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BRIEF COMMUNICATION

Understanding myocardial infarction trends during the early COVID-19 pandemic: an infodemiology study

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Abstract

During the first months of the coronavirus disease 2019 (COVID-19) pandemic in early 2020, Google Trends data in the United States showed a strong increase in search query frequency for chest pain symptoms despite a concurrent decrease in search interest for myocardial infarction. This suggests a reduced attention to acute coronary syndrome (ACS) and chest pain as its main symptom during this time period. These observations could help explain why cardiovascular mortality rose dramatically despite a strong decrease in hospitalisation rates for ACS.

During the first months of the coronavirus disease 2019 (COVID-19) pandemic in the early 2020 in the United States, a marked decrease in hospitalisation for acute coronary syndrome (ACS)[1–3] was observed, the underlying causes of which have not been well understood to date. Moreover, recent mortality data from the National Center for Health Statistics (NCHS) revealed a strong increase in cardiovascular excess deaths in the entire United States (Supporting Information Fig. S1). Interestingly, the largest increases in cardiovascular mortality were observed in places most severely impacted by the pandemic, such as New York City, with cardiovascular mortality up to 398%.[4] This has led to concerns that patients with ACS might have delayed or neglected care with potentially fatal consequences. Plausible scenarios include: (i) patients were hesitant to visit emergency departments either for fear of contracting COVID-19 or because of strict adherence to social distancing guidelines;[5] (ii) detection and management of ACS were hindered or delayed due to system overload and deviation from normal operating procedures; and/or (iii) patients were mistaking actual ACS symptoms for COVID-19-related conditions and were therefore staying at home.[3]

Search engine query data have become an increasingly valuable tool for nowcasting and monitoring patient behaviour in a variety of medical fields. Senecal *et al.* previously showed that search engine queries for ACS symptoms correlate closely with actual geographical, monthly and diurnal incidence of ACS.[6] We sought to investigate whether search engine query data provided by Google Trends showed any changes in search activity for symptoms or terminology related to ACS and myocardial infarction (MI) since the COVID-19 pandemic began in the United States. We hypothesised that changes in Google search behaviour could provide additional insight into why hospitalisation rates for ACS decreased despite increasing cardiovascular mortality.

To identify searches related to symptoms indicative of MI, the terms 'chest pain', 'chest pressure', 'chest tightness' and 'chest discomfort' were used as these have been shown to have the greatest sensitivity for MI.[7] Of these, chest pain was by far the most frequently used

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search term (Fig. S2). To identify searches related to specific interest in MI, the terms 'heart attack', 'heart failure', 'heart disease', 'heart pain' and 'myocardial infarction' were used as these were the most prevalent terms in this category with 20–65 million entries on Google (Figs 1,S2). We analysed both short-term transient trends in a 1-year period ranging from 1 July 2019 to 1 July 2020 (Fig. 1A), as well as long-term trends over a 4-year period from 1 July 2016 to 1 July 2020 (Fig. 1B). The same time windows were used for depiction of NCHS mortality data for ischaemic heart disease, hypertensive disease and diabetes. Both NCHS and Google Trends data were directly accessed online from the respective websites. Google Trends results for individual terms were given as a relative search volume on a range of 0–100 as described by Google.

Searches for chest pain, the most common and most sensitive symptom for ACS,[7] increased rapidly between 4 March and 19 March 2020 by up to 73% compared to January and February 2020 (Fig. 1). This closely followed the increase in search query frequency for the most commonly searched COVID-19-related symptoms of 'fever' and 'cough', which increased by up to 105% between 10 March and 22 March 2020 compared to January and February 2020. Surprisingly, during the same time, search query frequency for heart attack decreased by 16% from 7 March to 19 March, although it historically closely followed search frequency for chest pain. Indeed, such a strong negative divergence in search behaviour for heart attack relative to chest pain has not been recorded on Google Trends for the past 10 years. The only other time heart attack search frequency

