COVID-19 Epidemiology and Google Searches

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Dear Editors,

We read "Increased internet search interest for GI symptoms may predict COVID-19 cases in US hotspots" by Ahmad et al with interest.[1] Authors compared search volume for gastrointestinal (GI) symptoms with COVID-19 incidence in 15 states to observe that searches for *ageusia, loss of appetite*, and *diarrhea* correlated with disease burden at 4 weeks. We commend the authors for bringing attention to the role of digital epidemiology in the fight against the pandemic. Findings are important and could have substantial public health implications. Further examination of the factors that could influence these relationships may be worthwhile.

As the authors demonstrated, choices for data collection could impact results. In this study, 15 states were chosen for analysis, ensuring equal coverage by disease burden. Would an expanded sample including all 50 states be informative? It is possible that factors including state-by-state differences in testing capabilities could influence measurable disease burden.

Incorporation of time-lagged cross correlations is prudent since it is expected that search activity will precede case diagnosis. Lag times of 1, 2, 3, and 4 weeks were examined to find that a lag time of 4 weeks corresponded best to case load. Authors appropriately acknowledge this exceeds the 1-2 week lag time observed with influenza. Research has shown that median time from symptom onset to hospital admission is 7.0 days (IQR 4.0-8.0).[2] People tend to search symptoms at the time they are experiencing them. Therefore, the increased incubation period for COVID-19 compared to influenza does not completely explain the increased lag between symptom searching and case

volume. One alternative explanation is that searching prior to symptom onset may be
more indicative of disease interest than disease burden, which could contribute to this
delay.

Among the GI symptoms analyzed, ageusia and loss of appetite can also be
encountered with upper respiratory symptoms due to nasal congestion and malaise.
Perhaps diarrhea is the most specific GI symptom as SARS-CoV-2 uses angiotensin
converting enzyme 2 receptors in the intestinal enterocytes, resulting in diarrhea, similar
to norovirus.[3,4] One systematic review and meta-analysis found a pooled rate of 7.4%
of COVID-19 patients with diarrhea and 4.6% with nausea or vomiting.[5] Since GI
symptoms are not present in over 90% of patients, estimation of COVID-19 cases
based on GI symptoms appears suboptimal compared to more typical respiratory
symptoms. People often use search engines to investigate symptoms before seeking
medical care during a pandemic or otherwise. It is estimated that 72% of American
internet users look online for medical information, and 77% start with a search engine.[6]
Thus, assessing searches for fever and common respiratory symptoms as controls or
comparisons to searches of GI symptoms and capturing the relative frequency of
searches occurring with COVID-19 or independently of COVID-19 could provide further
insight.

In our own analysis of Google Trends, we made similar observations with a few
distinctions. We assessed COVID-19 plus diarrhea searches and United States
COVID-19 epidemiology using the Pearson correlation coefficient. We utilized CDC
data for reported incidence and mortality (deaths per capita), cross-referencing with US
census data.[7,8] In contrast to the current study, we found no significant correlation

between state-by-state searches for COVID-19 plus diarrhea and disease incidence (p=0.19). However, there was a weak correlation between COVID-19 plus diarrhea searches and mortality (R= 0.31, p=0.03), and use of individual state health department data, instead of CDC data, revealed a weak correlation (R=0.37, p=0.008) between search frequency and percent positivity. Assessment of a control search term, fever (a more common symptom of COVID-19) also revealed weak correlations between fever and disease incidence (R=0.29, p=0.041) and between fever and mortality (R=0.38, p=0.007). Additionally, we examined searches for diarrhea alone. At outbreak emergence, diarrhea was searched twice as often as COVID-19 and eight times as often as COVID-19 plus diarrhea. We also observed that peak search activity for COVID-19 and diarrhea paralleled initial media reports describing GI symptoms of COVID-19, suggesting that internet activity could be shaped by media coverage. In other infectious disease surveillance studies, the Pearson coefficient R-values are often >0.70, not 0.2-0.4 range, as demonstrated in our analysis. Our findings suggest that diarrhea searches do not correlate well with disease burden; however, while analysis of online searches for GI symptoms and COVID-19 is not likely to be a good substitute for more traditional epidemiological methods, search activity could still be useful as part of a more complex model. As you have concluded, Google Trends is a valuable tool, and it is our responsibility to carefully understand and refine its role in this global pandemic.

References

1. Ahmad I, et al. Clin Gastroenterol Hepatol 2020.
2. Wang D, et al. JAMA 2020;323(11):1061-1069.
3. Zhou P, et al. Nature 2020;579:270-273.
4. Zhang H, Int J Infect Dis 2020;96:19-24.
5. Parasa S, et al. JAMA Netw Open 2020;3(6):e2011335.
6. Fox S DM. Health online 2013.
    https://www.pewresearch.org/internet/2013/01/15/health-online-2013/
7. Coronavirus Disease 2019. Centers for Disease Control and Prevention website.
    https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.html
8. Population in the United States. United States Census Bureau.
    https://data.census.gov/cedsci/all?q=Total%20Population%20in%20the%20United%20States&hidePreview=false&tid=ACSDP1Y2018.DP05