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## Short communication

# Vaccine hesitancy and anti-vaccination in the time of COVID-19: A Google Trends analysis

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## ABSTRACT

The COVID-19 pandemic has produced many calls for a vaccine. There is growing concern that vaccine hesitancy and anti-vaccination presence will dampen the uptake of a coronavirus vaccine. There are many cited reasons for vaccine hesitancy. Mercury content, autism association, and vaccine danger have been commonly found in anti-vaccination messages. It is also mused that the reduced disease burden from infectious diseases has paradoxically reduced the perceived requirement for vaccine uptake. Our analysis using Google Trends has shown that throughout the pandemic the search interest in a coronavirus vaccine has increased and remained high throughout. Peaks are found when public declarations are made, the case number increases significantly, or when vaccine breakthroughs are announced. Anti-vaccine searches, in the context of COVID-19, have had a continued and growing presence during the pandemic. Contrary to what some may believe, the burden of coronavirus has not been enough to dissuade anti-vaccine searches entirely.

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## 1. Introduction

The coronavirus disease (COVID-19) pandemic has resulted in a widespread call for a vaccine, which has been particularly prevalent in the mainstream media. Vaccine hesitancy and anti-vaccination rhetoric, which can result in delay of acceptance or refusal of vaccines, interacts in a complex way with wider contextual factors such as these media headlines [1].

Anti-vaccination movements are known to use heavily emotive and anecdotal stories to persuade readers of their relevance [2,3]. Two heavily used arguments are dangers associated with perceived mercury content in common vaccines, and the ongoing debate regarding the measles, mumps, and rubella vaccine (MMR) and autism [4]. Even though the scientific community rejected the results of Andrew Wakefield's original paper, citing a potential link between autism and MMR, its effects are still evident within the general population [5]. In fact, fears of vaccine safety and side effects of vaccines are widely cited as a primary reason parents hesitate or refuse to have their child vaccinated [6–9].

As well as Wakefield's autism link, concerns over mercury content in vaccines can often spark concerns. These hypotheses of mercury damage from vaccines have been found to be without scientific grounding [4]. Studies included within Naprawa's review (2012), investigating mercury content and autism, have all concluded there to be no correlation between these factors and vaccination use.

The terms vaccine hesitancy and anti-vaccination, which are connected, yet different ideas have previously been used interchangeably in the literature [10]. Vaccine hesitancy may be considered in current literature to be a catchall category of delayed and/or refusal of vaccine uptake and potential decision-making category. Anti-vaccination is regarded here as the opinions and actions against vaccination use, which itself may be considered a downstream effect of vaccine hesitancy [10].

Prior to the coronavirus pandemic, anti-vaccination group messages were noted to surge in prevalence on social media platforms immediately after pro-vaccination mainstream media coverage [11]. At this time, it was also noted that a large contextual factor in anti-vaccination movements was, surprisingly, the effectiveness of vaccines themselves. The success of vaccines over the years has led to a significant decrease in the burden of communicable disease [12,13]. This in turn has meant that the perceived impact of these diseases has decreased [14]. In essence, the positive effect

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of vaccination has paradoxically decreased the value of utilising vaccinations [14].

The COVID-19 pandemic has had a profound and multi-faceted impact worldwide. It calls to question whether this has had any resulting positive impact in subduing the anti-vaccination movement.

We used Google Trends to investigate this possible association between COVID-19, the development of a vaccine for this disease, and anti-vaccination group terminology as described above. Google Trends monitors the volume and density of searches conducted via Google, which accounts for 85% of Internet searches worldwide [15]. Google Trends has been used throughout the COVID-19 pandemic as a tool for monitoring various aspects of the disease at the population level, including public awareness and interest [16,17].

To our knowledge, this is the first study to use Google Trends to monitor public searches relating to anti-vaccination terminology in association with COVID-19.

The aims of this study were to: 1) Monitor the temporal and geographical search popularity of anti-vaccine searches in conjunction with the pandemic and vaccine development timeline, and 2) Explore the association between the absence of disease and vaccine hesitancy and anti-vaccine group growth.

