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# Representation of long COVID syndrome in the awareness of the population is revealed by Google Trends analysis

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## ABSTRACT

In some COVID-19 patients, symptoms persist for several weeks and sometimes, after the acute disease phase, these patients develop new symptoms, which then represents a transition into the so-called long COVID. The exact demarcation of the terms and generally applicable definitions are still discussed, but the phenomenon is most commonly referred to as long COVID.

In this study, Google Trends data have been used to track levels of public awareness for long COVID and some important symptoms during the course of the COVID-19 pandemic.

The results of this analysis clearly demonstrate the public interest in the new topic of long COVID, as documented by a corresponding search volume. This is related to the disease COVID-19, which is being spread by the corona pandemic. Relevant symptoms for COVID-19 or long COVID, for example ageusia and anosmia, only started to receive more public attention during the pandemic.

Therefore, Google Trends is a useful tool to demonstrate the population's awareness of certain infodemiological topics like long COVID.

## 1. Introduction

SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) has spread worldwide since its first known appearance in Wuhan City, Hubei province (Central China), in December 2019. The resulting COVID-19 (coronavirus disease 2019) pandemic has extensive, long-term health, social and economic consequences worldwide.

The severity of the novel disease COVID-19 ranges from asymptomatic to severe (Jennings et al., 2021). Patients are showing various more or less common symptoms, ranging from fever, cough, anosmia, and ageusia up to life-threatening symptoms such as difficulty breathing or shortness of breath (Jennings et al., 2021; Naralia and Permatasari, 2021).

Most patients fully recover from a SARS-CoV-2 infection, but in some patients, symptoms persist for several weeks or are newly developed in the weeks following the initial, acute COVID-19 phase, which then enters a post-acute phase: post-COVID-19 syndrome, post-acute sequelae of COVID-19 (PASC), chronic COVID syndrome (CCS) - commonly referred to as long COVID (e.g. Proal and VanElzakker, 2021; Jennings et al., 2021; Baig, 2021). The terms long-haulers or #LongCovid were introduced in mid-2020 and soon became commonplace as described in detail by Callard and Perego (2021).

A generally accepted definition is still being discussed, but long COVID usually describes the persistence of symptoms for more than 4 weeks and/or the appearance of new symptoms. Post-COVID-19 syndrome is characterized by symptoms lasting longer than 12 weeks (Koczulla et al., 2021; Soriano et al., 2022). Both, ongoing symptomatic COVID-19 (week 4–12) and post-Covid-19 syndrome (from week 12), can be summarized as long COVID (Sivan and Taylor, 2020; Gorna et al., 2021).

However, in public usage little distinction is made in these subtle differences and the unusual long persistence or occurrence of symptoms is commonly referred to as long COVID (Callard and Perego, 2021).

Definitions of long COVID include the persistence of symptoms for several weeks beyond the acute phase of COVID-19 and subsequent recovery (e.g. Jennings et al., 2021). Long COVID encompasses a variety of symptoms and affects multiple organ systems. These symptoms include fatigue, shortness of breath, sleep disturbance, cognitive impairment, headache, muscle ache, ageusia, anosmia, and others (Crook et al., 2021). Studies have described different results on how many patients are affected by long-lasting symptoms after an initial SARS-CoV-2 infection and some studies have found values for the persistence of at least one symptom of over 70% of COVID-19 patients (Nasserie et al., 2021; Taquet et al., 2021). Most likely, however, a frequency of up to 15% of the

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post-COVID syndrome can be assumed (Koczulla et al., 2021). Epidemiological approaches are required to further study the spread, causes and consequences of long COVID conditions.

“Infodemiology”, short for information epidemiology, was defined by G. Eysenbach as a term for the scientific evaluations made through search engine data such as Google Trends data (Mavragani and Ochoa, 2019; Springer et al., 2021; Eysenbach, 2009).

The aim of this study is to evaluate the worldwide representation and awareness of long COVID through the search interest, as shown through the analysis of available Google Trends data. The course of search interest in long COVID and its symptoms during the progress of the pandemic is to be examined. We hypothesize that long COVID and relevant symptoms will only appear during the pandemic and then generate sustained interest that is not negligible.

2. Data & methodology

Google Trends data have been widely used for tracking the COVID-19 pandemic (Strzelecki, 2020). The data are anonymous as no names or any other personal user information are revealed. Google Trends provides comparisons of up to five search terms or topics. The results for each search term or topic are related to the maximum value of the interest of the respective query, which is set to 100 in Google Trends for this peak.

In this study, data were collected with the following settings in Google Trends (<https://trends.google.com/trends>): the period was set the “last five years”, the region was selected as “worldwide” and “all categories” and “web search” were set.