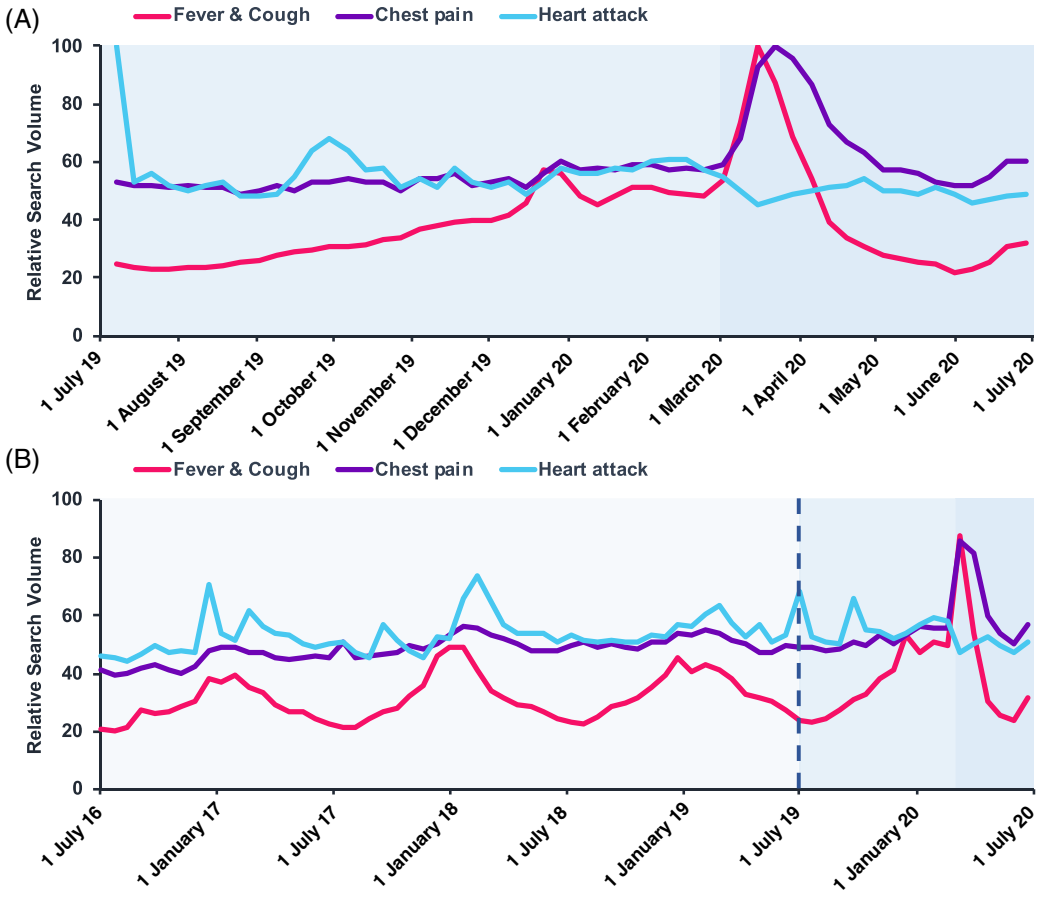

Figure 1 USA interest in search terms related to (symptoms of) myocardial infarction and coronavirus disease 2019 (COVID-19). Google Trends relative search volume (RSV) for the time periods (A) 1 July 2019–1 July 2020 presented as weekly data and (B) 1 July 2016–1 July 2020 presented as triweekly data for the most sensitive symptoms for both COVID-19, 'fever and cough' (averaged, pink line), and acute coronary syndrome, 'chest pain' (purple line). Also depicted is the RSV for 'heart attack' (light blue line). Dashed line indicates the time frame considered for short-term trends (1 July 2019–1 July 2020; as in A). Fill colour gradient (light blue) represents the following periods: 1 July 2016–1 July 2019, 1 July 2019–1 March 2020 and 1 March 2020–1 July 2020 (search query on: 11 September 2020).

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distinctively diverged from chest pain in the observed 1-year time frame was a strong transient increase in search frequency in October 2019. This appeared to be directly related to news media coverage of Senator Bernie Sanders' heart attack, who at that time was one of the presidential candidates of the Democratic Party.

Our observed rise in search requests for chest pain symptoms coupled with a decreasing search interest in MI coincided with the observed decrease in ACS hospitalisation rates and a rise in cardiovascular mortality during April and May 2020. It is possible that at least a portion of these ACS cases were directly related to COVID-19 infections as recent studies report a highly increased risk of thromboembolic complications as well as ST-elevation myocardial infarction (STEMI) in COVID-19 patients.[8,9] However, irrespective of the underlying cause, it is important to note that decreased search interest in the term heart attack despite rising cardiovascular mortality is probably indicative of a reduced attention to chest pain as the main symptom of ACS in the general population. As such, heart attack shows a seasonal pattern during December–January 2016–2019 (Fig. 1B) that is coincident with the usual peaks of MI during the winter months[10] and can also be noted in NCHS mortality rates (Fig. S1). However, no such seasonal trends in search volumes for chest pain could be observed.

Discussion

The steep increase of search volumes for chest pain in March 2020 might be explained by the strong presence of COVID-19 in news media and daily life that resulted in a decreased awareness of the perceived importance of other common diseases such as ACS. Of note, as health media reports of Bernie Sanders' heart attack in October 2019 coincided with a respective increase in search volumes, this might indicate that online search behaviour for ACS-related terms is influenced by increased public awareness. Another related explanation is that patients might have misinterpreted actual ACS symptoms by rather attributing them to a known or suspected COVID-19 infection and therefore did not present to an emergency room.

It is important to note that, while Google search queries are valuable for studying the population at large, younger people are likely overrepresented in Google search data due to more frequent use of the Internet. Moreover, search requests for symptoms and pathologies do not mean the individual is actually suffering from them and therefore should not be equated with traditional epidemiological or clinical data. In addition, the included NCHS mortality statistics are based on death certification that might be less accurate because of the impact the COVID-19 pandemic had on the healthcare system. Especially during the heights of the pandemic in spring 2020, deaths from COVID-19 might have been attributed to cardiovascular mortality as a result of incomplete diagnostics and investigations.

In summary, Google Trends data in the United States showed a 73% increase in search query frequency for chest pain symptoms during spring 2020, despite a concurrent 16% decrease in search interest for MI. This suggests a reduced attention to ACS and chest pain as its main symptom and could help explain why cardiovascular mortality has risen despite fewer hospitalisation rates for ACS. These observations have important implications for the anticipated 'second wave' of COVID-19 infections during the winter months of 2020/2021 as they underline the importance of raising awareness in the general population that chest pain is a potentially life-threatening symptom of MI that should be evaluated by a medical professional, even during the pandemic.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web-site:

Figure S1. Cause-specific mortality in the United States.
Figure S2. Comparative search volume for search terms related to symptoms of myocardial infarction and COVID-19.

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