## 2. Methods

We conducted several searches on Google Trends on 5th July 2020. We first explored the popularity of search terms relating to COVID-19 and a vaccine, during December 2019 – July 2020, with results plotted against worldwide cases of COVID-19 over the same time period. We next searched for terms relating to COVID-19 and vaccine, with terms commonly used by anti-vaccination groups or proponents, specifically, “mercury” and “autism”. A separate Google Trends search was conducted for “coronavirus vaccine” and “safe” or “dangerous”. These terms were chosen to represent a scope of the common potential anti-vaccination search terms. These were chosen from the most commonly encountered anti-vaccine arguments in research, namely the association between

vaccines and autism, concerns over mercury content and finally a broader exploration of searchers’ concerns for the safety and/or potential danger of the novel vaccine [4]. Searches relating to anti-vaccination terminology were found to be markedly more prevalent in the USA, therefore total cumulative cases in the USA are plotted alongside these searches.

Google Trends does not display total numbers of searches over time, but provides population-adjusted data reflecting the popularity of the search at a given time. Therefore, large populations with large numbers of searches will not necessarily produce the greatest search interest.

While these search terms acknowledged a broad range of potential anti-vaccine rhetoric around the coronavirus vaccine, it is worth acknowledging the limitations of these searches. These searches were conducted in English so it is possible that the results of geographic search location may be skewed by language. Furthermore, it is recognised that there may be further coronavirus-specific search terms which may be used in addition to the ones chosen here. These include terms relating to the new conspiracy of microchips in the vaccine, and other colloquial terminology used to describe coronavirus, including accounting for typographical errors in search terms.

## 3. Results

Fig. 1 demonstrates global search interest in terms relating to COVID-19 and vaccine, from December 2019 to July 2020. This shows a lag in interest in these search terms, until early-mid March, at which point there is a significant peak in interest. This peak immediately follows the declaration by the World Health Organisation (WHO) of COVID-19’s pandemic status on 11th March 2020. A second smaller surge in search interest on vaccines and COVID-19 occurs in early June, coinciding with the announcement by WHO to wear a mask in all public areas on 6th June 2020. Overall, public searches on terms relating to a vaccine and COVID-19 have remained at high intensity since the initial first peak in March. All four of the search terms represented in Fig. 1 were

