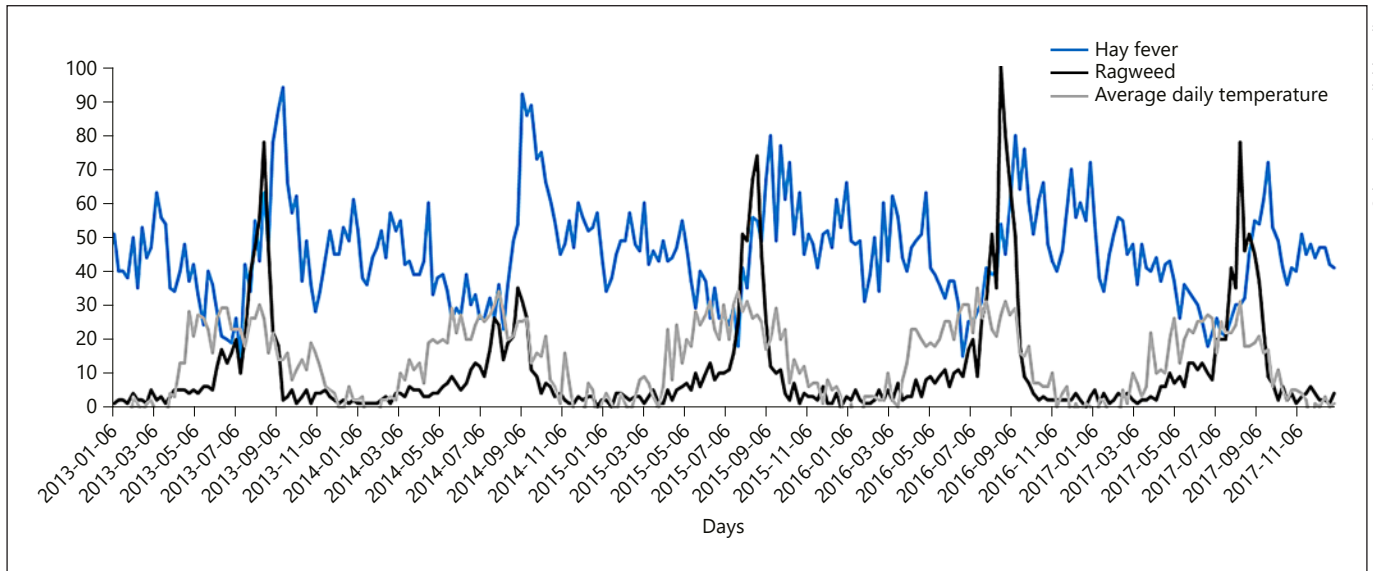


Fig. 2. Five-year Google Trends for “hay fever” and “ragweed” queries using manually translated terms (Cyrillic) and average daily temperature in Ukraine. y axis: Google Trends queries per day and temperature in °C.

Further validation of the terms “hay fever” and “ragweed” was provided by the comparison of these GT queries with average daily temperature (Fig. 2). A strong positive correlation between “ragweed” queries and the average daily temperature ($R = 0.86$; $p = 0.01$) was observed. Analysis of 5-year graphs revealed that the peak of “ragweed” queries came after the maximum of average daily temperature.

Then we compared the frequency of GT queries with mugwort and ragweed pollen counts (Fig. 3). In 2013, the season of mugwort pollination started on July 21, 2013 and caused the increase in GT “hay fever,” “allergy,” and “ragweed” queries (Fig. 3a). We observed a strong positive correlation between the “allergy” and “ragweed” queries ($r = 0.75$; $p = 0.01$), ragweed pollen count ($r = 0.68$; $p = 0.01$), and mugwort pollen count ($r = 0.85$; $p = 0.01$), and between the “ragweed” query and ragweed pollen count ($r = 0.65$; $p = 0.01$) and mugwort pollen count ($r = 0.73$; $p = 0.01$). Additionally, there was a significant positive correlation between the “hay fever” query and ragweed pollen count ($r = 0.55$; $p = 0.01$). In that year, the season of ragweed pollination started between August 4 and August 11, 2013 (2013-08-04 – 0 m^{-3} ; 2013-08-11 – 81.47 m^{-3} ; 2013-08-18 – 34.56 m^{-3}) and caused further increase in the “hay fever” and “ragweed” queries. The level of ragweed pollen grains of 81.47 m^{-3} induced the highest number of “hay fever,” “allergy,” and “ragweed” queries. The maximum of pollination was on 2013-08-11 – 81.47 m^{-3} , 2013-08-18 – 34.56 m^{-3} , and 2013-08-25 – 7.4 m^{-3} .

