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Brief Communication

Infodemiology of status epilepticus: A systematic validation of the Google Trends-based search queries

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ABSTRACT

People increasingly use Google looking for health-related information. We previously demonstrated that in English-speaking countries most people use this search engine to obtain information on status epilepticus (SE) definition, types/subtypes, and treatment. Now, we aimed at providing a quantitative analysis of SE-related web queries. This analysis represents an advancement, with respect to what was already previously discussed, in that the Google Trends (GT) algorithm has been further refined and correlational analyses have been carried out to validate the GT-based query volumes. Google Trends-based SE-related query volumes were well correlated with information concerning causes and pharmacological and nonpharmacological treatments. Google Trends can provide both researchers and clinicians with data on realities and contexts that are generally overlooked and underexplored by classic epidemiology. In this way, GT can foster new epidemiological studies in the field and can complement traditional epidemiological tools.

1. Introduction

Status epilepticus (SE), an abnormally prolonged or recurrent epileptic seizure, represents a serious, life-threatening medical emergency requiring a prompt, aggressive treatment. Overall, it has an incidence ranging from 10 to 41 patients per 100,000 [1] and is characterized by high mortality (range: 1.9–40%) [2].

Causes include cerebrovascular diseases (stroke or hemorrhage), infections (meningitis, sepsis), history of epilepsy, low antiepileptic drug levels, alcoholism, drug intoxication or abrupt withdrawal, encephalitis and encephalopathies, neurodegenerative diseases, sleep deprivation, tumors and paraneoplastic syndromes, autoimmune disorders, and metabolic impairments [3]. However, a certain fraction of SE cases remains unknown [3].

The treatment of SE follows a staged approach [1,4]. Benzodiazepines (such as diazepam, lorazepam, midazolam, and clonazepam) represent first-line therapies. After failure of benzodiazepines, the following antiepileptic drugs can be used: phenytoin/fosphenytoin, valproic acid, levetiracetam, and lacosamide [4]. In the presence of continuing SE despite these drugs, therapeutic options usually include anesthetics (propofol, continuous midazolam administration, isoflurane, lidocaine, and ketamine) or barbiturates (phenobarbital, thiopental sodium, and pentobarbital) [5,6]. Nonpharmacological management options (such as surgery, electroconvulsive therapy, transcranial magnetic stimulation, and vagus nerve stimulation or VNS) might be taken into consideration for super-refractory cases of SE, where seizure control cannot be achieved with anesthetics or barbiturates [5,6]. These therapeutic options are rarely used, besides being poorly supported by scientific evidence [5,6].

People increasingly use the search engines looking for health-related information. We previously demonstrated that in English-speaking countries most people use the Internet in order to obtain information on SE definition, types/subtypes, and treatment [7].

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In this study, we aimed at providing a quantitative analysis of SE-related web queries. This analysis represents an advancement, with respect to what was previously discussed, in that the Google Trends (GT) algorithm has been further refined and correlational analyses have been carried out in order to validate the GT-based query volumes. Furthermore, recommendations provided by Nuti et al. in their systematic review on the use of GT in the field of health care have been taken into account, in order to increase the rigor and the reproducibility of the current research [8].

2. Material and methods

Google Trends is an online tracking system of Internet hit-search volumes that recently merged with its sister project Google Insights for Search (Google Inc.). Google Trends is freely available and accessible at www.google.com/trends. Google Trends enables searching and monitoring of Internet-related activities concerning a particular topic over time. This interest can be visualized in terms of relative search volumes (RSVs) from the plot displayed automatically by GT.

Google Trends global data were analyzed from 2004 to the present (specifically, 21st November 2015), searching for "status epilepticus". The "search topic" option was used, typing the keyword in the search box and waiting for the autocomplete service. The option "status epilepticus" labeled as a "disease or medical condition" was then selected. This search strategy was preferred over the "search term" strategy in that the first approach automatically includes not only all webpages containing that keyword but also all the pages related to that keyword (in this case, SE). The "search term" strategy is limited to searches in a certain natural language. As such, the query performed with the "search topic" option results in a broader query [9]. Furthermore, the "search topic" overcomes the issues of keywords searched in their local languages and enables researchers to compare the same query among different countries and realities. Despite the fact that our particular keyword "status epilepticus" is language-free, the query with the "search topic" strategy, in this case, also results in higher query volumes (Fig. 1, Fig. 2).