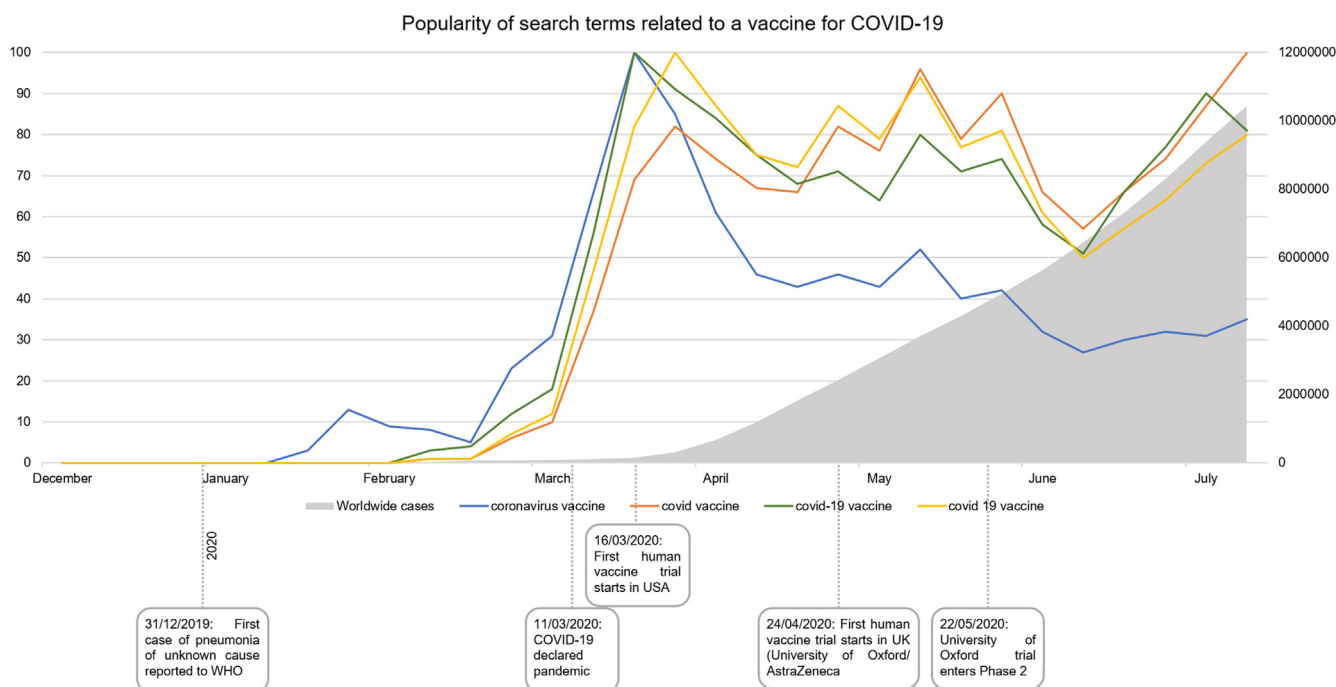


Fig. 1. Popularity of search terms related to a vaccine for COVID-19, plotted against cumulative worldwide cases (grey shaded), and key events in the progression of the COVID-19 pandemic.

shown to have greatest population-adjusted density in sub-Saharan Africa over the study period, being most popular in Uganda, Kenya, and Ghana.

Fig. 2 shows interest over time in searches related to COVID-19, vaccine, and anti-vaccination terminology, specifically “mercury” and “autism.” For all searches, interest peaks in early-mid March, coinciding with WHO’s declaration of the COVID-19 pandemic. Of note, there is a further surge in interest following commencement of the first human vaccine trial for COVID-19 in the USA, on 16th March 2020. When looking at global distribution of searches relating to anti-vaccination terminology, popularity was noted to be far greater in the USA than in any other country. Searches on a COVID-19 vaccine using the terms “safe” and “dangerous” followed a similar pattern and were also most popular in the USA, over the study period.

#### 4. Discussion

Our results demonstrate a number of striking patterns in search interest generated by users of Google exploring the COVID-19 vaccine, and anti-vaccination terminology during the pandemic.

Fig. 1 suggests that interest in vaccines overall has greatly increased due to the COVID-19 pandemic. The peak in popularity in searches relating to COVID-19 and vaccine, seen in early-mid March, appears to be largely in favour of vaccines. Prompted by the declaration of the COVID-19 pandemic by WHO on 11th March 2020, the peak potentially represents searches for a vaccine due to prevalence of the disease, as well as media coverage. This supports the earlier theory that an increased disease burden could increase positive interest in vaccines. It may also support earlier assertions that vaccine-hesitant tendencies are pushed forward due to the lack of consequence (communicable disease burden) being prevalent in the population.

The second smaller surge in public interest relating to COVID-19 and vaccines occurs in early June and may be due to multiple events in the global COVID-19 timeline. WHO’s announcement to advise the wearing of face-coverings on 6th June 2020 was, and continues to be, a highly socially contested issue. Around the same time, cases of COVID-19 in the USA took a sharp increase (as shown in the last graph of Fig. 2). The search interest in COVID-19 vaccines has subsequently remained high, but it is not clear whether this interest is positive or negative.

Reviewing Fig. 2, it is clear that public interest in anti-vaccination search terms in relation to a COVID-19 vaccine peaks in early-mid March, coinciding with the start of human vaccine trials in the USA, where these search terms are most popular. This interest is subsequently sustained, particularly in autism-related search terms, and those including the terms “safe” or “dangerous.”