In 2014, the season of mugwort pollination started on July 20, 2014 and decreased on August 24, 2014. This start of pollination caused the increase in “hay fever” and “ragweed” queries (Fig. 3b). A strong positive correlation between the “hay fever” query and ragweed pollen count ($r = 0.55$; $p = 0.01$) was observed. Furthermore, there was a significant positive correlation between the “ragweed” query and mugwort pollen count ($r = 0.64$; $p = 0.01$). In that year, the season of ragweed pollination started between August 17 and August 24, 2014 (2014-08-17 – 1.24 m^{-3} ; 2014-08-24 – 18.5 m^{-3} ; 2014-08-31 – 4.94 m^{-3}) and caused further increase in “hay fever,” “ragweed,” and “allergy” queries. The level of ragweed pollen grains of 18.5 m^{-3} induced the highest number of “hay fever,” “ragweed,” and “allergy” queries. The maximum of pollination was on 2014-08-24 – 18.51 m^{-3} , 2014-09-07 – 54.95 m^{-3} , and 2014-09-21 – 55.54 m^{-3} . During this year, we observed a specific pattern of *Artemisia* and *Ambrosia* pollination – non-overlapping wide peaks due to meteorological conditions.

The 2015 season of mugwort pollination started on July 26, 2015 and caused the increase in GT “hay fever” and “ragweed” queries (Fig. 3c). A strong positive correlation between “hay fever” queries and the ragweed pollen count ($R = 0.67$; $p = 0.01$), “allergy,” and “ragweed” queries ($R = 0.77$; $p = 0.01$) was observed. In that year, the season of ragweed pollination started on August 5, 2015 (2015-08-05 – 12.95 m^{-3} ; 2015-08-06 – 40.12 m^{-3} ; 2015-