Pearson's coefficient was calculated with SPSS software V22.0.0 package (IBM Corporation, Armonk, NY, USA). In order to validate the GT-based SE-related queries, correlational analysis was performed systematically, looking for all the correlations between GT-generated SE-related RSVs and the terms concerning SE etiology and management, both pharmacological and nonpharmacological, extracted from the most recent published guidelines and integrated with those suggested by expert clinicians. Also, these last terms were searched using the "search topic" strategy.

A two-tailed p-value < 0.05 was considered statistically significant.

3. Results

The search using "status epilepticus" as keyword and the "search topic" option yielded the highest RSV, while some SE subtypes such as epilepsia partialis continua and aura continua were little searched (Fig. 1).

Google Trends-based SE-related query volumes were well correlated with information concerning causes (Table 1) and pharmacological (Table 2) and nonpharmacological treatments (Table 3).

In particular, as far as etiology is concerned, positive correlation coefficients were obtained with some acute conditions, such as head trauma injury and concussion, cerebral hemorrhage, hematoma, and sepsis (even though in this last case the p-value indicated a borderline statistical significance), while negative correlation coefficients could be observed for alcoholism, cancer, encephalitis and meningitis, encephalopathy, epilepsy, hypoglycemia, and stroke (Table 1).

In the case of pharmacological treatment options, all correlation coefficients were positive, apart from the correlations with phenytoin/fosphenytoin, topiramate, valproate, and ketamine (Table 2).

In the case of nonpharmacological treatment, all correlation coefficients were negative, apart from the correlation between SE and ketogenic diet (Table 3).

4. Discussion

Classical epidemiological studies are time-consuming. Furthermore, most available population-based studies reflect the epidemiology of selected Western countries, particularly the United States. For some countries such as New Zealand, data are still unavailable, and the EpiNet project is expected to soon release the incidence rate of SE in the greater Auckland area [10]. For Thailand and other developing countries, national databases present some challenges and are usually limited in information concerning incidence and treatment outcome [11].

Infodemiology (a portmanteau of information and epidemiology, an expression coined by Gunther Eysenbach) could in principle overcome these shortcomings because of the widespread diffusion of the new information and communication technologies [12,13]. Subjects that were previously difficult to reach with the classic epidemiological tools could now be easily reached. Furthermore, another advantage of infodemiology is the possibility of tracking and monitoring information in real time. Google Trends and other infodemiological tools have been extensively used in the field of neurological and neuropsychiatric diseases, showing good correlation between the Internet activities and the real clinical/epidemiological data [7,14–19].

In our study, the lack of epidemiological data in countries outside Europe and the USA prevented us from performing a correlation

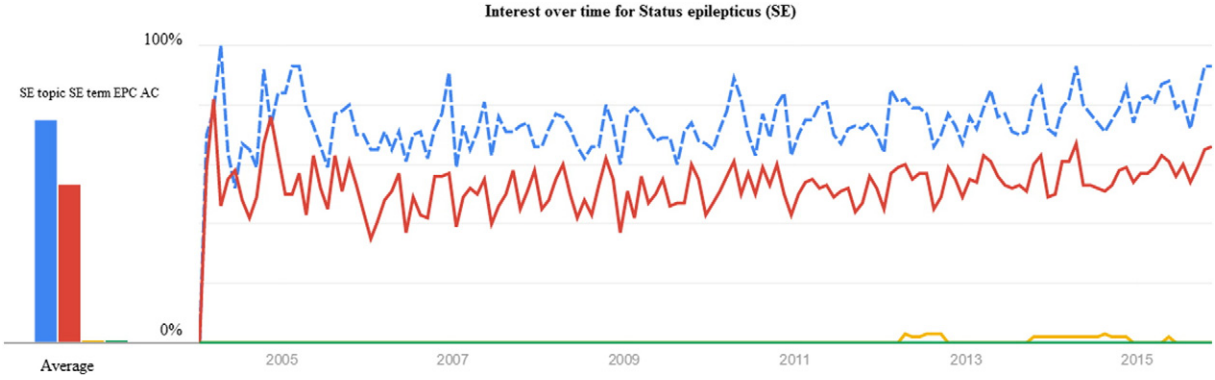

Fig. 1. Google Trends curve as RSVs for "status epilepticus" (search topic: blue), "status epilepticus" (keyword: red), "epilepsia partialis continua" (yellow), and "aura continua" (green) from 2004 to November 2015. Abbreviations: AC (aura continua), EPC (epilepsia partialis continua), SE (status epilepticus).