It is striking that “autism” and “mercury” are such popular searches, potentially fuelling arguments against a vaccine which has not been created as of yet. These results confirm that these are arguments common to all types of vaccinations, even though there is no research to correlate a COVID-19 vaccine with either aspect. This use of unsupported associations of vaccines to ill health and morbidity, in anti-vaccination rhetoric, has been cited elsewhere in the literature [4].

Various discourse analysis studies have shown that, anti-vaccination social and online posts will contain emotional rhetoric, story recounts, and heightened fear around vaccine safety [2,7,11,18,19]. Pro-vaccine posts have been found to generally attempt to counter these stories with fact, statistics and evidence-based articles [18–20].

It is likely that searches including the terms “safe” or “dangerous” with those relating to a COVID-19 vaccine, account for questions such as “would a COVID vaccine be safe/dangerous?”. It is

well-documented that anti-vaccination groups have a much more prevalent presence on social media than pro-vaccination groups [3]. Websites and documents associated with such groups may appear first in the list of results, for individuals conducting these potentially ambivalent and investigative searches. This in turn has the potential to dissuade more individuals from a positive attitude towards vaccines.

Anti-vaccination messages are generally easier to find on the internet, due to their use of content that is more consumer-orientated and user-friendly, as opposed to science-based articles on the pro-vaccine debate [3]. It would seem reasonable to suggest that as a scientific community, as well as producing evidence-based research, we have a duty to raise public awareness and interaction with pro-vaccine online information. It stands to reason that a greater public interaction and consumer friendly message base may aid this effort. Simply providing evidenced based rationale has been shown to be ineffective in addressing anti-vaccination group mindsets, with the Dunning-Kruger effect being cited as a reason for anti-vaccination discreditation of medical evidence [21]. One case study investigated a change in tact, whereby an online discussion board followed the layout of presenting appealing stories, facts, video links and emotive stories of the consequences of the communicable diseases prevented by vaccines [20]. Although this was a successful means of information dissemination, it should be noted that this pro-vaccine webpage would only likely attract pro-vaccine individuals. Furthermore, one would have to consider the professional and ethical standing of this method.

There are several limitations to such analyses using Google Trends. Although Google accounts for 85% of Internet searches, it does not account for other search engines. It is also not reflective of areas where there is limited Internet access, where there may potentially be populations with pro- or anti-vaccination views, in part due to this lack of access to unlimited information. It is also important to recognise that the COVID-19 pandemic is a dynamic situation which, in turn, means that anti-vaccination views relating to this are likely to evolve too.

#### 5. Summary

In summary, we have demonstrated that Google Trends can assist in monitoring aspects of public health perceptions, such as attitudes towards vaccines, during rapidly changing global health crises such as the COVID-19 pandemic. It is able to provide real-time information, as well as geographic variations in search trends, potentially reflective of the public response within a given population.