In this study, search topics were used instead of search terms for better coverage, as using search topics covers a group of terms that share the same concept in every language. The topics “long COVID” and

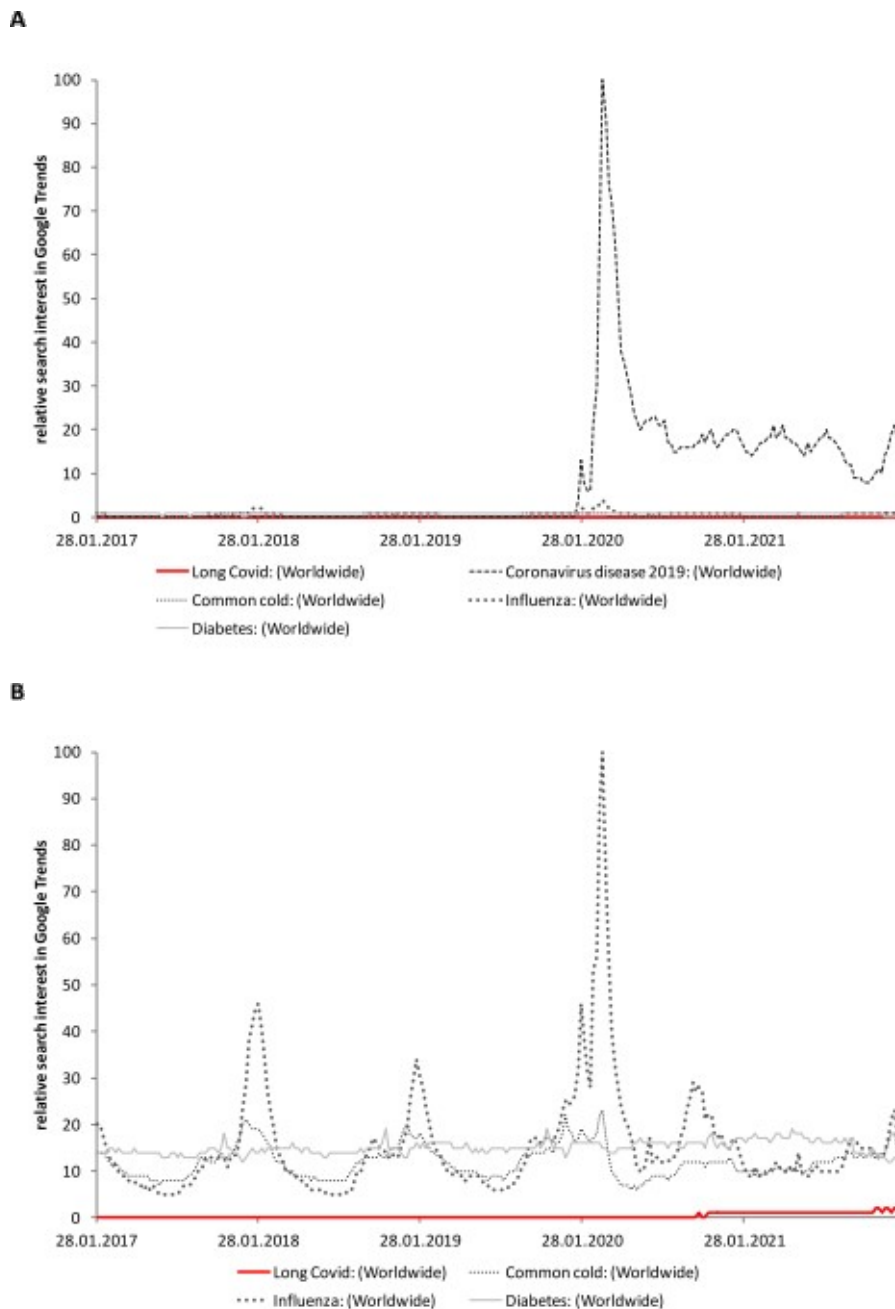


Fig. 1. Relative search interest in disease-related search topics as indicated according to Google Trends data with (A) and without (B) coronavirus disease 2019 as reference.

“coronavirus disease 2019” were queried in comparison with the following disease-related topics: “common cold”, “influenza”, “paediatric multisystem inflammatory syndrome”, and “diabetes”.

The following search topics were selected according to main symptom complexes (Crook et al., 2021): “ageusia”, “anosmia”, “shortness of breath”, “clouding of consciousness” (cognitive impairment), and “fatigue” or “fatigue syndrome”.

Google Trends data were accessed in January and February 2022.