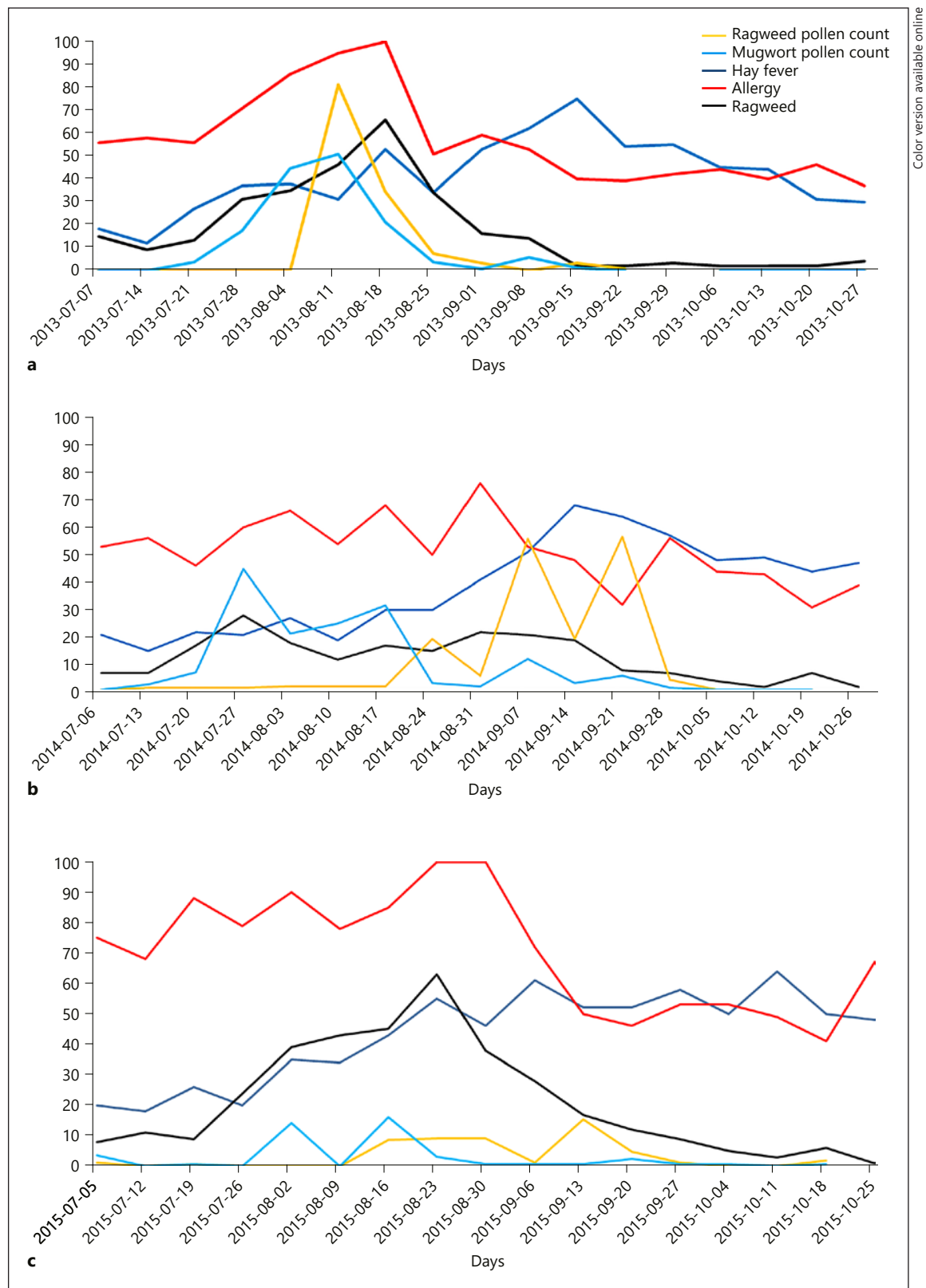


Fig. 3. Year profiles of Google Trends for “hay fever,” “ragweed,” and “allergy,” and ragweed and mugwort pollen count in Ukraine. **a** 2013. **b** 2014. **c** 2015. y axis: Google Trends queries per day and pollen count in grains m^{-3} .

08-07 – 25.32 m⁻³; 2015-08-08 – 15.45 m⁻³) and caused further increase in “hay fever” and “ragweed” queries, and the most important increase in “allergy” queries. The level of ragweed pollen grains of 12.95 m⁻³ induced the most “hay fever,” “allergy,” and “ragweed” queries. The maximum of pollination was on 2015-08-19 – 49.9 m⁻³, 2015-09-10 – 44.46 m⁻³, and 2015-09-11 – 65.43 m⁻³.

Discussion

In this study, we examined the GT queries which could be used as Cyrillic equivalent terms for “hay fever.” Using these terms, we compared GT queries with *Ambrosia* and *Artemisia* pollen counts and a meteorological parameter of average daily temperature.

Our study showed that Ukrainian Google users apply the GT query “runny nose” which went in parallel with the seasonal pattern of ragweed pollination in Ukraine. Thus, in further analysis, we used the Cyrillic equivalent term for “runny nose” (“nasmork”) as “hay fever.” A similar situation was observed concerning the term “ragweed.” Ukrainian Google users searched the Cyrillic equivalent “ambrosia.” Our data showed that direct translations by GT are not appropriate in Ukraine. In our opinion, there are significant cultural and linguistic differences in the knowledge and use of terms. In Ukraine, we need to use “ragweed” (“ambrosia” in Cyrillic) in addition to “allergy” and “hay fever” (“nasmork” in Cyrillic) to account for the pollen seasons. Due to GT queries profile, Ukraine had the “B” pattern according to the classification by Bousquet et al. [12].

The comparison of “hay fever” and “allergy” with average daily temperature revealed a peak of “ragweed” queries after the maximum of average daily temperature. The data went in parallel with the observations of other investigations [15].

We analyzed 3-year mugwort and ragweed pollination to elucidate the co-occurrence of the *Artemisia* and *Ambrosia* pollen seasons. Our data showed that the *Artemisia* pollen season generally occurred between the middle of July and September but started between 19–25 days before the beginning of the *Ambrosia* pollen season. A similar profile was described for the pollen season in Poland [16]. At present, there are different studies reporting various values of *Ambrosia* pollen concentrations provoking symptoms in allergic patients from 5 grains m⁻³ to 30 m⁻³ [17, 18]. We observed that the 2013 ragweed pollen season started between August 4 and August 11, 2013 with a concentration of pollen grains of 81.47 m⁻³, the

2014 season started between August 17 and August 24, 2014 with 18.5 m⁻³, and the 2015 season started on August 5, 2015 with a concentration of pollen grains of 12.95 m⁻³. These concentrations provoked the increase in GT “hay fever,” “ragweed,” and “allergy” queries. Thus, our data support the concentration of more than 10 pollen grains as clinically significant for Ukrainian patients because of *Ambrosia* allergenicity. These data are supported by the observations in Poland [16].

We conclude that to account for ragweed pollen exposure by GT, three terms are required in Ukraine: “allergy,” “hay fever,” and “ragweed” (in Cyrillic equivalents). GT may be a useful tool in the differentiation of pollen season, especially when the seasons overlap as in the case of *Artemisia/Ambrosia*. The combination of GT tools with pollen counts may also be used in large-scale epidemiological studies. The results of our study may be used in further development of the MACVIA-ARIA sentinel network [8], especially for countries where the Cyrillic alphabet is used.

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Statement of Ethics

The authors have no ethical conflicts to disclose.

Disclosure Statement

The authors have no conflicts of interest to declare.

Funding Sources

The authors declare that no competing interests exist.

Author Contributions

I. Kaidashev conducted and supervised the manuscript development; H. Morokhovets provided the Google Trends search and statistical processing of the results; V. Rodinkova managed the process of pollen concentration count; J. Bousquet designed the conceptual framework of the present research.

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