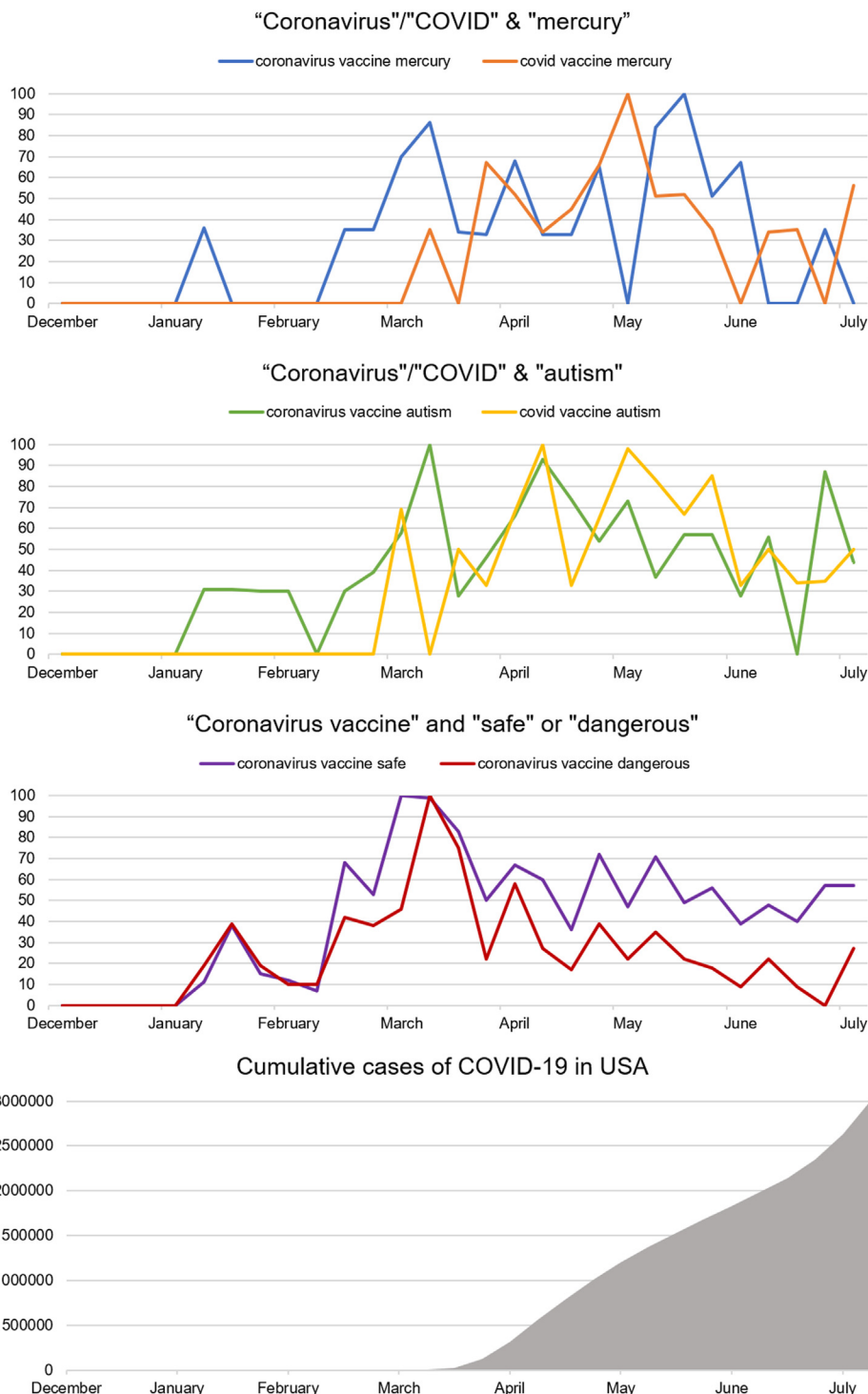
Our results show peaks of interest in relation to a COVID-19 vaccine as the pandemic has progressed. We have also demonstrated evidence of spikes in search activity in relation to anti-vaccination rhetoric in the wake of advancements in a COVID-19 vaccine. These findings help to assert previously known information that anti-vaccination discussion peaks after mainstream media pro-vaccine coverage, but also show that the prevalence of disease burden among the population is not enough to discourage all anti-vaccination searches alone.

This work draws attention to the continued online anti-vaccination presence. We have highlighted the ongoing need to address and subsequently reduce vaccine hesitancy as the search for a COVID-19 vaccine continues.

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### Timeline of search popularity for phrases relating to coronavirus vaccine and anti-vaccination terminology



**Fig. 2.** Timeline of search popularity for phrases relating to coronavirus vaccine and anti-vaccination terminology. From upper to lower: searches for "coronavirus" or "COVID" and "mercury"; "coronavirus" or "COVID" and "autism"; searches for "coronavirus vaccine" and "safe" or "dangerous"; cumulative worldwide cases of COVID-19.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.vaccine.2021.03.019>.

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