### 3. Results

As shown in Fig. 1A, the relative search interest for the topic of COVID-19 dominates compared to the topics of long COVID and other

common diseases such as diabetes, influenza, and the common cold. The relative search interest for COVID-19 is so high that all other search topics provide insufficient data (Fig. 1A). The high level of public interest in the new disease at the beginning of 2020 is particularly remarkable.

Without COVID-19 as a reference, the control topics influenza and common cold show a seasonal trend, while the topic diabetes is relatively constant throughout the year (Fig. 1B). When looking at seasonal infectious diseases, differences are to be seen only in years marked by the pandemic, as for example a clear decrease in the peak height of the common cold can be observed (Fig. 1B).

In contrast, at the beginning of 2020, the beginning of the corona pandemic, there was an exceptionally high peak shown for influenza. Comparisons of COVID-19 with influenza may have played a role here.

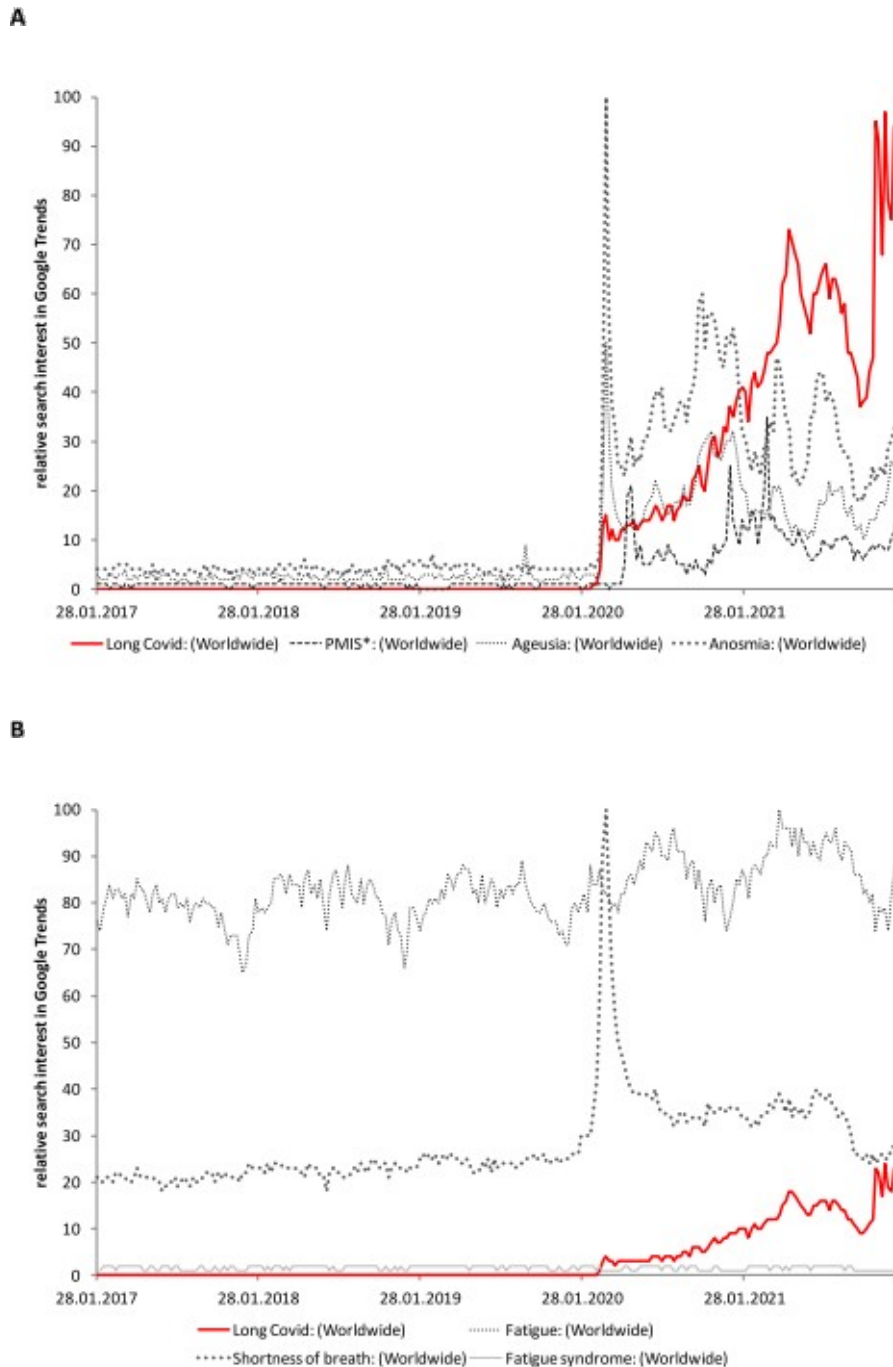


Fig. 2. Relative search interest in search topic long COVID in relation to other topics as indicated according to Google Trends data (\*Paediatric multisystem inflammatory syndrome).

There were also further changes in the peaks of the 2020/21 and 2021/22 seasons compared to the pre-corona years (Fig. 1B).

In order to be able to examine the interest in long COVID and its development over time in more detail, the investigation was focused on this search topic specifically. Fig. 2 shows the corresponding Google Trends data for the past five years.

The long COVID topic shows a mainly rising trajectory of public interest beginning in early 2020. Overall, the relative search interest in long COVID is higher than for some other COVID-19-related conditions, such as the paediatric multi-system inflammatory syndrome (PMIS) associated with COVID-19 (Zou et al., 2021), which shows to be low in interest, apart from three peaks (Fig. 2A). In contrast, the interest in the COVID-19-related symptoms ageusia and anosmia decreases after one initial peak each (Fig. 2A). The topic of shortness of breath (SOB) shows its first peak in connection with the corona pandemic (Fig. 2B). Unlike ageusia and anosmia, this symptom showed to have had significant relative search volume already in the years before the pandemic. The topic of fatigue (medical condition) also shows a clear relative search interest, which was barely influenced by the pandemic in the period examined (Fig. 2B). Other topics, such as fatigue syndrome, achieve significantly lower search volumes.

Under the more colloquial phrase “clouding of consciousness” respectively “brain fog”, the topic of cognitive impairment was found in Google Trends. Compared to long COVID, the curve is at an overall low level and shows a slight increase starting in 2020, with a further increase starting around early 2022 (data not shown).

#### 4. Discussion

The results of this Google Trends analysis clearly demonstrate the public interest, documented by a corresponding search volume, for the new topic of long COVID. This is related to the disease COVID-19, which is being spread by the corona pandemic. At the same time, the chronological progression is displayed for the search interest by Google Trends data.

This study has some limitations, such as the popularity or availability of Google's search engine not being the same in all parts of the world. Therefore, data from areas of the world where Google is the most popular search engine are more representative than in others, such as China, where other search engines are used. In addition, only selected terms, for which topics were available at Google Trends, were examined, with the potential consequence of overlooking other search terms. Additionally, Google Trends uses subsamples in its evaluation, potentially leading to slight deviations in the course of the curve in the case of multiple queries, especially in those with a lower search volume.

The relative overall interest of the population corresponds to the area under the curve. It could be shown that there is an outstanding and sustained interest in the general disease topic of COVID-19. In contrast, the relative interest for the long COVID syndrome is significantly lower but shows a certain and sustained increase for the period examined. It also shows the representation of long COVID, which is clearly present, in public awareness and in relation to other long-known and common diseases. The data also show the seasonality of the infectious diseases influenza and common cold and, in the course of the pandemic, also the effects of the corona measures taken (Wilder-Smith and Freedman, 2020).

The term long COVID and associated symptoms are still evolving. Therefore, this study used symptoms or symptom complexes whose connections to long COVID have already been established (Crook et al., 2021). Accordingly, there is a possibility that other symptoms related to long COVID have not yet been considered. The study clearly demonstrates the effect of COVID-19 on search interest in COVID-19-related symptoms. For example ageusia and anosmia, which only became more popular and relevant during the pandemic. The topic of fatigue (medical condition) also shows a clear relative search interest at a relative high pre-pandemic level, which was barely influenced by COVID-19

pandemic. Cognitive impairment, colloquially known as clouding of consciousness or brain fog, also plays a role in search interest during the COVID-19 pandemic. In terms of search volume, however, it remains of secondary importance.

#### 5. Conclusions

Despite the limitations of the study, analysis of the available data shows a clear trend.

While interest in some relevant symptoms has declined again after an initial peak at the beginning of the pandemic, long COVID shows a relatively steady increase during the pandemic period under investigation, intermittently punctuated by a significant dip towards the end of 2021. Although the relative interest in long COVID is low in relation to the search volumes for other diseases, it nonetheless demonstrates the growing public concern and sustained interest for the disease. As a consequence, this clinical condition should also be given lasting consideration in the healthcare system.

Google Trends data provide a useful tool to show the progression as well as the representation and awareness within the population. Furthermore, understanding how people are using available tools such as search engines like Google amid global health crises can help develop tailored information and educational materials for the current and future pandemics.

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#### Declaration of competing interest

The authors declare no conflicts of interest.

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